A STUDY OF THE REFLECTIVE ABILITIES OF PHYSICS I TUTORS DRAWN FROM THEIR CONCEPTUAL UNDERSTANDING OF A CO-OPERATIVE TUTORING ENVIRONMENT

BY

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SOLI DEO GLORIA

DECLARATION

I declare that A study of the reflective abilities of Physics I tutors drawn from their conceptual understanding of a co-operative tutoring environment is my own work, that it has not been submitted for any degree or examination in any other university and that all resources that I have used or quoted have been indicated and acknowledged by complete references.

MOIRA CATHERINA BLADERGROEN SEPTEMBER 2009

SIGNED……………………………………

ABSTRACT

This study is an extension of work previously performed by Linder et al. (1997). It sought to explore university Physics I tutors' conceptualization of Physics I tutorials and their conceptualization on issues relating to observations and interactions during tutoring, through involvement in a reflective practicum. The study was premised on socio-cultural constructivism, co-operative learning, situated learning theory and reflective practice.

The study developed over two phases. In phase one the reflective thinking processes of the tutors were explored. Upon reflection on the literature the research context was further developed which allowed a final exploration into the tutors' conceptualisations of the Physics I tutoring context. During this final exploration, i.e. the second phase, tutors were exposed to an organized, longitudinal sensitisation session, i.e. tutor-training over a period of nine months. Tutors were introduced to co-operative learning and the various processes of reflective practices namely, follow-me, modelling and joint experimentation, reflection-in-action and reflection-on-action.

Analysis of the data was carried out using the phenomenographic research perspective. An analysis of the categories of description was used to demonstrate the tutors' ability to reflect, based on their conceptual understanding of and interactions during the physics tutoring. These categories favoured the development of extended criteria to enhance reflection amongst physics tutors. These extended criteria were then used as a basis to suggest a model to support reflection amongst Physics I tutors.

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LIST OF ABBREVIATIONS

C	Coach
R	Researcher
S	Student
T	Tutor
PoTM	Post tutorial meeting
PrTM	Pre-tutorial meeting
TM/Tut	Tutorial meeting
UWC	University of Western Cape
ZPD	Zone of Proximal Development

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CHAPTER 1: BACKGROUND TO THE STUDY

1.1 Introduction

Before the 1994 elections in South Africa, the educational system of South Africa was characterized by talk and chalk and an individualistic approach. After democracy, a number of changes occurred in the country. These changes focused on allegiances, and relations with others. Education institutions embraced this new approach as they strove towards social development.

The current South African Government was faced with the reality of the previously insidious policy which left the average black student socio-economically disadvantaged, subsequently affecting their emotive - and cognitive development. Despite various attempts and interventions, the 'disadvantaged students' still struggle to reach and maintain their prospective ability in an ever developing scientific environment. However, when considering the new challenges brought about by democracy, including the awareness that the vision for a progressive education seems to be ridiculed by the anti-educational policies and practices of the current regime, one cannot be involved in education without being critical and reflective about where you are, what you are doing, and where you are going. Hence, the need for any individual who makes involvement with education, to be a 'reflective practitioner'.

Local studies by scholars highlighted a number of problem areas in the learning of science. In physics, which is the domain of interest for this study, recent studies still show that every new generation of first year students hold the same misconceptions and alternative conceptions as the previous generation (Adams, 2003, Hendricks, 2001, Alant, 2001, Govender 1999).

The institutional requirements for the 'disadvantage student' when studying science (specifically physics) are exposure to various teaching-learning activities with the expectation that these students must achieve a 'pass grade', before advancing to the next academic level. These teaching-learning activities include assignments, tutorials, practicums, tests and examinations. This study looked at one of these activities for learning, namely exposure to tutorials. Previous outcomes of studies performed at the physics department encouraged a co-operative environment for the tutorials. This study was thus challenged by an evolving context based on collaboration and cooperation which were outcomes driven. These kinds of developments differed vastly from the context of the previous regime. The need thus developed to investigate the ability of university physics' tutors to reflect on their conceptualization of Physics I tutorial. These conceptualizations were directly related to the tutors' experience and views about their tutoring; and on issues relating to the conceptualizations of physics as a discipline. The focus of this study was on the tutors' ability to 'think about what they are doing when doing it, and after doing it'.

Previous studies investigated physics students' conceptualization of physics content, but this study is unique in that it investigates the tutors' conceptualization through reflective practice. Despite the fact that there is a plethora of evidence available which describes the difficulties students experience when learning physics, this study operated from the premise that the information is not necessarily shared with the tutors. The researcher thus operated from the presupposition that she knew the problems exist, thereby exploring how tutors viewed the tutoring context, and to what extent they were able to make these experiences and views verbally explicit.

1.2 Purpose of the study

The aim of this study was to explore university physics tutors conceptualization of first-year undergraduate science student's tutorials. This exploration was related to the observation and interactions of tutors during tutoring. In the process it would also become evident whether the Schönian notion of the role of reflection in the teaching and supervision contexts was extended meaningfully to the context of tutor-student interaction. More specifically the study explore

1. Tutors' views on becoming reflective practitioners.
2. Tutors' experiences whilst applying the Schönian model.
3. Tutors' meta-learning development.
4. The effect of reflective practicums on the tutors physics as a learning areas.

The study was further guided by the following explorations:

1. The tutors' sense-making conceptualisation of the tutor-student situation.
2. The tutors' conceptualisation of the impact of the process of reflection–in-action and reflection–on–action during and after the tutorials.
3. The descriptive accounts given by the tutors of the strategies they utilized during student difficulties.

4. The descriptive accounts of the tutor's metacognitive development in terms of being a 'role-model'.

1.3 Significance of the study

a. Various research studies suggest that success in reflective learning can be achieved when satisfactory coaching or facilitating and legitimate interchange of ideas is offered to the students. The research setting allows for that kind of interchange, i.e. that between the tutor and the students.
b. This study hopes to make a contribution towards efforts directed at enhancing the learning that occurs during the tutorials, and subsequently influencing other learning areas positively.
c. Traditionally, students rely very heavily on rote memorisation when involved in learning. A need exists within physics departments to expose students to more reflective learning approaches in an attempt to improve the learning processes and quality of the learning outcomes.

1.4 Outline of the study

The study consists of four chapters in addition to the introduction. Chapter two reports, through a broad range of perspectives on teaching and learning, on the history of educational research. The chapter provides a background on the development and advancement on learning theories. It further continues to show that despite changes and developments of learning theories, the changes in education structures are often invisible or slow in occurrence.

The chapter then proceeds to assist the reader in gaining insight into the thinking processes through the complementary lenses of three theories namely constructivism, reflective practice and situational activity. A critical approach is taken and a theoretical framework is constructed appropriate to this study. This critical assessment highlights the weaknesses in the various theories on teaching and learning and how this warrants the use of more than one theoretical approach to develop an informed understanding of learning.

Chapter three gives an outline of the methodology, epistemology and methods that were used in the study, including the reasoning underpinning the various choices. The researcher draws a clear distinction between the notion of research methodology and research method. Through this approach the researcher wishes to show appreciation for the contributions made by the feminists' movements, but also acknowledges that this distinction is not widely used. However, the researcher hopes that through her work scholars will be encouraged to embrace such distinction.

The chapter continues to justify the use of apparent conflicting research paradigms, i.e. that of naturalistic inquiry, grounded theory and phenomenography. Chapter three continues to show how the method utilized by the researcher was influenced by the methodology of the researcher i.e. the epistemological, ontological and methodological premises of the researcher.

The data collection context and techniques and the data analysis process are then introduced.

Chapter three then continues to show that although the research was a qualitative naturalistic inquiry, the process was not without problems. It was thus necessary to re-examine the research methods and methodologies. This process became the reflective process for the researcher through which different shortcomings were identified, reflected upon, adapted and changed and then implemented. This chapter subsequently became the reflective process for the researcher long before the tutors were officially involved in their reflective process.

Chapter four reports on the results of the exploration of the tutors' conceptualization of Physics I tutorial. The results of the study are presented and discussed. The evidence presented in chapter four is then used to develop extended criteria to assess reflection amongst tutors, which is presented in chapter five.

In chapter five it is argued that often professional development and competence are guided by the ability to reflect on the theory and practice of a domain. Criteria over and above those proposed by Schön were necessary in this particular study to encourage reflection. Three criteria were then identified that encourage reflection.

Finally, for these criteria to be most effective a reflective enhancement model is proposed. The model proposes the various areas that need to be addressed should change be envisaged towards a reflective approach.

1.5 Limitations of the study

The study was limited to Physics I tutors only. These tutors varied in age, gender, language, socio-cultural groups, and academic acquisition. This study did not take any of these variations into consideration.

There were only five tutors employed for the year, all who took part in the study. This makes generelizability very difficult. Also these five tutors had to mediate the physics content to eighty students, sometimes even more. This makes one-on-one interactions between tutors and students very difficult. In the video recording room it was often difficult for the tutor to attend to all students during the hour. This accounted for a great deal of frustration with both the tutors and the students.

Every year new students enroll as tutors; the turn over rate of the tutors is thus high. It was difficult to explore the impact of extended exposure to the tutees. Also, these tutors were all full time students – their own studies were their first priority. This often led to tutors being late for pre-tutorial meetings or that tutors had to leave early because of their own academic commitments.

CHAPTER 2: THEORETICAL FRAMEWORK

2.1 Introduction

A team of lecturers and postgraduate students associated with first-year teaching within the Department of Physics has initiated many changes to the teaching programme to meet the challenges of a student population that is increasingly becoming socio-culturally more diverse. The changes occurred in an evolutionary way where greater emphasis were put on active student involvement in learning while, at the same time, enhancing the quality of the educational experience. The focus thus shifted from earlier emphasis on teaching to observational and peripheral participation by the students. This thesis reports on an extension of this research project.

In this thesis university physics tutors conceptualisation and experiences on first-year undergraduate science student tutorials are investigated and reported on. These conceptualisations are related to the physics tutors' conceptualisations of physics as a discipline. This study proposes to look at their direct experience, thereby focussing on the development of tutoring practice as an essential link in developing the learning outcomes of first-year university teaching. The tutors' verbal and written expressions of their conscious and subconscious thinking, actions and conceptual developments during the interaction with physics students in tutorials are presented from the perspective of unsystematic observation and loosely structured interviewing, followed by a guided reflective process conducted during the academic year (see chapter 3 for further discussions).

This research further aimed to gain insight into the thinking processes through the complementary lenses of three theoretical views namely constructivism, reflective practice and situational activity. The reason for this is that, fundamentally, the growth and development of science knowledge can be described through numerous paradigms and epistemologies. Through the years, however, these theories and epistemologies have been under constant challenges, conflicts and new developments. A critical approach is therefore taken and a theoretical framework is constructed appropriate to this study. The critical assessment of the theoretical frameworks highlight the weaknesses in the various theories on teaching and philosophies of learning, and how this warrants the use of more than one theoretical approach to develop an informed understanding on teaching and learning, in this study specifically referring to tutoring as a specific form of teaching, i.e. that of supplementary and complimentary to main stream teaching.

In the literature reviews that follow, an introduction to the historical development on the philosophies of learning and theories on teaching is given. The locatedness of this study is demonstrated by in-depth discussions on these philosophies and theories.

2.2 Historical perspectives on teaching and learning

The history of educational research is characterised by a broad range of perspectives on teaching and learning. As theories about cognitive development advanced, learning theories changed. Despite these changes and developments in learning theories, the changes in education structures are often invisible or slow in occurrence. These structures refer specifically to classroom interactions between students and teachers, students and students and students and learning materials.

An early study by Von Glasserfeld (1999) gives a good account of the history of these learning theories stating that the contemporary trends can be traced back to ideas that were launched independently by thinkers who, except for the most recent, either did not know one another or had no relevant interaction. He further argued that when a history is written, it should show, among other things, the extent to which professional thinkers and philosophers 'do their own thing', argue virulently and sometimes effectively against others who hold divergent views, but most completely disregard (or happen to be ignorant of) anyone who might have worked in a direction similar to their own. This led to several of the key ideas being invented time and time again.

A summary of the work of Huitt (2006) states that the developments around learning theories have been characterized by the social and cultural turmoil of the 1960's and the 1970's; by the development of social construction of knowledge of the 1980's and 1990's. The development of social construction occurred amidst the presence of a number of approaches and philosophies about learning. For instance, it is well known that sceptics during the 16th century (e.g. Montaigne, Hume, Mersenne, Berkeley and Kant) argued that human beings can never have knowledge about the real world. The Italian philosopher Vico (1710) underwrote this notion when he developed the famous phrase stating that God is the artificer of man, man the god of artefacts. Vico argued that in order to know anything, one would need to know what it is made of. God alone knows the real world, because it was he who constructed it; the human now, analogously could know only what humans have constructed. Vico thus developed the thought of cognitive construction. These ideas were extended by scholars such as Benthom (1760) who supplied the notion of conceptual analysis. He introduced the first 'operational recipes' for the construction of concepts and the notion around operational analysis. This notion was later extensively used by Piaget (1970), who launched the notion of constructivism in developmental psychology. But before that, Mach (1905) and Bogdanov (1909) developed the notion of instrumentalism, which led to the development of pragmatism at the beginning of the twentieth century. Bridgeman (1936) argued that an understanding of the physical world requires mental operations on the part of the observer. Bridgeman thus continued to define concepts in terms of the operation that gave rise to them.

Intertwined with the development of the abovementioned philosophers, a shift in focus from teacher centeredness to learner centeredness occurred, accompanied by a post-modern awareness of culture and its impact on learning developed. One of the influential consequences was the development of the theory of constructivism (discussed in-depth further on). There is thus considerable evidence that the widely accepted development process of these theories was from positivism and post positivism to critical theory, followed by constructivism. There exist extensive literature on constructivism providing considerable evidence that constructivism is not a recent event, but has been evolving over years.

2.3 Constructivism

Perhaps one of the most well-known theories on learning – constructivism - is viewed as an epistemology anchored in cognitive psychology. Constructivism also has its roots on a practical level in the progressive model of Dewey (1968). Through the work of Kuhn (1962) a neatly expressed epistemological view of constructivism exists. The influential work of Kuhn (1962/1970), states that knowledge is a social artefact, which is maintained through a community of peers. Knowledge is thus not based on objective reality, but is consensually formed through social interaction.

For the sake of clarity consideration must be given to the difference between constructivism and constructionism. Dewey (1933, 1998) is often cited as the philosophical founder of constructivism, whereas constructionism is connected with experiential learning which builds on some of the ideas of Jean Piaget. Ausubel (1968), Bruner (1990), and Piaget (1972) are considered the chief theorists among the cognitive constructionists, while Vygotsky (1978) is the major theorist among the social constructionists. Activity theory and situated learning are two examples of modern work based on the work of Vygotsky and some of his followers. The importance of the influence of worldview and the influence of the socio-cultural background on the development of knowledge was highlighted by Cobern (1994, 1996,) Jegede (1995, 1996), Jegede & Okebukola ((1988), Ogunniyi (1987, 1995, 2002) and Tobin (1996).

Constructivism is further viewed as a theory of learning, i.e. a meaning-making theory rather then a teaching theory (Mackinnon and Scarf-Seatter, 1997). Constructivism is thus a theory of learning where humans construct meaning from current knowledge structures. The main notion of constructivism is that individuals create their own understanding or knowledge through the interaction of what they already know, also through their own belief system, ideas, events and activities with which they come into contact. Knowledge is thus acquired through involvement with content rather than through imitation and repetition. Knowledge can thus not be transmitted by a teacher, i.e. information can only be shared by a teacher. Knowledge can then be constructed by the learner. Although constructivism is not accepted universally, there is agreement that human beings are not machines and do not live in isolation from the real world. Behaviourism has largely been substituted by constructivism, but there is the reality that the principles of contiguity, repetition, reinforcement through feedback and motivation are still important processes of learning.

Vadeboncoeur (1997) identified 3 broad strands of constructivism i.e. Piagetian constructivism (psychological constructivism), socio-cultural and emancipatory constructivism. In social constructivism the individual (or the student/learner) is situated within a socio cultural-context. This places the emphasis on human development for social transformation, because the development of the individual is derived from social interactions. During interactions amongst individuals or groups there will be sharing of cultural meanings, which subsequently leads to the development of the individual. Where the individual is involved with the environment, both the individual and the environment will change, leading to the construction of knowledge. When borrowing from schooling environments, which form the socio-cultural setting (where the subject of study is the dialectical relationship between the individual, social and cultural milieu) the awareness comes that theory and practice do not occur in a vacuum, but is shaped by dominant cultural settings.

There is thus a shift towards more co-operative teaching and learning but the reality is, however, that the teaching and learning environment does not only consist of the teacher and the learner. In the context of teaching and learning there are other factors involved and often needed that influence the teaching-learning environment. According to Kearsley (1999) earlier work of Bruner provides the following principles needed for a context which will be conducive for constructivist learning. These principles focus on possible teaching strategies which could be used to support and enhance constructivist learning:

1. Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness).
2. Instruction must be structured so that it can be easily grasped by the student (spiral organization).
3. Instruction should be designed to facilitate extrapolation and/or fill in the gaps (going beyond the information given).

For many, as in South Africa, constructivism holds the promise of a remedy for an ailing education system and provides a robust, coherent and convincing alternative to existing paradigms. However, all advocates of constructivism agree that it is the individual's processing of stimuli from the environment and the resulting cognitive structures, that produce adaptive behaviour, rather than the stimuli themselves (Harnard, 1982). A major problem, however, is that making connections between thinking (in terms of knowledge, intellectual skills, attitudes, etc.) and behaviour has proven very illusive (Doyle, 1997). One reason is that other factors, such as situational variables, emotions, and consequences, all play an important role in the production of overt, adaptive behaviour. Doyle (1997) confirms this notion by arguing that mental representations such as attitudes, mental models, scripts, and schemas are, of course, related to behaviour, but the relationship is often complex and counter-intuitive. There is also a growing body of evidence that suggests that the mental representations on which decisions and behaviour are based can be highly variable, depending on subtle aspects of the particular situation or context. So until more is known about the form, content and function of mental models of systems in a particular research setting, assessments of systems thinking interventions should measure both behavioural and/or cognitive changes. This suggests that without a unifying theory as to how the different learning theories interact within a single individual to produce behaviour, we have to study these different viewpoints independently and then piecemeal them together into a 'teaching-learning-curriculum'.

Supporters of a constructivist approach further suggest that educators first consider the knowledge and experiences students bring with them to the learning task. The curriculum should then be built for students to expand and develop this knowledge and experience by connecting knowledge and experience to new learning. Advocates of the behavioural approach, on the other hand, promote the decision as to what knowledge or skills students should acquire and then developing a curriculum that will provide for their development. Those advocating a constructivist approach should thus consider that there are a variety of principles from operant conditioning and information processing learning theories that can be utilized within this approach. For example, when mediating a student's learning it is certainly appropriate to teach a specific skill using direct instruction, observe students practicing the skill, and providing corrective feedback. The major issue is whether to start with a curriculum that is taught step-by-step in an inductive manner as suggested by the behaviourists or to start with the student's knowledge and understandings and help the individual fill in gaps necessary to solve a situation-specific problem as suggested by the constructivists.

Principles of learning from an information processing perspective such as recognizing the limits of short-term memory provide many opportunities for students to connect prior knowledge to current learning, and recognizing the need for spaced practice can also be implemented within a constructivist approach. Again, the major distinction is in where to start: with a pre-designed curriculum or with the student's experiences and knowledge base.

The conclusion can be drawn that if we start with the student's knowledge base before we have established desired end goals, there is a tendency to have the students simply "make progress," thereby limiting students who are not adequately prepared. These students may develop adequate thinking skills, but can have large gaps in their knowledge, cognitive and physical skills. On the other hand, if we focus only on desired end goals, especially knowledge goals, without consideration of the student's acquired knowledge and background, we run the risk of developing knowledge and skills that have no meaning to the learner and are therefore easily forgotten.

2.3.1 Collaborative social learning

Brown, Collins and Duguid (1989) emphasize the notion of collaborative social interaction. Through this process, learning advances, enabling students to develop and use cognitive tools in authentic domain activity. Situated learning is thus a general theory of learning with the focus on problem-solving skills based on the two principles namely that knowledge needs to be presented in an authentic context; and learning requires social interaction and collaboration.

As far back as 1898, however, Triplett already introduced the notion of social interdependence, i.e. that human beings are social beings and are therefore dependent on each other. It was only much later, during 1949 that Deutsch revisited this notion which then developed into the current notion of co-operative learning.

To fully understand the inter-relation between learning and the social environment consideration will now be given to the social interdependence theory and co-operative learning.

2.3.2 Social interdependence theory

The theory on social interdependence was introduced by Triplett (1898). During 1949, Deutsch introduced the basic theory on social interdependence based on the intrinsic motivation point of view of Lewin (1935). The basic premise of the theory is that humans are social beings (Vygotsky, 1978, 1986) and the nature of this social interdependence determines the response of the individual within the social domain, which subsequently affects the outcomes.

The outcomes of individuals are thus affected by each other's actions. These interdependencies can be co-operative or competitive. Deutsch (1949) identified two basic continua, namely, the goals set by people involved in a given situation and the type of actions taken by people. The result of these two continua is what affects the three basic psychological processes of human beings, namely, substitutability, cathexis (which for interest sake is a Freudian concept indicating an investment of psychological energy in objects outside of one - self, such as friends, family and work) and inducibility. Deutsch put the social interdependence on two continua with the third continuum being the result of the first two.

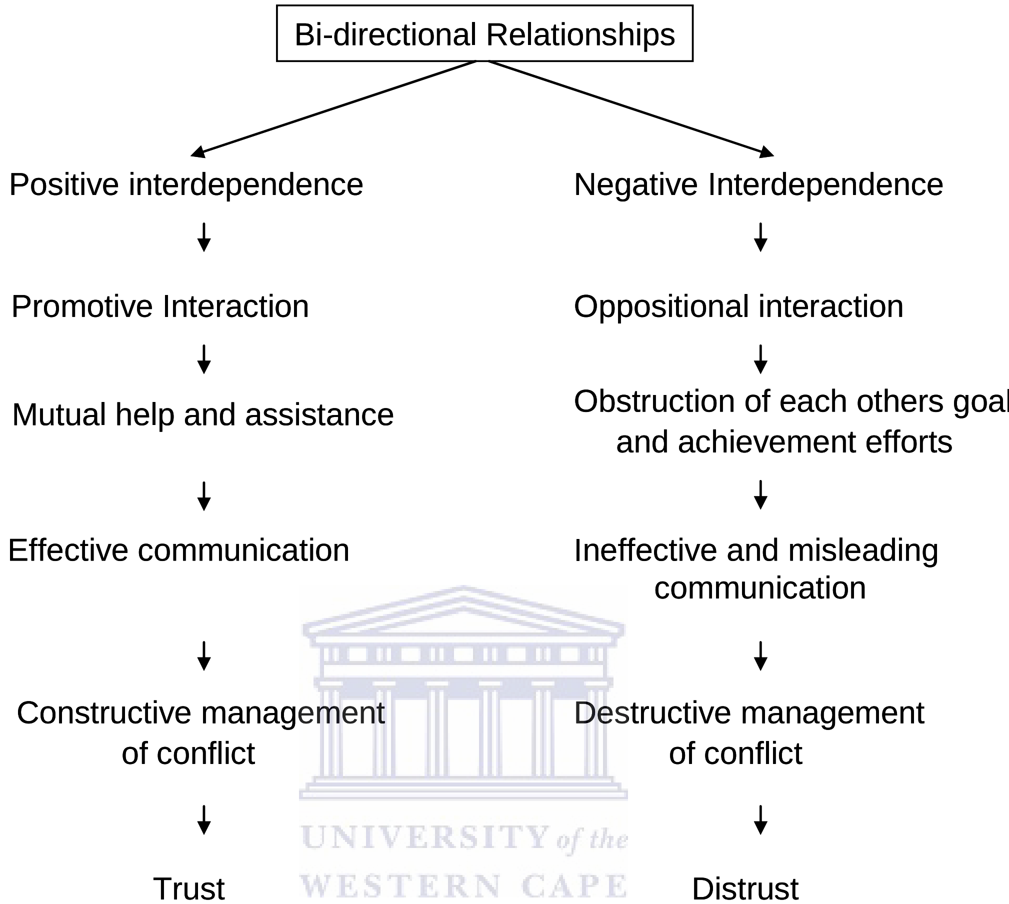

Figure 2.1: Bi-directional relationships as proposed by Deutsch (1949)

According to Deutsch (1949), the bungling hypothesis states that in a co-operative situation, ineffective individuals will be disliked whilst being liked in a competitive situation. Individuals who have a low-performance level will thus be disliked in a co-operative situation. The failure of the group will affect the evaluations of the performer negatively, called ‘blaming the bungler.’ Johnson et al (1989) opposes this notion stating that a co-operative situation allows for low-performers to be liked because -:

1. It is an expectation that others will act to facilitate the achievement of one's goals that influences liking, not the actual facilitation (Johnson and Johnson, 1979).
2. A low-ability partner will be liked if he/she is perceived as trying hard to facilitate the groups' success (Trosvold, Johnson and Johnson, 1981).
3. Individuals are perceived in multi-dimensional ways (Armstrong, Johnson and Barlow, 1981, Johnson, Johnson, Scott & Ramolae, 1985).
4. Personal commitment to low-performing individuals is built through actively working together to achieve mutual goals, especially when help and assistance is given to low-performing individuals.

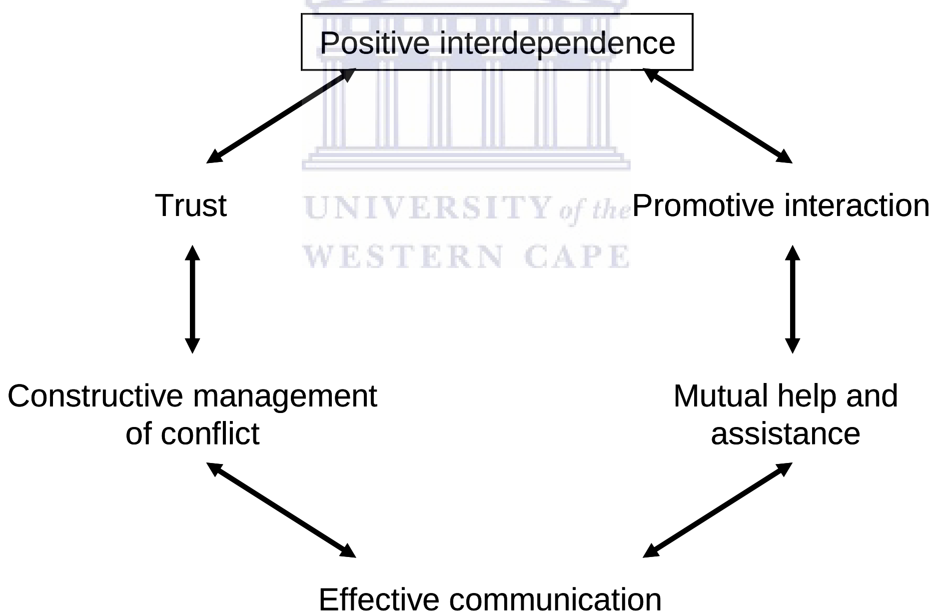

Figure 2. 2: Positive interdependence as proposed by Deutsch (1949)

Deutsch(1949) further identified two types of relationship, namely bi-directional (see Figure 2.1) and reciprocal relationships, where bi-directional relationships involve positive and negative interdependence. Positive interdependence (see Figure 2. 2) is a result of promotive interaction. Negative interdependence (see Figure 2. 3) is a result of oppositional interaction.

According to Johnson & Johnson (1989, p.9), Deutsch (1949) viewed each of these interdependency processes as a ‘package, with each part a door into a whole. Since each process can induce the others (i.e., the relationships are bi-directional), they are likely to be found together. Whether a process is positive or negative, it has a set of characteristic elements, which are typical and constantly present in either of these two processes. One element will always lead to the other i.e. in positive interdependence there will always be an element of cooperation which will lead to mutual help and assistance, exchange of needed resources, influence and trust.

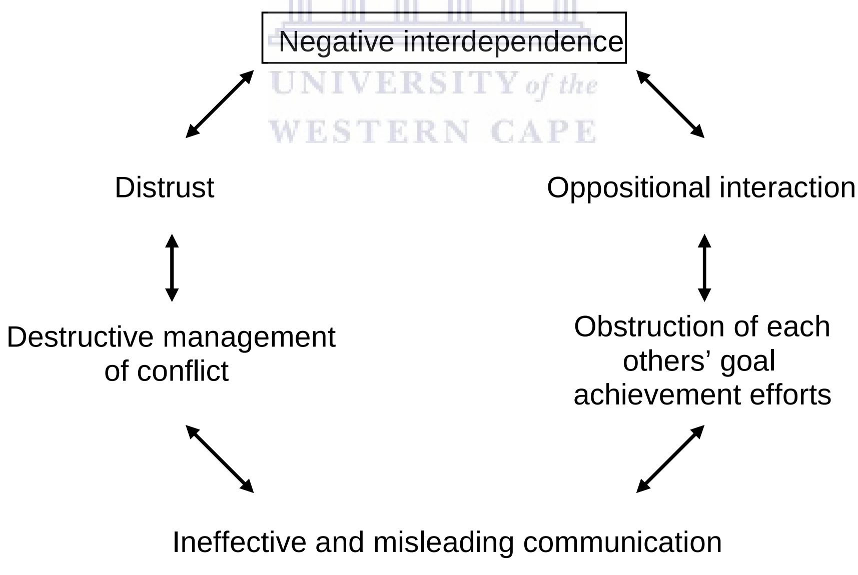

Figure 2. 3: Negative interdependence as proposed by Deutsch (1949).

Any part of the social interdependence process elicits the other parts of the process. In negative interdependence there will always be an element of competition and a lack of cooperation and trust.

2.3.3 Co-operative learning

'What the child can do in co-operation today he can do alone tomorrow'. (Vygotsky 1986, p.188)

According to Nielsen (1994), co-operative learning can be traced back as far as 1875-1880, when Colonel Parker introduced this concept to his school. Maller (1992) studied cooperation versus competition. His findings indicated that cooperation was more efficient amongst group members who were similar in age, intelligence and experience similar social factors. Following Parker, Dewey (1936, p.79) also focused on the social aspects of learning and asserted that the 'isolation of subject matter from a social context is the chief obstruction in current practice to securing a general training of the mind'. As stated earlier, the theory developed by Deutsch is based on two continua, namely-:

1. The interdependence among the goals of the people involved in a given situation, and
2. The type of actions they take.

Deutsch suggested that the goals may be positively or negatively related, and that the actions may be effective or ineffective. When these two continua are combined, Deutsch hypothesized on the joint effect on substitutability, cathexis and inducibility. The origin of these two types of social interdependence was, however, based on what Lewin (1935) called 'intrinsic motivation' i.e. tension within an individual which moves the individual into achieving desired goals.

But then, during 1978, Vygotsky introduced another element i.e. the social nature of language and its influence on student learning. Vygotsky hypothesized that the potential for development at any time is limited to what he calls the 'zone of proximal development' (ZPD) defined as follows: Working alone the child may function up to a certain level. Working in collaboration with more capable peers, or perhaps with adult or professional guidance, the child may function at a higher level. This middle ground that the child is capable of reaching with assistance and not on his/her own is the ZPD. The child thus acquires higher order skills by exercising those skills in the ZPD with the help of others. Those skills are then internalized up to the point when they can master it on their own. Through the use of the 'zone of proximal development', Vygotsky (1978, p.85) concludes 'what children can do with the assistance of others might be, in some sense, even more indicative of their mental development than what they can do alone'.

(Various scholars [McClintock and Sonquist (1976), Aronson, Blaney, Rosenfield, Sikes and Stephan (1977), Johnson, Johnson, Johnson and Anderson (1976), Barnes and Todd (1977), Johnson and Johnson 1979)] all tried to develop an understanding of the working of co-operative learning. The focus now gradually moved more to specific learning strategies.

Recently scholars such as Moffett (1994, p.85) expressed themselves strongly against what they term 'the commercialization of a natural human process':

> …a perfectly natural human process requiring no commercial materials was proceduralized beyond recognition. Small group interaction was ritualized fore and aft by so much goal setting and assessment, briefing and debriefing, that little time remained for the substantive collaboration itself, which was so formalized, moreover, that little choice of spontaneity remained.

Despite the claims made by Moffett about the apparent 'abuse' of co-operative learning by groups, the positive outcomes associated with co-operative learning are indisputable. Sharo (1980) investigated the learning strategies that were employed and the mechanics of group work, and concluded that all of the methods reviewed resulted in superior performance in small groups as opposed to large groups.

With Moffett's notion and the results produced by Sharo in mind this research work will also make use of the work presented by Johnson and Johnson. Co-operative learning as presented by Johnson et al., (1976, 1979, 1981, and 1991) is based on the theoretical frameworks of Lewin (1935, 1948) and the seminal work of Deutsch (1949, 1951, and 1983). According to Johnson et al (1989) individuals can be engaged in individual and/or group activities. These activities can promote, obstruct or have no effect on the performances of others. All of these activities are social in nature and manifest as co-operative, competitive or individualistic. The actions of one individual may effect the actions of another individual, now called social dependence, or it may not effect the actions of another individual, then called social independence. When social dependence and interdependence are lacking, operational activities become individualistic. Each one of these social interdependences (i.e. positive or negative interdependence) also has its own bi-directional relationships. Positive interdependence, cooperation (and psychological health) are interwoven and each one will induce the other. These three outcomes, namely, the joint efforts to achieve mutual goals, joint efforts to achieve positive relationships and psychological health each have their own specific bi-directional relationship.

Within co-operative situation efforts to achieve mutual goals often -

1. Creates caring (cohesiveness) and committed relationships.
2. Creates positive relationships which are powered by the caring and committed relationships.
3. Promote psychological health.

Johnson et al (1989, pp.54-55) claims that cooperation promotes-:

1. Greater productivity and achievement.
2. More frequent use of higher-quality reasoning.
3. More frequent process gain.
4. Greater transfer of learning.
5. Joint rewards are perceived as more fair then differential rewards.

In a learning situation, group work does not necessarily guarantee high achievement performances. A number of plausible theories as to why co-operative experiences should have an impact on interpersonal preferences have however been proposed although not all have been tested one against the other. Co-operative efforts will however be successful if specific elements are present namely -

1. Positive interdependence.
2. Considerable promotive (face-to-face) interactions.
3. Frequent use of relevant interpersonal and small group skills.
4. These elements are bi-directional and one element will induce and promote the other.

1. Positive interdependence. It is one of the criteria needed to ensure successful cooperation. Group membership and interpersonal interaction within a group are not sufficient to ensure the success of a group. Johnson and Johnson (1989) argue that outcome interdependence is what ensures productivity and achievement of a group. Outcome interdependence creates feelings of personal responsibility to work towards mutual benefit of the group.

2. Considerable promotive (face-to-face) interactions. Participants in the group provide each other with help and assistance, exchange needed resources, provide helpful feedback, challenge reasoning and conclusions, open to influences, act responsibly and trustworthily, demonstrate high achievement and intrinsic motivation. Efforts individuals commit to achieve goals they perceive as being meaningful and worthwhile, exhibit low anxiety and stress levels.

3. Frequent use of relevant interpersonal and small group skills. The group's future effectiveness will be determined by leadership skills, good communication skills, decision-making, trust building- and conflict resolution skills. Cooperation amongst groups, whether inside or outside teaching-learning environments, enhances the well-being of the various groups involved, but it also makes the members in the group vulnerable to each other.

2.4 Cognition and metacognition

Although there is strong evidence relating to the efficiency of small group work, there is little knowledge about the ways in which these activities facilitate learning. Maurer (1987) in Artzt and Armour-Thomas (1992) provides a definition on the notion of cognition and metacognition:

> …Students don't learn, they interpret. They actively work to make sense of … find regularities and patterns in … the teacher's demonstrations and explanations. However, what students get out of a lesson may be quite different from what the teachers intends or even from what the teacher actually presents. The regularities the student picks up may be quite incidental to the intended lesson e.g., apparent surface structure rather than meaning. Also, if the teacher has left a gap, for instance, s/he hasn't explained yet what to do if there is nothing to borrow from in the next column and the students get problems wrong, it may not be because they 'haven't understood' some part of the procedure, but rather because they have already invented an alternative to that part. Unfortunately what students pick up from a lesson is highly dependent on what presumptions they bring into the classroom.

> …a student may be just a bug away from having it all right…..a bug is caused by an imaginative generalization; it's just an imaginative generalization in the wrong direction (Maurer, 1987, p.171).

Maurer thus connects his argument with that of socio-cultural constructivism and the notion of worldview (see section 2.3). The intention of the teacher may be different from that of the learners. The productivity of the teaching learning situation is thus dependent on the transformation of the situation of the situation. This notion of successful transference is discussed in depth in section 2.6 under situated learning theory. However one of the critiques against small group learning is that the emotional and psychological aspects of human interactions are often ignored in studies involving small group learning.

2.4.1 How student groups are used to facilitate learning

When students work in groups, the classroom environment and social interaction between students and teacher is enhanced and learning is promoted. Students show each other what they are doing, so they need to articulate their strategy. Through this articulation, information as to the thinking pattern of the student becomes available to the tutor. They will thus become aware of differences in thinking strategies and the process of metacognition will occur. The management of the group, the role of the tutor and the learning mechanisms that take place in group situations that foster individual cognitive growth, need to be explored. It is important for the tutor to 'model' the processes the student goes through, through demonstrations, i.e. the tutor must be explicit on the things students do that lead them astray.

Schön addresses this issue (see a discussion of Schön's works later in the chapter) and highlights the fact that most professional institutions introduce students firstly to 'relevant science', which is then needed for the 'practical applications' later. They argue that the teaching of scientific principles should precede the development of skills in their application (Schön 1983, pp.26-31). The application of scientific knowledge leaves the user with uncertainties, instabilities, uniqueness and value conflict accompanied by the problem of rigour or relevance that is so pertinent in any science related activity. Schön further suggests that more is needed to counterbalance the effects of the Positivist approach to theory and practice. Schön argues that, when a person is involved in everyday activities it is often difficult to give an accurate account of his/her activity. To describe or recognize specifics for this activity, tacit knowledge is required. This is called knowing-in-action (Schön 1983, p.49). To think about what s/he is busy with, Schön refers to as reflection-in-action.

Schön further drew distinction between the following concepts as classified below -

a. (i) **Knowing-in-action**. Is the tacit knowledge needed to explain a situation or phenomena satisfactorily.

(ii) **Reflecting-in-action**. Often situations arise for which one cannot give good account or explain satisfactorily. Learners' tacit knowledge, however, alerts them to some 'problem' that might be present.

b. (i) **Theory-in-action.** During interaction with a problem or phenomenon one develops a theory, be it correct or incorrect, which explains certain behavioural patterns or occurrences. Because of this newly developed theory, learners may react to this theory called 'action response'. When the theory of the learners is challenged they react to it, called 'theory response'.

(ii) **Knowledge-in-action.** Schön stated three ways of acquiring knowledge-in-action, i.e. the knowledge that is needed during the practice (e.g. the knowledge needed in self-instruction and apprenticeships), the knowledge that is tacit and difficult to demonstrate, and practicum (the student can acquire knowledge from experiences by others, thereby reducing time constraints that may occur in, for example, apprenticeship training).

c. (i) **Knowing-in-practice.** The tacit knowledge needed and used in a practical situation to make sense of the environment – the possibility exists that the knowing-in-practice can become increasingly tacit and spontaneous, i.e. a person is drawn into a situation of increased patterns of error which s/he cannot correct, and can become selectively inattentive to phenomena that do not fit her/his categories of knowing-in-action. Through the process of reflection-in-action the learner can be corrected, i.e. 'over learning' occurs and the person becomes sensitized to knowing-in-action again.

(ii) **Reflecting-in-practice**. A more in depth discussion will be undertaken in section 2.6 below on the aspects of reflection in practice and reflection-of-practice.

There is thus a general consensus about the usefulness of small groups for instruction. (Johnson and Johnson, 1989, 1991, Slavin, 1991). Research performed confirms this notion (Davidson, 1990). Small-group activities improve problem solving abilities of students. Although there is optimism about the efficiency of small-group activities, very little is known about the ways in which these activities produce their positive effect (Slavin, 1991, Basset, 1988).

2.5 Schönian view on reflection and reflective practitioners

Schön was concerned with the development of reflective practice and learning systems within organizations and communities. In 1983, he published *The Reflective Practitioner* in which he sets out to examine the behaviour of "professional problem-solvers" (for example engineers, architects, etc.) whose reliance on formal and explicit formulae was less than their implicit, unstated methods utilised in their practice. Even though Schön did not explicitly concentrate on teachers as reflective practitioners, there is the suggestion that it is possible to borrow from Schön's work for the teaching-learning situation. Schön (1983, p.17) referred to teachers in his work: 'Practitioners are frequently embroiled in conflicts of values, goals, purposes, and interests. Teachers are faced with pressures for increased efficiency in the context of contracting budgets, demands that they rigorously "teach the basics," exhortations to encourage creativity, build citizenship and help students to examine their values'.

The process of reflection occurs on a more regular basis than is generally acknowledged; examples include individuals reflecting on private personal issues. These thoughts are often used to shape individuals lives and understanding of real-life situations. One of the main differences between individual personal reflection and formalised 'reflective practice' as a tool for supporting learning is that students are often expected to produce evidence of reflection. This evidence can be in the form of a personal development portfolio, diary, learning log, critical incident journal or even a video diary. When individuals engage in this structured, evidence-based activity, they are often referred to as 'reflective practitioners'. Race (2002, p.1) asserts that the act of reflecting is one which causes us to make sense of what we've learned, why we learned it, and how that particular increment of learning took place. Moreover, reflection is about linking one increment of learning to the wider perspective of learning, i.e. seeing the bigger picture. In contrast to pedagogical reflective practice however, everyday reflective practice does not always involve such depth of engagement or evidence of reflection.

Hall (1997) identified various forms where reflective practices are used i.e. action learning, action research, course and unit reviews, "clinical supervision", critical incident analysis, engaging a critical friend, drama/role play, journal keeping, mentoring, mind mapping, peer observation, programme reviews, reflective teaching practice workshops/seminars, self-accounting professionals, storytelling, teaching portfolios and teaching and learning networks.

According to Munby and Russel (1993, p.193) the work of one of America's most important philosophers, Dewey, serves as a starting point to view reflection. Dewey's philosophy holds experience critical to learning, understanding, and effectively living in a constantly changing environment. He sought the development of a philosophy that could improve the lives of people in their communities and serve as a guide for continual societal improvement in an effort for each individual in a community to become the best human being s/he could be. In an effort to avoid the contradictions that plagued many earlier philosophies which sought to separate the mind from the body, Dewey's philosophy did not disregard the importance of human thought and feeling as a component of experience. Dewey (according to Grange, 2004) sought to avoid the many incongruities which resulted in the prevention of the melding of human experience with the reality of the world. What bothered Dewey was the fact that the discipline traditionally charged with presenting an integrated view of nature, human beings, and the universe, was guilty of devising ways and means to separate these interrelated domains. Philosophy had become the enemy of experience, not its champion (Grange, 2004, p.3).

According to Grange (2004) reflective thinking holds two characteristics, i.e. when a state of doubt or hesitation occurs during a practical situation, an act of inquiry will develop to analyze this doubt and dispose of the perplexity caused by the doubt. Some researchers, according to Munby and Russet (1993, p.197), view reflection as a conscious and deliberate move, away from the habitual ways of responding to a situation in practice. Reflection is thus the restructuring of mental practice and not merely the deliberation about a specific problem. Schön (1983) advances this idea by adding the notion of 'tacit knowledge' held by practitioners.

Reflection, however, involves a dialogue between students and their peers, students and teachers, and students and work placement tutors, all of whom can provide useful feedback necessary for reflection. To begin to reflect on their learning, students need to be encouraged to make sense of new knowledge in relation to their existing understanding. The learning cycle developed by Kolb (1984) (see Figure 2.4) is a useful and simple tool for illustrating to students the connection between reflection and improved learning.

In professional and vocational education reflection can be used as a means way of helping students to take responsibility for their own learning and to identify ways in which they can advance their practice and professional conduct. Academic programmes also emphasize autonomous learning and encourage students to develop a sense of ownership over work by reflection and planning. In both spheres use is made of learning journals and reflective logs to support learning and skill development. These 'products' provide evidence of thinking, and therefore validate reflection within the context of formal education. Of course, on a daily basis individuals use personal diaries and journals to map thoughts, emotions and ideas. People reflect for different purposes and in different contexts, but the aim is the same: to understand better and make sense of what is felt and experienced.

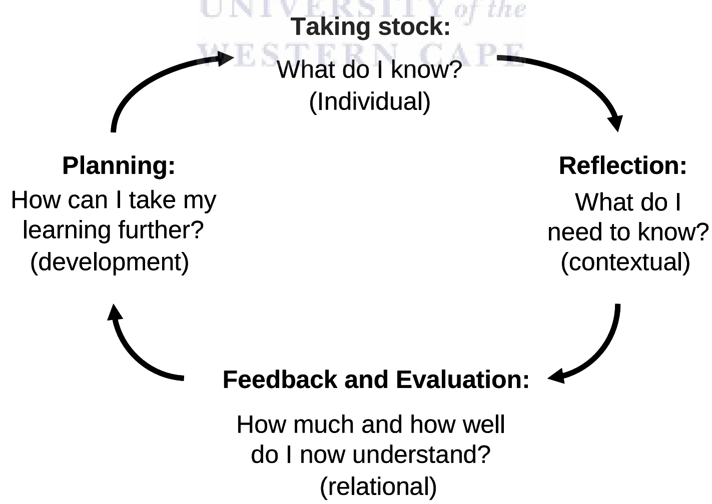

Figure 2.4: Learning cycle developed by Kolb (1984).

Webb (1997, p.192) argues that the learning process begins with an event which is experienced. To learn from that experience we require an opportunity for reflection on that experience, the ability to abstract and internalise the experiences and subsequent reflection in the form of a theory which may then be tested in new situations.

The 'experience' referred to can take many forms. A work placement is an obvious learning experience upon which the student can reflect. However, students also have learning experiences in classrooms, with groups and friends, and when totally removed from the formal learning environment. Personal reflection can often be prompted by a lack of experience and a desire to understand and find direction. However, where reflection is used to support learning in an academic or vocational environment, it most commonly follows a planned activity or series of learning experiences. Reflection is thus a way to assist students to think about ‘what’ and ‘how’ they are learning. It is a way to provide meaning and achieve a deeper understanding of learning material and experiences. This can be achieved by relating new information to existing knowledge and experiences. According to Boud, Keogh and Walker (1985, p.19) ‘reflection is an important human activity in which people recapture their experience, think about it, mull it over and evaluate it. It is this working with the experience that is important in learning’.

When reflective practice is used in the training of prospective teachers, researchers often go about the notion of reflection in a superficial way trying to involve students in a more complex process then is often realised. The work of Smith (2005) is a clear example of an ad hoc approach to a complex issue. For example Smith (2005, p.234) argues that ‘… on many professional development programmes the notion of 'reflection' has been used very loosely and in a process connected to professional learning in a broad sense'. Smith, however, goes about the notion of reflection in an unsystematic way, not fully understanding the notion of reflective practice as suggested by Schön. Further the suggestion by Smith (p.236) about her state of 'confusion' between the models of reflection and 'other contradictions' can be devalued if an exploration of the literature on Situated Learning Theories was performed (see discussion on the work of Lave and Wenger in section 2.7).

It is at this point that students can make use of feedback from peers or in the case of this research work, tutors. Engaging in a dialogue with others helps students to make sense of what they know. Relating the feedback given by others to their current understanding also helps the student.

It is argued that reflection helps students to understand what they already know; identify what they need to know in order to advance understanding of the subject; make sense of new information and feedback in the context of their own experience; and guide their choices for further learning.

Schön (1987, pp.138-139) argues that in the event of the instructor trying to maintain unilateral control of the dialogue and the student resists him, then in the ensuing rounds of 'attack and defence' it is unlikely that either party will stop to reflect on his or her meaning or inquire into the other's. If the instructor tries to maintain unilateral control of the dialogue and the student submits to him, then it becomes difficult for the student to make a public test of his or her own understanding or explore the instructor's meanings, for it might undermine his unilateral control. If a student is confused and unable to articulate her confusion, then she needs to be helped to see that questions are possible and encouraged to ask them; but such encouragement is incompatible with a theory in use (or an instructor) that is based on mystery and mastery.

Once a learning binding is created, the search for convergence of meaning requires that student and 'expert' try to enter not only into each other's way of seeing design but into each other's ways of framing the interaction in which they are engaged, i.e. some of the elements of reciprocal reflection-in-action are essential to unbinding a learning binding, i.e.

- Focus attention on the present interaction as an object reflection in its own right.
- Getting in touch with and describing one's own largely tacit knowing-in-action.
- Reflection on each other's understandings of the substantive material that the instructor wants to convey and the student wants to learn.
- Testing what one has understood in the other's knowing-in-action and framing of the interaction; testing what the other has made of one's own attempts at communication.
- Reflection on the interpersonal theories-in-use brought to the communicative process.

Schön developed three elements of thinking, namely, learning systems, double-loop learning and organizational learning. This research will use the third element Schön developed which refers to the relationship of reflection-in-action during professional activities. The focus for Schön's doctoral presentation (1955) was Dewey's theory of inquiry, and this provided the pragmatist framework that runs through his scholarly work. Schön thus looks at an alternative epistemology of practice where inherent knowledge-in-practice can be understood as an 'artful doing'. The idea is that textbook schemes are not followed rigidly, but actions need to be thought through thoroughly. Activities are recorded, talked though and discussed with the guide/expert.

The consequence is a set of questions and ideas about activities and practice development which foster reflection-in-action and reflection-on-action. During these reflective processes a repertoire develops, i.e. a collection of ideas, images, examples and actions develop which the practitioner can draw upon, thereby developing theories and responses that fit the new situation/problem.

Three areas of critique however exist within this framework.
Firstly, not all situations allow extensively for reflective activities but require immediate response. Secondly, Schön presents a descriptive concept with a rather empty content, i.e. there is clear emphasis on action being informed, but there is little focus on the commitments imposed. Thirdly, Schön failed to put into practice his own formal theory on his own work, i.e. he failed to apply his own suggested method of interrogation of his own work although he was very clear on reflection upon one's own work: 'In all of these examples, I shall describe processes that managers often undertake but upon which they seldom reflect'. (Schön, 1983, p.243). This implies that Schön went through a rather unreflective way to present his work. He further neglects the situatedness of practitioner experience, so this inevitably requires of

this research to draw on the work of Lave and Wenger (1991) to provide a counter for these weaknesses in the work of Schön.

However, Clark (1995) understands Schön's conception of professional practice involving knowledge-in-action. For any professional to reflect on their activity, it will be widely accepted that s/he will have the knowledge required to reflect on their actions. This reflection will, however, take place during an 'in-action' situation. According to Clark, the knowledge generated by the practitioner develops during the reflection-in-action process. One can thus assume that the knowledge generated by the practitioner needed to reflect on their actions is generated over time as s/he reflects-in-action. Reflection is an ongoing process of which there is neither beginning nor end.

To summarize: Schön (1983, 1987) and Schoenfeld (1987) suggest that difficulties in problem solving often can be related to students' inability to monitor and regulate the cognitive processes they are engaged in during the activity of problem solving. A study done by Schön suggests that students do have the ability to reflect–in-action on their own professional education.

Reflection involves consideration of the teaching model, which underlies the definitions, techniques, and applications presented in a teaching and learning situation. The ideas are then tried in the classroom, and compared with one's experiences. By doing so, the teaching material is integrated most effectively into the teacher's own teaching philosophy and practice. Reflection, according to Clark (1995, p.243), can be either a personal activity or a public activity or a combination of the two. Also, it can be a review of one activity in terms of a particular set of rules or it can be a process whereby particular aspects of one's practice are problematised in an attempt to gain new insight into one's particular practice.

The reflective practitioner, specifically practitioners involved in teaching, often reflect on situations that are unique and difficult to predetermine. The practitioner/teacher thus tries to make sense of their context through problem setting (Schön, 1983). The teacher starts with an initial theory of teaching and learning and based on personal experiences as a learner in reflective practice; the teacher applies this theory in classroom practice, observes and reflects on the results, and adapts the theory. The classroom becomes a kind of laboratory where the teacher considers which teaching model underlies the definitions, techniques, and applications of the teaching theory and teaching practice. By reflection-in-action the teacher learns to integrate the theory and practice most effectively into his or her own teaching philosophy and practice and develop a new theory. This theory provides a unifying rationale for the activities that the teacher uses in the classroom; classroom observation and reflection enable the teacher to refine the theory and adjust teaching practice. This cycle of theory building, practice and reflection continues throughout a teacher's career, as the teacher evaluates new experiences and tests new or adapted theories against them. Understanding why an activity or practice was productive or non-productive in the classroom becomes a key element in the progression from novice to master teacher.

Problem setting involves the processes whereby the practitioner categorizes the issues s/he will attend to and frames the context in which s/he will attend to them. Problem solving according to Copeland et al. (2005) should not be viewed in a negative form, but should be viewed as a normal, healthy creative process in which practitioners are involved to make sense of challenging situations. Problem solving and learning are necessary components of reflection, according to Parsons and Stephenson (2005). The practitioner makes use of past experience or previous knowledge to make sense of current situations. The use of past and present experience in present action will influence future developments, and this is what Yinger (1990) presents as 'ongoing conversation of practice'. Through a spiral process of framing, reframing, experimentation and 'back talk' the practitioner reflects and comes to new understanding of the practice situation. Parsons and Stephenson (2005) identified four attributes related to problem identification: (a) A problem is identified. (b) This problem has meaning to the practitioner. (c) The problem derives from a concrete situation in practice, and finally (d) the problem is one of import for successful teaching/learning in the context in which it is identified.

Schön (1983) asserts that at some point of a student's professional career, s/he learns to stage a dialogue between their field and classroom experiences and use this discovery to control and direct their own learning.

2.6 Situated learning theory

The current paradigms in education specifically pertaining to teaching and learning involve the following:

1. Both the learner and the teacher can and should construct knowledge.

2. Learners are now perceived as active constructors; discoverers and transformers of their own knowledge.
3. Learning is fundamentally social, requiring a supportive environment/community to unleash the intrinsic motivation of the learner.
4. The main objective of any institution is to develop students' competencies and talents.
5. The relationship between student and institution becomes more personal.
6. Learning is co-operative in the classroom and the institution acts as a co-operative team member.
7. The institution accepts teaching is a complex enterprise that requires considerable training.

Explorations hitherto articulated were undertaken to develop an understanding of current trends in the teaching and learning context in South Africa. Traditionally it was believed that students were passive, empty vessels, who operate in isolation and in competition with their environment. The student's motivation was perceived to be intrinsic with an impersonal relationship with fellow students and environment. The teacher in turn was assumed to know it all and was able to fill the 'empty vessels' through classifying and sorting students on the basis of their academic performance. It was also believed that any person who is an expert in his/her field can teach someone else successfully. But as development occurred in the area of learning theories there was a significant change in the teaching – learning environment.

The work of Gibson, Piaget, Bruner and Vygotsky were, amongst others, significant precedents to existing theories in education, specifically with relation to constructivism (social practice theory). In the context of teaching and learning there are other factors (i.e. social, political, and environmental) involved and often needed, that influence the teaching-learning environment. Lave and Wenger (1991), Lave (1977, 1988, , 1993, 1996), Schön (1983, 1987) reacted against the notion that learning amounts to changes in capacities or behaviour of learners. According to Hammersley (2005, p.6) it was a reaction against work on artificial intelligence which attempted to understand human intelligence and learning by analogy with the operation of computer programs. In their writings Lave and Wenger put emphasis on two basic notions. Firstly, learning involves social participation in communities. Learning, therefore, requires social interaction and collaboration. Secondly, knowledge needs to be presented in an authentic context, i.e., settings and applications that would normally involve that knowledge. The learner will ultimately behave in ways which will be recognised by the particular community as competent. Although there is a shift towards more co-operative teaching and learning, the reality is that the teaching and learning environment does not only consist of the teacher and the learner. Lave & Wenger (1991) further argues that learning is a function of the activity, context and culture in which it occurs. Where in previous approaches to learning it involved knowledge which was abstract and out of context, learners now become involved in a community of practice which embodies certain beliefs and behaviours. As the learner moves from the periphery of this community of experts to the center and becomes more engaged and active in this culture, learning becomes more unintentional rather then deliberate.

Lave's argument that learning as it normally occurs is a function of the activity, context and culture in which it occurs (i.e. situated) is in contrast with most classroom learning activities which involve knowledge which is abstract and out of context. Social interaction is a critical component of situated learning, i.e. learners become involved in a "community of practice" which embodies certain beliefs and behaviours to be acquired. As the beginners or newcomers move from the periphery of this community to its center, they become more active and engaged within the culture and hence later assume the role of expert or old-timer. Furthermore, situated learning is usually unintentional rather than deliberate. These ideas are what Lave & Wenger (1991) call the process of "legitimate peripheral participation."

From the situative perspective, successful transfer means improved participation. Whether transfer occurs depends on how the situation is transformed. Whether it is difficult or easy for the learner depends on how the learner was "attuned to the constraints and affordances" in the initial learning activity. According to Anderson, Reder & Simon (1996) knowledge is not just "in the head, if it is to be found there at all, rather knowledge consists in the ways a person interacts with other people and situations". The situated perspective does not say that group learning will always be productive, regardless of how it is organized, or that individual practice cannot contribute to a person becoming a more successful participant in social practices. It does, however, call for more varied learning situations. Students need opportunities to participate actively by formulating and evaluating problems, questions, conjectures, conclusions, arguments, and examples.

Whereas the cognitive perspective attempts to explain processes and structures at the level of individuals, the situated perspective focuses on interactive systems and the resulting "trajectories" of individual participation. It borrows research methods and conceptual frameworks from ethnography, discourse analysis, symbolic interactionism, and socio-cultural psychology. Reasoning can thus be adaptive in ways that are not well explained by current cognitive theory.

Other researchers made contributions to further develop the theory of situated learning. Brown, Collins & Duguid (1989) emphasize the idea that cognitive apprenticeship supports learning in a domain by enabling students to acquire, develop and use cognitive tools in authentic domain activity. Also that learning, both outside and inside school, advances through collaborative social interaction and the social construction of knowledge. The need for a new epistemology for learning - one that emphasizes active perception over concepts and representation thus exists.

Examples of communities in action include Vai and Gola tailors in Liberia, Yucatec Mayan midwifes in Mexico, ship navigators in the US navy, meat cutters in US supermarkets and participants in Alcoholics Anonymous (Lave and Wenger, 1991 (ch. 3); Suchman and Trigg, 1993). In all cases, there was a gradual gaining of knowledge and skills as novices learned from experts in the context of everyday activities.

Situated cognition, anchored instruction, apprenticeship learning, problem-based learning, generative learning, constructivism, exploratory learning: these approaches are all grounded in, and derived from, constructivist epistemology.

In summary Lave and Wenger do not mention that there are competing groups within specific occupations. There may be multiple communities of practice within occupational fields. Every community of practice establishes its own aims, and work procedures. In the work of both Schön and Lave and Wenger the emphasis is on the importance of practical knowledge and skill. Knowledge and skill develop through active engagement with an activity.

Situated learning acknowledges the value of all forms of reflection and the knowledge they can produce. For example, Lave and Wenger argue that narrative knowledge is more compatible with, and plays a more important role in relation to situative learning than that of propositional knowledge (Lave and Wenger, 1991, pp.105-109). They further argue that there are no clear distinctions between learning and full-fledge participation. For instance, problem solving involves learning even when the practitioner is highly skilled and experienced.

Schön rejects the notion that a profession is an occupation whose practice is based on a body of scientific knowledge. However, Hammersley (2005) suggests there needs to be a revision of this notion. Short-comings in the situative learning theory summarised by Hammersley (2005, p.13-14) reads as follow:

> It is worthwhile emphasizing that the concept of situated learning is of considerable value in challenging the academic neglect, or even dismissal, of the learning and knowledge of ordinary people, and in stressing the need to understand than if everyday activities are to be studied effectively. Furthermore, as we have seen, it can also be used to emphasize the fact that research is necessarily a practical activity, and the important

implications of this. However, in my view it involves a tendency to overcompensate for earlier errors, assigning excessive value to supposedly spontaneous everyday learning – and the knowledge this produces – as against the role of critical reflection by practitioners and of academic inquiry. The line which I have traced relies heavily on the idea of situated practice as involving tacit knowledge and learning by doing. What is down-played in significance is not just direct teaching, but also those forms of reflection which seek to represent the practice, or aspects of it, in terms of propositional accounts. The value of this kind of reflection is treated by Lave and Wenger as limited if not negative: What counts is learning that takes place through action. In my view Schön's notion of reflective practice and Hirsts' (1983) concept of practical educational theorising are more convincing.

2.7 Tutorials

For this dissertation the researcher will make use of the definition of tutorials as presented by Black, Bliss, Hodgson, Ogborn and Unsworth (1997, p.5) stating that tutorials are '... a regular meeting of a number, greater then one and less than ten, of students with a tutor. Much of it is equally relevant either to a particular course, or to tutorials in which a tutor helps with all of the work of his students. However, some ideas and problems are relevant only to the latter alternative… a class of about sixteen students with one tutor, organised with a different and specific purpose, that of training in certain skills…' The authors continue to identify three types of tutorials, namely:

1. Tutorials, which take what comes, i.e. unplanned tutorials where tutors have to react impromptu, i.e. on the spur of the moment (Black et al 1997, p.9).
2. Tutorials with some prepared basis. This situation can occur when there is an agreement to discuss an issue, prepared tactics in the tutors mind, and prepared work by students, (Black et. al. 1997, p.27).
3. Tutorials where student and tutor work together, (Black et. al 1997, p.43). The primary role of the tutor is thus to help the students master problem solving techniques.

The research described in the following chapters included elements of all three types of tutorials proposed by Black et al (1997). This means that tutors were prepared for the tutorials; this preparation involved discussions with fellow tutors and a coach on the physics problems which students were supposed to solve during the tutorials. That implied that both tutor and student were in some sort of agreement on their roles and expectations for the tutorials (these roles and expectations are part of the issues investigated in this research work). Unanticipated difficulties experienced by the students during the tutorial did create a challenge for the tutor to solve unrehearsed.

2.8 Conclusion

This chapter presented a review of relevant literature related to teaching and learning. The importance of constructivism as a theory for learning was explored to locate the importance of existing knowledge structures during the meaning making process. The importance of involvement with content during the meaning making process, the development and use of cognitive tools in authentic domain activity (collaborative social interaction), the reality that the outcomes of individuals are affected by each other's actions (as described in social interdependence theory), the act of reflecting (i.e. that act which causes us to make sense of what we've learned, why we learned it, and how that particular increment of learning took place) and the positive outcomes associated with co-operative learning were further explored. The notion that knowledge be presented in an authentic context; and that learning requires social interaction and collaboration appeared to be central to the literature reviewed.

The works of Schön were introduced to demonstrate the link between social interactions and reflective practice as a tool for supporting learning. The point was made that pedagogical reflective practice differs from everyday practice.

Finally, given the context in which the research was conducted, namely that of physics, a need arose to explore writings on social participation in communities. This was done because the literature hitherto explored suggested that learning required social interaction and collaboration, and that the knowledge presented needed to be presented in an authentic context.

From the literature it was also suggested that group learning will always be productive, regardless of how it is organized. The call, however, was for more varied learning situations. Also, students needed more opportunities to participate actively by formulating and evaluating problems, questions, conjectures, conclusions, arguments, and examples, which related closely to reflective practice.

As a result of the seminal work of a number of scholars and philosophers on teaching and learning, the way was paved for the start of a process whereby university physics tutors' conceptualization of first-year undergraduate science student's tutorials related to the observation and interactions during tutoring could be explored. The evolvement of the process and ultimate conclusions that were drawn from the research are discussed in the following chapters.

CHAPTER 3: RESEARCH METHODOLOGY AND METHOD

PHASE 1

3.1 Introduction

It is widely accepted that through research one is capable of delivering knowledge and insight into situations which would otherwise not have been possible under normal circumstances. This research is aimed at delivering insight and understanding into the reflective abilities of physics tutors, tutoring first year university students, through the use of actual tutorial sessions.

This study developed over two phases. The methodological framework and data collection methods for both phases are described in section 3.2 and 3.3 respectively. Thereafter, the findings, recommendations and conclusions of phase 1 are presented which formed the basis for the development of phase 2 (discussed in chapter 4).

3.2 Methodological framework

The methodology of this research work was heavily influenced by the definition offered by the feminist movement approach which states that research methodology involves itself with the epistemological views (see section 3.2.2) of the researcher. Differently stated, the researcher's views on teaching and learning affect the method used by the researcher. For example, a researcher coming from a pure science background may view research as producing objective, empirically verifiable knowledge, hence the positivist epistemology. Such researcher may utilize quantitative methods to do his/her research. On the other hand, a researcher coming from a constructivist background may utilize a qualitative method to do his/her research, because he/she believes that the products of research are useful and meaningful constructions of the subjects. Case (2000, p.52) supports Guba and Lincolns' (1994, p.105) view that the beliefs of the researcher influence the research process, whether those beliefs are made explicit or not. Ingerman (2002) supports this notion stating that:

> Qualitative pedagogical research puts much emphasis on articulating and discussing the perspective and theoretical framework of the researcher, which may include a discussion of basic assumptions of how the world is constituted, what constitutes knowledge, which method to employ, and why that method should be employed. In physics research much more of the world view is taken for granted and does not have explicitly articulated. Emphasis is much more put on the results, even though important details of methods are presented, e.g. presentation of mathematical formalism and sketches of experimental techniques. The feminist movement has had an important role in problematizing the role of the researcher in research, arguing (among other things) for making a distinction between method and methodology. The point of that is to acknowledge that the validity and generalizability of the research is not ensured by the usage of a certain scientific method, but it depends rather on the researcher's methodology, i.e. his/her underlying beliefs and attitudes including the reasons for using a particular method. (Ingerman, 2002, p.53).

Hence the definition of methodology (from a feminist perspective) which put emphasis on 'why research is being done', i.e. how we will go about studying a phenomenon, whereas method relates to how the research is carried out. The definition of methodology affirms the belief that the perspective and theoretical framework of the researcher has a direct impact on the research method, hence the belief that research is never completely value free (it is important to note that the researcher is not arguing for a feminist approach in the research work, but is merely expressing appreciation for the works on the definition of methodology brought to the for by the feminist movement).

The methodology for this research was subsequently guided by elements of three research paradigms, all informing the research questions. These research paradigms included naturalistic inquiry, grounded theory and phenomenography. Section 3.2.1 gives a brief explanation of these three paradigms.

3.2.1 Research paradigms

3.2.1.1 Naturalistic inquiry

The best description of a naturalistic inquiry is that the traditional sense of a qualitative or statistical design is not pre-selected, but emerges during the process. This does not imply that naturalistic inquiry goes into the research setting unorganized and waits for something to emerge. With regard to the latter and from a conventional perspective, research design will have the following specifications: statement of a problem, statement of a theoretical perspective, statement of method, a time schedule, samples, budget projection and statements of expected end product(s). In viewing these specifications the idea might be created that naturalistic inquiry is an ad hoc and unstructured research process but that is not necessarily true. During a naturalistic inquiry the naturalists will start with a specific problem (but that's as far as similarities with conventionalists go); theory emerges from the inquiry; sampling is contingent and serial to maximize the scope and range of information obtained; instrumentation is internal (i.e. subjective), so the instruments become refined and knowable as they sort out salient elements and target in on them; data-analysis is open-ended and inductive; timing, budgets and expected results remain unspecified. This implies that the research design of a naturalistic inquiry emerges, develops and unfolds during the research process. Because there is a close link between naturalistic inquiry and constructivism, and because the philosophical stance that informs the methodology of this study, i.e. the theoretical framework of this study was based on constructivism, using naturalistic inquiry became an obvious choice.

3.2.1.2 Grounded theory

Grounded theory (developed by Glasser and Strauss during the 1960's) is a method for analysing data; it is most commonly employed on naturalistic field data, but has also been used on historical and documentary data, and has since become one of the hallmarks of the qualitative tradition. Strauss & Corbin (1990) define grounded theory as a qualitative research method that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon. In other words, the goal is to go from the specific to the general without losing sight of what makes the subject of a study unique.

Grounded theory also requires that the theory which emerges from the data, but does not see these as separate. Data collection, analysis and theory formation are regarded as reciprocally related, and the approach incorporates explicit procedures to guide this (Becker, 1993).

Analysis involves three processes, from which sampling procedures are derived, and which may overlap: open coding, where data is broken open to identify relevant categories; axial coding, where categories are refined, developed and related; and selective coding, where the 'core category' or central category that ties all the categories together, is identified and related to other categories. These processes have been followed both in phase 1 and phase 2 of this study. Two key procedures, asking questions and making comparisons, were specifically detailed to inform and guide the analysis and to assist in theorising.

Part of the uniqueness of grounded theory is the fusion of the data collection and data analysis; hence the initial data collection and - analysis from phase 1 which was used to shape the continuous data collection and analysis of phase 2. Strauss and Corbin (1990) provide four central criteria, which were carefully executed during this study to assist in developing a good grounded theory approach. The criteria are:

- It should fit the phenomenon providing that it has been derived from diverse data and is true to the everyday reality of the context.
- It must provide understanding and must be comprehensible to the subject/case studied and to other subjects/cases involved in that context.
- It must provide generality. The data is often comprehensive, and the interpretation is conceptual and broad. The theory thus includes extensive variations. The theory should be abstract enough to be applicable to a wide variety of contexts in the area of study.

- It must provide control by stating the conditions under which the theory applies and it must provide a basis for action in the area of study.

3.2.1.3 Phenomenography

Scholars such as Marton and Booth (1997), Haselgren and Beach (1996), amongst others contributed to the development and establishment of the concept of phenomenography, namely that understandings of whatever phenomenon or situation, in a sufficiently large population or sample of people, may vary in a limited number of qualitatively different ways, which are crucial for the quality of subsequent learning and also its outcomes. Phenomenography aims at description, analysis and understanding of experiences as they manifest themselve in different discourses; although most generally in a conversation between the phenomenographer and an interviewee. The relatively distinct field of inquiry indicated by such an orientation is labelled phenomenography.

Phenomenography has played an important role in suggesting to educational developers an agenda for researching and improving educational practice. Phenomenographers do not claim to study what is present in the world (reality), but they claim to study what is present in people's conceptions of the world (Webb, 1997). In regard to the latter, conceptions and ways of understanding were not seen as individual qualities, but rather conceptions of reality were considered as ‘categories of description’ used in facilitating the understanding of concrete cases of human functioning. Since these categories of description may appear in different situations, the set of categories are stable and generalizable between the situations even if individuals move from one category to another on different occasions. The totality of such categories of description denotes a kind of collective intellect, an evolutionary tool in continual development (Morton and Booth, 1997).

Because phenomenographers are interested in 'what is present in people's conceptions of the world', certain problems were posed during this study. An example is the question of how this phenomenography takes into account the historical and social construction of thought. It was difficult to defend the idea that observations can 'simply' be reported or that categories are 'simply there' in some way outside of the historical and social experience of the researcher. Bernstein (1983, p.139) addresses this issue very clearly stating that 'We are always understanding and interpreting in light of our anticipatory prejudgments and prejudices, which are themselves changing in the course of history'.

From the definition of naturalistic inquiry and that of phenomenography, they appear to be in direct contrast. But for the purpose of this study, however, elements of phenomenography were needed to bring balance to the study. However the problem with a phenomenographical approach was the inability of the researcher to have a pristine perception, make neutral observations, build objective categories and give neutral interpretations, because each of these activities was informed by theory and prejudice (see the discussion in 3.2). It seems likely then that phenomenographic research will tend to report the history of a particular discipline as the researcher understands it and as she reconstructs it through the people she interviewed. Also, phenomenographic explanation is prone to the reproduction of the discourses it studies.

So the 'prejudices' of the researcher, as she constructs and interprets categories of understanding, were never devoid from her own historically and socially informed understanding. So, although the researcher used phenomenography as a data collection and data analysis tool, she never claimed to be completely free of her own socio-cultural understanding and experiences of the context in which this study was based.

However, the work of Govender (1999) was instrumental in developing insight into the variations that may occur in students' (in this instance the physics education students) conceptualisation of the sign conventions of mechanics, which was the physics theory the tutors were working with. This study thus operated from the premise that the first year physics students would have similar conceptions of the sign conventions of mechanics (Govender 1999, p.169 and p.201), thereby delimiting any 'prejudices' of the researcher in terms of the physics context.

3.2.2 Epistemology

Earlier on the researcher argued that the method utilized by her was influenced by the methodology that she was using i.e. her epistemological, ontological and methodological premises. This implied that the way the researcher viewed teaching and learning determined the method used by her. Notwithstanding the fact that the research methods are often the systematic, rigorous, objective, repeated use of procedures, during the utilization of the research method/s the researcher tested what she thought about reality against what she observed in reality; what she observed was viewed in the light of what she knew.

To conclude a constructivist epistemology was used for this study because it allowed for the generalization of results within a specific context, contrary to a positivist epistemology which allows for the application of constructs universally, but is highly unachievable in a study where the subjects are human beings.

3.3 Data Collection

The same data collection techniques were used for both phase 1 and phase 2. These included video recordings, interviews and discussions.

The context and samples and data collection techniques will now be discussed followed by some concluding remarks on the reliability, validity and ethical issues influencing this study.

3.3.1 Sample and context

The sample involved physics tutors working with first-year science students (tutees). The tutors represented different academic development levels in physics (i.e. 1 MSc student, 2 honours students, 1 third-year and 1 second-year student).

The first phase of the study was executed during the first half of the third university term of 2004, during which particular physics contents (mechanics, which includes vectors; motion along a straight line; motion in a plane; Newton’s law I and II; work and energy; impulses; and momentum; and mechanical equilibrium, i.e. equilibrium of a rigid body) were introduced to the tutees. The context was thus a rich, uniform learning environment provided by a uniform physics content of tutorials, which occurred on a weekly basis. The theoretical conclusions that were generated were thus highly context specific (see chapters 4 and 5).

3.3.2 Data collection methods

Three data collection techniques were used in phase 1 and phase 2 of this study, namely video recordings, interviews and discussions. Each one of these data collection techniques will now be discussed.

3.3.2.1 Video recording

Part of this study is the trend towards naturalistic inquiries. Video-taping can, on the contrary, be perceived as an intrusive observation method. However to capture what had been said and taken place during the tutor-tutee interaction, and to capture interviews and discussions between the researcher and the tutors and tutees, video-taping appeared to be the method of choice. This choice also had the advantage that less descriptive - and more insightful observations could be made through video-recording. It also allowed for authentic and truthful data to be collected and presented, opened and made available for scrutiny. In order for the recordings to be least disturbing to the tutorial, a remote controlled camera setup was used as shown in Figure 3. 1. This setup allowed the researcher (8) to capture anything from the words written by the tutees (using the zoom and angle control on panel 6 to control camera 4 or 5) to the tutors actions (using the zoom and angle control on panel 6 to control camera 3). The movements of the cameras during their angle- and zoom control could hardly be noticed since they were positioned near the ceiling.

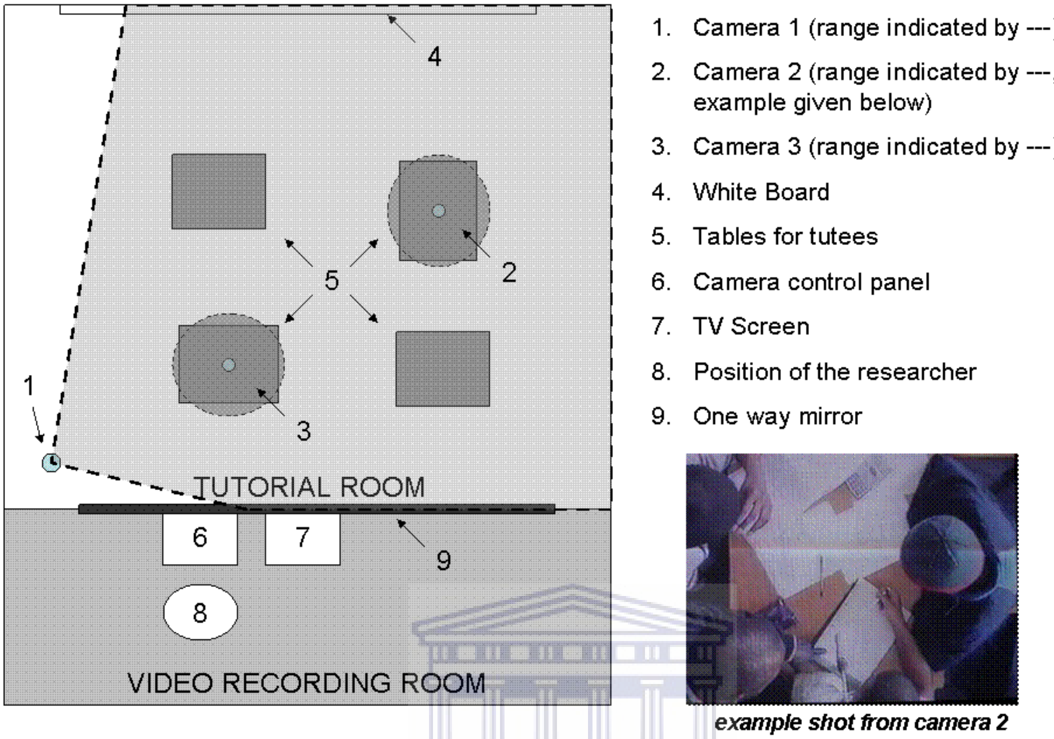

Figure 3. 1: Schematic representation of the video recording setup

During the video recording process more than one group were present in the room. The researcher, however, videotaped only one group. Neither the tutor nor the tutees knew which group was focussed on during the video recordings. The tutor, subsequently, had to interact with all tutees during the tutorial. Noteworthy is that opportunities were planned in the physics problem for tutees to be involved with the physics problem without the immediate attention of the tutor.

Three sets of video recordings were done. With every pre-tutorial meeting, tutorial and post-tutorial meeting a video recording was made. Transcriptions of these videos were then prepared. The sequencing of the transcriptions of the video recordings was made based upon selective transcripts.

The tutorials itself involved the interactions of the tutor with the tutees, as well as interactions of the tutees with each other, and with the physics problem. There were three cameras for the researcher to use, meaning that the researcher could focus on all three aspects, i.e. the tutor-tutee interaction of the tutor with the tutee, the tutee-tutee interaction (through camera 2 and 3 zoomed out) and the tutee-physics problem interaction (through camera 2 or 3 zoomed in).

Although this study's main focus was not on the learning events of the tutees, no need existed to transcribe those interactions. But these instances were however video-taped should the study later on require an exploration of these instances.

3.3.2.2 Interviews and discussions

The protocol of the discussions and interviews was designed with the research questions in mind. The discussions took place on two levels: level one involved discussions between the coach, the tutors and the researcher during the pre-tutorial and post-tutorial meetings; whilst level two involved the discussions between the tutor and the tutees. During the pre-tutorial sessions the discussion was mostly about the physics problem, difficulties experienced in solving the problem and ways how to address those difficulties. The post-tutorial discussions took the form of reflection about the tutorial. The interview generally aimed at getting tutors and tutees to talk about their expectations and experiences about the tutorials, their approach to learning, and their views on their meta-cognitive process developments. The researcher played a participant role. A semi-structured interview-style was utilised to probe for contradictions in responses or to adhere to the original purpose of the study.

The social interview setting remained the same throughout the study to create a sense of familiarity.

3.3.2.3 Data analysis

In the light of the complexity of grounded theory the researcher aimed at understanding what was happening in the tutorial setting, and how the tutors managed and conceptualized their roles. This was done through observation, conversation and interviews (i.e. techniques for collecting data for grounded theorising). After each bout of data collected, the researcher identified the key elements, categorized the relationship/s of these elements to the context, and then derived a theory about the context in which the research took place.

The study comprised two phases. During the first phase the research methods were tested against the intentions of the study (see chapter 4 for a discussion on phase two). The data collected during this phase were from pre- and post-tutorials and from narratives of the actual tutorial classes.

The pre-tutorial meeting was an individual, video recorded pre-tutorial interview in an informal setting, conducted to investigate the tutors' current understanding of tutoring; -current approaches to tutoring; tutoring style and objective/s for the tutorial. It was also used during the post tutorial meeting to stimulate reflective conversation about the tutorial sessions

The tutorial was also video recorded and a transcription was then prepared reflecting the researcher's observation of the tutors' interactions with the tutees during the tutorial (see appendix B). An example of the physics problem that tutees were exposed to, can be viewed in appendix A.

3.3.3 Reliability, validity and ethical issues

Internal and external validity, reliability and objectivity are aspects often difficult to achieve in a constructivist epistemological position, hence the provision made for internal validity through triangulation, i.e. through the use of multiple methods of data collection.

External validity is concerned with the generalisability of results and is often a quality of the research process. As this study was based in a constructivist epistemology, external validity acquired a new meaning. This study was not so much focused on generalisability, but still wanted to maintain validity, so careful journaling of the research process was a means to attain external validity and to allow external scrutiny of the research process.

The above discussions on methodology and epistemology suggest that objectivity or value-free research is an unattainable goal. This study involved human beings as the subject and the researcher; with none of these participants being value-free. A suggestion by Lincoln and

Guba (1985) that values be made explicit in the reporting of qualitative research was consistently implemented in this study. These values include personal, paradigm, theoretical and context values.

Given South Africa's' rich diversity in terms of language and culture, which were all present amongst the subjects of this study, the researcher subsequently followed the suggestion made by Lincoln and Guba, and strove towards making values explicit during the reporting of the research (see chapter 5, sections 5.5 and 6).

To conclude, this study was firmly based on a constructivist view of learning. Although that in it did not automatically prescribe the research methodology. The methodology was also guided by a constructivist epistemology, where epistemology is concerned with the nature of the knowledge generated in the research.

The research was conducted in a naturalistic setting i.e. occurring within a natural setting by using humans as an instrument; hence the omission of a representative sample. The researcher did not seek to generalize measurements to a larger population, but rather to discover as much as possible to answer the research questions successfully, i.e. how tutors view learning and how they learn when they are in the position of a reflective practitioner, for this reason the researcher's view that her research findings are useful and meaningful constructions,

The qualitative aspects of the study were addressed using naturalistic research techniques namely interviews, questionnaires, observations, and video-recordings capturing the talkaloud activities in the tutorials. Because prior hypothesis did not exist in this particular research, deductive analysis was not warranted. Inductive analysis was favoured in this research because analysis proceeded in categories already developed during preceding studies, and also those categories proceeded from the research data.

3.4 Findings emanating from Phase 1

The data collected during the first phase were analysed before the data collection for the second phase commenced. The analysis was done as described in section 3.3.2.3. Six main shortcomings of the first phase were identified. To overcome these shortcomings, several recommendations were suggested that lead to the development of phase two of this study (see chapter 4). The shortcomings with related recommendations were:

a) Low level of interest (-in the social aspects of tutoring)

The tutors generally displayed a low level of interest in the social aspects of tutoring. For example, the video recordings taken during the first three weeks showed that the researcher and the coach were involved in discussions around the art of tutoring whilst the tutors were working on the physics problem individually. Since the aim of the sessions was to encourage co-operative participation between the researcher, coach and tutors, it was evident that the tutors' level of interest in the art of tutoring needed to be increased.

b) Time constraints

Tutors were allowed to watch the videos at home after which a video recorded post- interview was conducted. Tutors spent an average of three hours watching the videos. During the discussions the tutors indicated that watching the entire videos was too time consuming. The researcher then recommended that the video be condensed into a package of meaningful incidences. The tutors would thus be exposed not only to his/her own interaction with the tutees but also to interactions between other tutors and tutees. The functionality of the videos would thus be increased. Moreover, the videos could be viewed co-operatively during the post tutorial sessions.

c) Poor preparation by tutors

During the pre-tutorial meeting the tutors were encouraged to envisage possible problems that tutees may experience with the physics problem. The tutors then had to come up with possible ways of assisting the tutees to developed full understanding of the problem at hand. Immediately another problem surfaced. From the analysis of the videos it became clear that the tutors came to the pre-tutorial meeting poorly prepared. The tutors acknowledged that they did not read through the specific chapter covered by the tutees, and therefore struggled to make meaningful contributions during the discussions. It was suggested that the tutors would be reminded about their commitment towards the preparation for the tutorials and the fact that they were being remunerated for the preparation time.

3.4.1 Role of coach

The research involved itself with reflective abilities in a co-operative environment. Yet, very little emphasis was placed on the interaction between the tutor co-ordinator (coach) and the tutors themselves. It was then decided that the emphasis should shift from a look at the tutors interactions with the tutees only, to the role of the coach in the development of the tutor's reflective abilities, as it was assumed that the development of the tutor not only occurs during their interactions with the tutees but also their interactions with the coach.

3.4.2 Role of co-operative environment

The tutors were trained co-operatively and the tutees worked in a co-operative environment, yet the researcher interviewed the tutors on an individual basis. A change was proposed towards a group interview. This would complement the initial co-operative training the tutors received, the co-operative environment they were working in and their collective views on both the training process and the tutorials itself.

3.4.3 Difficulty with reflection-in-action

The data also showed that the tutors had difficulty with the reflection-in-action process. For example, the tutors communicated well about their action in retrospect, but when the researcher spent time with the tutors in the tutorial sessions, probing them on their interactions with the tutees immediately after they had assisted the tutees, clear hesitation was visible. Further training and development of the art of tutoring was recommended.

3.5 Conclusion

During the execution of phase 1 the following six shortcomings were identified:

- Low level of interest in the social aspects of teaching,
- Time constraints,
- Poor preparation by tutors,
- Role of the coach,
- Role of the co-operative environment,
- Difficulty with reflection-in-action.

Since these shortcomings had the potential to influence the reliability and validity of the research findings and subsequent theorising, the need developed to address these shortcomings (see section 3.2.1.2). Phase 2 was introduced which aimed at minimising the effect of these shortcomings on the data collection, data analysis and the development of a theory on the reflective abilities of tutors. The development, implementation and findings of phase 2 are presented in chapter 4.

CHAPTER 4: PHASE 2

OPTIMIZATION OF RESEARCH ENVIRONMENT

RESULTS AND DISCUSSIONS

4.1 Introduction

The data analysis of research phase 1 rendered six shortcomings. These shortcomings all relate to the reflective abilities of the tutors. This chapter describes research phase 2 detailing the direction taken to deal with the identified shortcomings. The introduction of this chapter points out why the research intervention was needed. Section 4.2 discusses how the reflective conditions were optimized and section 4.3 refers to the reflective environment. The results of the analysis of the data collected during phase 2 are given in section 4.4. This is followed by a conclusion in section 4.5.

4.2 Underlying motivations for phase 2

During a discussion forum on constructivism Hake (2005) made the following statement: ‘Most physics teachers do not advocate pure "discovery learning" in which, for example, students are expected to "discover" or "construct" Newton's second law F = ma from scratch. Even Newton had to stand on the shoulders of giants to arrive at his second law’. This statement underwrites the findings formulated during phase 1 which highlighted the importance of motivation, preparation and the development of reflective practice and learning systems as proposed by Schön (see section 2.5).

A re-exploration of the work of Lave (see section 2.6) also supports the notion of motivation. The subjects in the study of Lave were all individuals who wanted to be in their respective professions. They were apprentices and apprentices' aims are to become like the old-timers, more precisely they wanted to be old-timers. The situation with the physics tutors was different. Their aim was to equip themselves in the area of the pure sciences. They want to be physicists. This research, however, put them in a position of a 'teacher', which was not necessarily their aim. The motivation to engage in activities that may improve the art of becoming an excellent 'teacher' was of lesser importance. A new approach (i.e. phase 2) was developed which aimed at greater involvement of the tutors in their tutoring role. This new approach and the subsequent results will now be discussed.

Based on the works and findings from Schön and that of Lave and Hake, motivational level of the tutors and the focused preparation of the reflective environment were deemed to be important to improve the reflective skills of the tutors. Section 4.3 gives account of this initiative to improve the reflective environment.

4.3 Optimization of reflective conditions

The effect of the shortcomings identified in phase 1 was minimized in phase 2 by exposing tutors to an organized, sensitization session, i.e. tutor-training over a period of nine months. During this time the tutors were introduced to co-operative learning and to the various processes of reflective practices, namely follow-me, modelling and joint experimentation, reflection-in-action and reflection-on-action. The tutor training occurred during 1 hour pre-tutorial meetings (PrTM). The researcher shared formal theoretical information about teaching with the tutors. In addition, the coach discussed the physics problems that were going to be presented to the tutees the next day during the tutorial meeting (TM). The TM the next day allowed an opportunity for the tutors to apply what they had learned or observed during the PrTM, using the Schönian model as a tool. Although tutors were exposed to the practice of co-operative learning and the Schönian model, the practice of these processes per se was not enforced. Tutors were allowed to buy into these methods out of their own free will. Tutors were never criticized if they did not follow these models, but were asked to justify their method of choice for student support. Two days after the tutorial the tutors were exposed to a post-tutorial meeting (PoTM). During this meeting the tutors were allowed an opportunity to reflect on the tutorials and to discuss any positive and/or negative experiences they encountered during the tutorial. There was no set agenda for this meeting and tutors were free to discuss any point that they viewed as important. The PrTM, TM, PoTM took place every week for two semesters.

The tutor training was characterized by the absence of assumptions on the theoretical understanding of tutors about the teaching environment and teaching processes. The focus of the tutor training sessions was towards a way of training the tutors in a specific intervention, in this case the different training style as defined by Schön (appendix c is an account of such a training session). The consequence of this cycle of training was then investigated in the last term of the academic year. The rest of this chapter reports on the findings of this cycle (phase 2).

4.4 Reflective environment

4.4.1 Sample

Five tutors took part in phase 2 of this study. The academic qualifications of these tutors included honour's degree, master's degree and doctoral degree in physics. The five tutors were expected to tutor eighty first-year physics students (tutees). Each tutor had a group of sixteen tutees per tutorial session. Both the tutees and the tutors were from the various cultural groups represented in the country. This study, however, did not focus on the effect of cultural- and language differences on the ability of the tutors to reflect-in-action and reflect-on-action.

4.4.2 Data collection process

The data collection process followed in phase 1 and phase 2 were identical. The theoretical and technical details on the interviews, video recordings and discussions were given in Chapter 3 (section 3.3).

4.5 Results

The results of the data collected during phase 2 involved two main categories, namely the views held by the tutors on tutorials and the actual reflective abilities of the tutors. The tutors' view of their role from various perspectives is presented in section 4.5.1. In section 4.5.2 a comparison of the tutors past experiences as tutee and present experiences as tutor are presented. Section 4.5.3 covers tutors identification of areas of dissatisfaction which is a prerequisite for reflection. Evidence of the tutors' reflective abilities in-action (section 4.5.3) and on-action (section 4.5.4) are presented thereafter.

4.5.1 Tutors' view on their role

This research work was a study of the reflective ability of university physics tutors through an exploration of the tutors' conceptual perception of the Physics I tutorials. What contributes to the uniqueness of this research work is that both the reflective ability of physics tutors and the environment in which the study took place were investigated.

The analysis rendered one main category on how tutors perceived their roles, namely a dependency role. This dependency role was related to the motivational role and the effective and competency role which the tutors perceived to play.

4.5.1.1 The dependency expectation of tutees vs. supportive expectation of tutors.

With reference to the tutees, the tutors mentioned that the tutees were expecting the tutors to help them (the tutees) solve the physics problems. When probed about this, the tutors responded with statements such as '*tutees want to establish the tutor's 'thinking' about the particular physics questions they get during the tutorial', 'tutees expect tutors to assist them by giving them the answers', 'to show them how to solve the physics problem', and 'to help them to understand physics concepts'*. In essence the tutors view the tutees' expectations to be of a dependent nature, i.e. a need for demonstrations on how to solve the specific physics problems, to support in giving the actual answers.

The tutors viewed their own role to be more supportive contrary to their view on the tutees of acting out a demanding role, e.g. '*tutees expect tutors to assist them, tutees expect tutors to show them how to solve the physics problem'*. This is in direct contrast with situated learning theory which suggests both tutee and tutor constructing, discovering and transforming their knowledge. Nonetheless given the context of the tutorials the relationship between the tutor and the tutees were more personal. The expectation (according to the tutor) of the teaching-learning environment was for tutees to develop competencies and talents in physics problem solving (see chapter 2, p.44 on situated learning).

The dependency expectancy as viewed by the tutors can however be classified further into four subgroups namely dependency for assistance and – testing, social responsibility expectancy and institutional efficiency expectancy.

<u>a) Assistance expectancy</u>

The reliance of the tutees on the tutors were presented in the following statements made by the tutors: *'assist tutees in the development of problem solving skills, assist tutees in gaining practice in the application of theory, assist tutees in developing group work skills, give assistance in difficult areas of physics'*. The expectancy for assistance often transgressed the boundaries, '*tutees expect us to assist them by giving them the answers'*. Tutors thus viewed tutees to still carry with them the notion of spoon-feeding.

The tutors' view about their role from a tutee's perspective was in direct contrast to their own view of their role, i.e. *to train the tutees on methods to approach physics problems.* The tutees require the tutors to model the problem solving skill, rather than facilitating their problem solving skills. The preferred method by the tutors was however to '*involve tutees in discussions and application of knowledge, advance the understanding of tutees, and develop tutees' understanding'.* These responses support the tutors' view to strengthen the tutees physics content knowledge, although it is in direct contrast to the tutees dependency expectancy.

<u>b) Testing expectancy</u>

The tutors were of the opinion that tutees expected them to be tested by the tutors. The tutors were thus aware of the fact that the tutees perceived them in the 'traditional role of teacher which involves teaching and testing: '*test understanding, test their knowledge, and test tutees application skills'.*

<u>c) Social responsibility expectancy</u>

The tutors' role went outside the boundaries of pure physics learning. It involved support in the social domain. This referred to '*developing the tutees confidence in his/her understanding of physics, provide a source of income, keep tutees focused, improve student's communication skills, prepare tutees for tests, and examinations, to motivate them to work independently'.*

d) Institutional efficiency expectancy

The tutors were also aware of their role in a broader context, that of the institution. In their responses they recognize that tutorials are a supplement course to class work (i.e. tutorials complement the lectures), recognize that tutorials are a means to prepare tutees for lectures, (i.e. for better student understanding), and assist in achieving a high pass rate amongst the tutees. The tutor thus understood their role to be one in which there were a close relation between what happened in the lectures and in the tutorials, i.e. the work of the 'apprentice' (tutor) complements the work of the 'old-timer' (lecturer). Also the tutorials could be held equally responsible for the final academic performance levels of the tutees.

4.5.2 Tutors' experiences of physics tutorials (as tutee in the past vs. as tutor presently)

The next set of findings emanating from data analysis involves tutors' experiences of first year physics tutorials when they were first year physics tutees. They were asked to compare their own experiences as a student with their current tutoring experiences. Their responses are presented below in Table 4. 1.

Table 4. 1: Tutors experiences of the first year physics tutorial as tutee opposed too currently as tutor

	As tutee they -	**As tutor they -**
1	*Expected answers*	*Lead tutees to the correct answer*
2	*View tutorials as not important*	*Recognize the importance of tutorials*
3	*Experienced tutors to be helpful*	*Aim at assisting tutees 'appropriately'*

4	*Aim at getting the right answer to the physics problem.*	*Strive towards conceptual understanding*

As first-year physics students the tutors regarded the tutorials as not being of importance. The answers to the physics problems were expected to come from the tutors. The main aim of the tutorials was to get to the 'right' answer. They experienced their tutors to be very helpful. On the contrary, as tutors they experience tutorials completely differently. Where tutorials were initially seen as not important, tutors now 'see' the importance of the tutorials. Tutorials now serve as a means to lead tutees towards the answer, and towards conceptual understanding of the physics problems, which can be achieved through the use of appropriate assistance.

In the context of being tutees, the tutors were questioned about their perception of group work. They responded as follows: '*an opportunity for tutees to share their knowledge and to assist each other*'. According to their observations they found that '*the more intelligent tutees worked harder';* subsequently *'there was less participation by weaker tutees*'. They also found that tutees would '*hide behind friends, and only communicate in the group when requested to do so'*. They further perceived group work as '*part of the tutor support structure'*.

Tutors then continued to compare their previous view on group work to their current view on group work. Tutors were convinced that they put their views into practice by being '*very helpful to the tutees, by encouraging tutees to attempt the physics problems and by promoting group work*'. Interestingly enough, and contrary to their role as being supportive, tutors found themselves in the unfortunate position of '*giving tutees the method to solve the problem*'. The conclusion can be drawn that tutors were still method driven, i.e. it was about 'plugging the values into the correct formula to obtain the correct answer'. The '*correct answer (is) what allows you to write tests and examinations and ultimately leads to promotion to the next academic level'.* Although there was the desire to assist and support within the tutors, they were not completely free of their own previous intentions, i.e. to reproduce the material in order to pass (Prosser and Millar, 1989, p. 514). The possibility exists that the use of the physics problem was not seen as a way to enhance tutees understanding of the physics concepts, but much rather as a way to test tutees ability to apply formulae. Meaning, even though the tutors indicated that they strove to conceptual understanding (table 4.1, no 4) they still preferred to lead the tutee to the correct answer (table 4.1, no 1). To conclude, the responses of the tutors do not indicate an observable intrinsic motivation (see section 2.3.3) to move students to the desired outcomes from a science education perspective, but rather from a pure science perspective. Also spontaneous cooperative interaction was not observed outside the tutorial meetings. Despite modelling social interdependence between the researcher and the coach, the operational activities of the tutors remained individualistic (see section 2.4, p. 24).

4.5.3 The road to reflection

One of the starting conditions for reflection is to be able to identify an area of dissatisfaction with the activity or situation you are involved in. The tutors have been taken through the following two steps in an attempt to make them aware of any dissatisfaction (as a tool for reflection) which they may experience. Firstly they were asked to identify the areas of dissatisfaction related to the tutorials and the tutees (see 4.4.3.1). Secondly, they were shown various examples which could potentially create dissatisfaction. It was presented in the form of a video clip (see 4.4.3.2).

4.5.3.1 Areas of dissatisfaction related to the tutorials and the tutees

Tutors identified the following areas of dissatisfaction related to the tutorials (quotes are extracted from Appendix d)

1. Dissatisfaction related to the physics problems: *the number of the physics problems was initially regarded as too many, and after changes were made to the content of the questions they then felt it was too little,*
2. Dissatisfaction related to the feedback on tutorials from the lecturers: *tutors did not get feedback on overall student performances, Tutors felt alienated from the 'community of experts', i.e. the lecturers*
3. Dissatisfaction related to organization of the tutorial; *tutors had no control over the composition of the groups, tutors were not involved in the administrative part of the tutoring context*

Changes to the physics problems involved the format and structure of posing the questions. While changes to the physics problems should be undertaken in accordance with research results about the problem identified, the other three reasons for dissatisfactions are related to (and resulted in) a lack of authority and autonomy over the tutees. This lack of autonomy could be a demotivational factor in the tutors' approach to the tutoring environment. These feelings of alienation were enhanced by the dissatisfactions experienced with the tutees. The nature of these dissatisfactions required more authority and autonomy for the tutor, to successfully address the dissatisfactions. Although tutors initially perceived their role to be complementary to that of the lecturers, they felt dissatisfied with their position in the 'institution'. There was little emphasis on the outcomes of the tutorials and more on the processes. Outcome interdependence (p. 26) which creates a feeling of personal responsibility stimulating mutual benefit of the group was thus not created. Furthermore tutors did not indicate dissatisfaction with their preparation from an education perspective. That is they were satisfied with the spontaneous operational procedures during tutorials. This satisfaction hindered their need for more active and engaged involvement with the 'community of practice'.

The dissatisfactions of the tutors related to the tutees were as follows:

1. Dissatisfaction related to scientific knowledge of the tutees: *tutees have little content knowledge, tutees did not know their formulas, tutees are not able to make deductions from existing formulas*
2. Dissatisfaction related to lack of commitment / discipline: *tutees do not attend the tutorials, tutees copy each other's work, tutees are unprepared, tutees do not seek help from tutor after the tutorials*

The tutors thus experienced three major dissatisfactions; firstly, they felt excluded from the communities of lecturers, secondly, the tutors questioned the motivation and seriousness of the tutees and lastly, they questioned the conceptual understanding and comprehension of the physics problems by the tutees. So even though the tutees could eventually give the correct answer, the tutor 'sensed' that giving the correct answer does not provide sufficient evidence that learning took place. This 'sensing' can be directly related to one of the problem areas identified by Govender (1999, p. 239), namely that there are 'limited different ways in which students experience sign conventions which are applied to the mathematical descriptions of some fundamental concepts in Newtonian mechanics'. Though the discourse of the tutors was limited, they were able to identify areas of dissatisfaction in line with studies done on the context of physics learning (Adams, 2003, Alant, 2001, Govender, 1999).

After the tutors identified the areas of dissatisfaction they made the following recommendations: *tutees should be presented with mini tests, tutees must be given time to review the work, longer time slots for tutorials, more physics problems needed for tutees to work on after the tutorial, make aims and objectives of the tutorial clear to tutees, equip tutees with physics problem solving skills.* The researcher thus concluded that tutors experienced a need for the tutoring situation to be transformed (in chapter 5 the researcher extent the recommendations of the tutors into criteria for reflection). The 'problem solving skills' tutors referred to should be, according to Linder and Erickson (1989, p491), a strive towards a sense of functionality and not a kind of problem solving instrumentalism.

4.5.3.2 Exposure to an actual tutorial situation (a video clip)

The next set of findings emanating from data analysis involves a discussion on an actual tutorial situation, i.e. the tutors were exposed to a unique video clip. The clip came from an actual tutorial with one of the tutors in the group. The tutors were asked to view the video clip as a group and then to reflect in writing on anything of interest in terms of the tutor-student interaction, student-student interaction, and group-content interactions.

From the video clip the tutors concluded that the tutor guided the tutees during problem solving, but instances occurred where the tutor was leading the tutees towards the correct answer. They felt that the tutor intervened too often in the activities of the tutees, yet spent too little time with the group, making his interaction with the group less effective. Also, the tutees in turn asked too few questions, and were struggling on their own for too long before they would request help from the tutor. The tutors also recognized one of the groups on the video clip who showed evidence of co-operative learning, whilst the other group did not work co-operatively. The tutors also noticed that the leader of one of the groups gave the wrong solution to a problem and that the rest of the group members did not correct or challenge her.

The tutors agreed that the language used in the physics problem was '*easy*' for the tutees to understand. The physics problems reflected the theoretical work covered during the lecture sessions.

Interesting to note is that the observations of the tutors were limited to contextual issues. They were able to 'see the obvious', yet when probed to make inferences from their observations, no responses came from the tutors. This is in direct contrast to the work of Lave and Wenger and Schön who both suggest the importance of practical knowledge and skill. The tutors were actively involved in tutoring yet struggled to develop active perception about the educational concepts and representations of the tutoring contexts (see p. 45). As a group, however, the tutors were able to reflect on the various issues involved in the teaching-learning environment as it was presented to them during the training sessions. That is, tutors concentrated mainly on the tutor-tutee-interactions and tutee-content-interactions. The tutors did not reflect on their supportive role towards conceptual development and conceptual understanding; and their role of support towards the development of problem solving skills (which incidentally the tutors regarded as their main roles).

Tutors were finally probed on the effect that their involvement with the tutorial had on their own learning. Their findings can be summarized as follows:

- Improvement of their own understanding; they related this to the assistance and guidance they offered to the tutees.
- Improvement of their communication skills (as a result of the exposure to the students and content)
- Positive effect on their motivation to understand (exposure encouraged continuous reading on physics content).
- Improved skills in problem solving and teaching strategies: the required continual adoptions of problem solving and teaching strategies allowed them to become

involved and experienced in reflection during their interactions with each other and with the physics content.

The interactions of the tutors with each other and with the students developed their own understanding of the physics problems. From a situated perspective the tutors became more productive and successful in their physics practices. The extent of this productivity was however not part of the focus of this study, but suggest an opportunity for future research.

4.5.4 The road of reflection

The next set of findings is derived from interviews (see chapter 3) during and after the tutorials. The findings are discussed under section 4.5.4.1 (reflection-in-action) and 4.5.4.2 (reflection-on-action) respectively.

4.5.4.1 Tutors' ability to reflect-in-action

The process of reflection-in-action could only be captured with the researcher physically present during the tutorial (to differentiate between data from reflection-in-action and reflection-on-action). Through observations and immediate dialogue after tutor-tutee interaction the researcher extracted the reflection-in-action of the tutors. The researcher identified the following during the tutorial: They (the tutors) knew the theory behind the physics problem and were able to solve the problems. Tutors were challenged with the following problems, namely tutees did not know how to start with the physics problem and needed assistance from the tutors. This meant that the groups had to wait for the tutor to become available before they could proceed with the task. From the discussions in the groups it became evident that the biggest concern with the tutees was the need to know the exact formula to solve the problem. There were incidences where the tutees knew how to solve the physics problem and needed confirmation only, which was given by the tutor. Incidences were also identified where tutees lacked the theoretical knowledge and understanding which warranted the tutors to explain the theory more in-depth before the tutees could attempt the problem. A summary of the responses of the tutors collected directly after a tutorial include the following:

- The tutors believed that they (the tutors) had the necessary '*conceptual understanding*' of the physics problem to assist the tutees with their problem solving skills.
- Tutors viewed tutees to lack the conceptual understanding of the physics problems.
- The tutees were '*lost*' if they did not know the correct formula to '*plug into*' in order to solve the physics problem.
- Some tutees were able to solve the physics problems, but lacked the confidence about their own understanding and cognitive abilities.

These responses indicate that tutors identified very specific problems experienced by the physics tutees.

4.5.4.2 Tutors' ability to reflect-on-action

Reflection-on-action happened during the post-tutorial meeting (PoTM). The structured questionnaire concentrated on three main aims, namely interaction between the tutor and the tutees, interaction between the coach and the tutor, and finally areas of dissatisfaction

The responses of the tutors to the structured questionnaire are presented in Table 4.2

Table 4.2: Tutors responses during the structured interview

Questions: Do you:	Yes (positive response)	No (negative response)
1.Get enough support from coach	4	1
2.Satisfy the needs of the lecturer and coach	5	
3.Recognize the strengths of tutees easily	5	
4.Recognize the needs of tutees easily	5	
5.Recognize what to do in a specific situation	3	2
6.Keep your own experiences in mind during tutorials	5	
7.Think tutees behave differently in their approach to learning from you when you were a student	1	4
8.Apply what you have learnt in tutorials to your own learning	5	
9.See tutees experience frustration during tutorials	4	1
10.Want to change the style that has been proposed to you to interact with the tutees	2	3
11.See any worth in tutorials	4	1
12.Feel satisfied with what you are doing	3	2
13.Think tutorials make an impact on the tutees' understanding	5	
14.See tutees afterwards for support	5	
15.See tutees on an individual level	5	
16.(Use) lecture (method) during consultation hours	1	4

Previous responses of the tutors indicated dissatisfaction with their position in the institution (see 4.5.3.1). If the communication network between tutors and institution is not open, it may influence the reflective ability of the tutors with reference to their role in the institution, considering that the mastery of reflection involves the development of a unique language, norms and rituals (see chapter 2) which is often well established in a professional context. A direct link however, between the institution, the lecturer and the tutors was the coach. A set of data was collected to establish the relationship and experiences between the coach and the tutors and will be presented next (Table 4.3).

By answering these questions the tutors were required to reflect on their interaction with the tutees, coach, the lecturer and with each other. These questions all allowed the tutors to put themselves in the role of the tutees, the coach and the lecturer and to assess how they satisfied the needs of the tutees, the lecturers and the coach. Tutors were allowed the opportunity to reveal their successes, problems and uncertainties and to reflect upon this.

Table 4.3: Dialogue and experiences of tutors with coach and tutees

Questions	Yes (positive response)	No (negative response)
Were you involved in a dialogue of words and actions	5	
Did you feel willing to be involved in this communication	5	
Did you always understand what the coach was explaining to you	4	1
Was there ever miscommunication between you and the coach	2	3
Did you ever have the feeling that you are expected to assist tutees in something you knew very little of	3	2
Did a unique language, norms and rituals develop during tutorials	3	2
Did your experiences of the tutorials become part of your intellectual development	5	
Do you want to change your interaction with the tutees	2	3
Was your tutoring style appropriate to the tutees' needs	4	1

To conclude, the data suggests that the role of the tutors allowed them the opportunity to apply the theoretical knowledge and to assess its successes. However, the tutors find themselves in a position of conflict. This conflict is caused by the stringent scientific methods characterized by the physics problem, the need to reflect on the thinking processes of the student, and attempts to solve the tutees' confusion. This conflict creates the need in the tutors to move from a fixed, step-by-step problem solving approach, to an approach where tutees were comfortable trying their own 'intuitive approach' (Schön 1983, p. 333). By practicing reflection-in-action and reflection-on-action the tutor would function as an independent person who makes quality judgments. There is less focus on covering a specific topic or content, and more focus on the development of problem solving skills. This approach may invariably cause tutors to be on different levels of reflection depending on their own understanding and insight into the physics problems, and different levels of experience with tutees.

The final set of findings were derived from the researcher's observations (see chapter 3) on the interactions and dialogues between the tutors, the tutors and coach and between the tutors and the tutees, which aimed at triangulating the written experiences of the tutors. The observations of the researcher are presented and discussed in the next sections.

4.5.5 Researchers observations

The researcher's observations from three events, namely the pre-tutorial meetings (PrTM), tutorials (TM) and post-tutorial meetings (PoTM) are discussed in section 4.5.5.1, 4.5.5.2 and 4.5.5.3 respectively.

4.5.5.1 Cycle of reflection during Pre-tutorial Meetings (PrTM)

The PrTM was the event where the coach introduced the physics problems to the tutors, and where problem solving strategies were demonstrated. Tutors did hands-on problem solving and thus experienced the difficulties and solutions to possible problem areas associated with a specific physics problem. The tutors were further sensitized to reflective practice and co-operative learning.

The coach requested a willing participant to do the calculations on the white board. Through this the coach invited the tutor to join in the process of problem solving. The rest of the group observed and gave input into the accuracy of the problem solving strategy. The coach and the tutors were now partners in the inquiry process, thereby standing side by side facing the problem. The coach adapted his role to the needs and expectations of the physics course and that of the lecturer. The kind of relationship the coach tried to establish with the tutors was thus influenced by internal and external forces. The external forces include the relationship between the lecturer and the role players who evaluate the course. The internal forces include the relationship the coach wished to establish with the tutors, and the factors needed to create a favourable relationship to tutoring.

Moreover, actions were regulated by the final solution to the physics problem. Applying own preferences to problem solving was not recommended, as these physics problems required a definite method to follow in order to obtain the solution. The coach thus tried to communicate the method by acting out different ways of interacting with the tutees during the problem solving activity (see figure 1.1). Although the problem solving method was regulated, the approach to the tutor and later tutor-to-student was less regulated.

Through the demonstrations acted out by the coach, and the tutors acting as tutees, the tutors experienced or observed the approach demonstrated by the coach. Tutors thus learned the problem solving skills through engagement with the physics, and they learned the art of

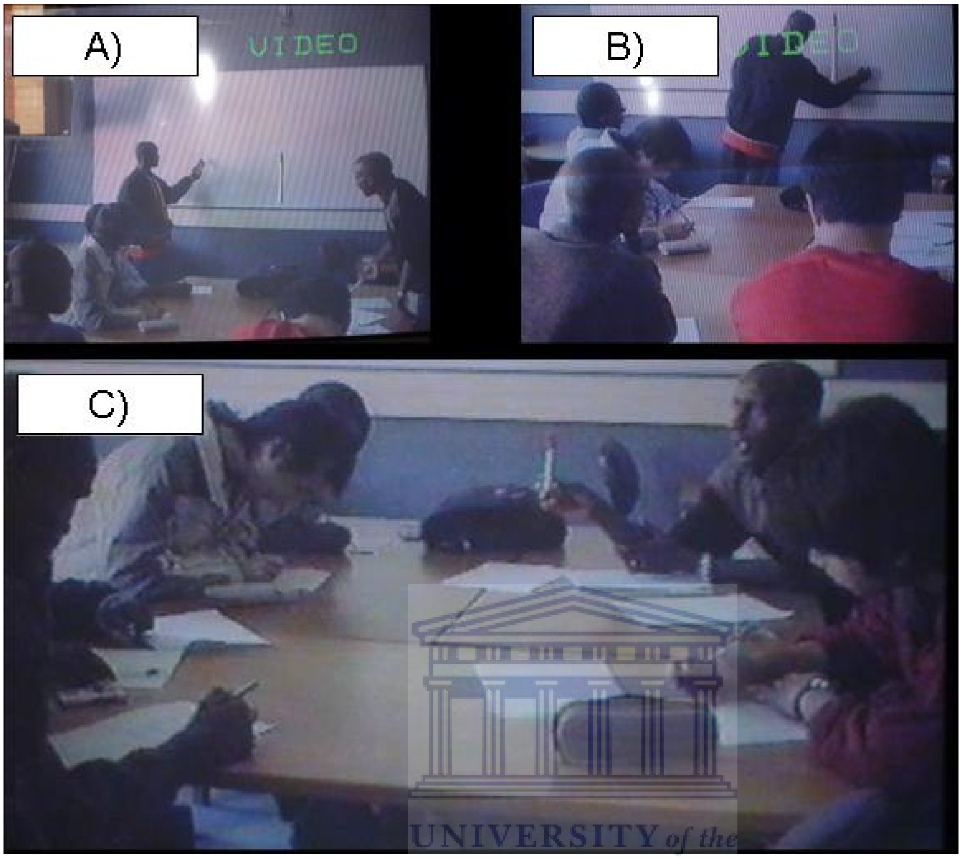

Figure 4. 1: Pre-tutorial meeting (PTM)

tutoring through demonstrations acted-out by the coach problem (i.e. they learn by doing), and simultaneously experience a specific tutoring approach (learn by experiencing).

The domain of the discourse the coach and tutors drew on was pure physic. The language of the discourse was consequently drawn from the pure science domain rather than science education. This was not unexpected as none of these students planned on entering the teaching domain. The nature of the dialogue between the coach and tutor included oral discussions, drawings and calculations. The interactions between the coach and tutors were characterized by criticism, questions, advice and demonstrations. The results presented by the tutors were analyzed by the accuracy of the specific steps/processes followed by the tutors.

The correct answer was seldom regarded as important (contrary to the tutors written experiences). The emphasis during this dialogue was on process (method) and performance (how the tutors go about solving the problem) rather than the final product, i.e. final answer (contrary to the tutors approach during the TM - see previous discussions).

The coach had a greater degree of freedom than his tutors. The interplay between the coach and tutors was direct and required a definite outcome in terms of the physics problem. A greater degree of reflection in action was thus needed by the coach to act out the required teaching approach during the PrTM.

The final task was broken up into smaller step-by-step guides. These smaller tasks made the bigger task more manageable to the tutors. Through the partnership in inquiry the tutors had freedom of expression. However, lack of preparation by the tutors prevented them from making an informed contribution to the verbal discourse. Through the unpreparedness of the tutors with regards to the calculations associated with a specific physics problem, the coach had to lean towards demonstrations which called for tutors ‘to follow’. As this was not his preferred method of coaching, criticism was evoked by the coach. The criticism of the coach, on the performance of the tutors, led tutors to become defensive. A paradox developed between acting out a design-like task (physics problem) and an unstructured, reflection-in-action task (tutoring process).

In conclusion, the PrTM occurred in a co-operative environment in which instructions were demonstrated to the tutors through the interaction of the coach with the tutors. Tutors were exposed to a demonstration of higher order reasoning, and a transfer of knowledge. The knowledge was introduced in an authentic situation, where opportunities for social interaction and a sharing of knowledge through collaboration were created (unfortunately notwithstanding the training that tutors received, they still came unprepared to the PrTM). There was a lack of accountability for their role as tutors assisting tutees to master problem solving skills.

However, the PrTM could have been more effective if the tutors had prepared for the PrTM (a part of the limited time allocated for the PrTM was lost because some basic physics knowledge was not readily available). The coach thus had to work 'harder' (through follow-me) to prepare/equip the tutors for the tutorials the next day. Subsequently, the coach experienced a degree of dissatisfaction because he could not train the tutors as effectively as he was hoping for.

4.5.5.2 Cycle of reflection during Tutorials (TM)

Tutors were now initiated into the traditions of teaching, i.e. the customs, methods and working standards. The tutorials however created a unique situation; on the one hand the tutors were introduced to the art of teaching and on the other hand, they had to apply research-based theory (physics problems).

During the TM the tutors had the opportunity to live out their observations from the PrTM, i.e. the tutors got to practice what they've observed. These actions were now regulated by their own preferences rather than external authority. The scientific knowledge of the tutors had to marry with real-life practice. When the tutors identified a problem, they had to do so in terms of their own frame of reference, i.e. how they saw and experienced the situation.

The situation required a quick and immediate response. There was, however, no opportunity generated in the PrTM to 'standardize' a specific method, as the thinking of the tutees remained an uncertainty. The tutorial situation was thus not textbook specific and tutors needed to improvise, invent and test on the spot. Although the PrTM tried to prepare tutors for various scenarios which may have been present during the tutorials, it was still left to the tutor to make unique on-the-spot decisions. The only certainty during the tutorials was the scientific method that would lead to solving the physics problem, but often unique situations presented them self as demonstrated by the two examples below:

Example one where the knowing-in-action of the tutees often failed them, as the following conversation demonstrates:

S: *Can you help us with number one.*

T: *Number one, OK.*

S: *We are lost.*

Example two demonstrates that tutors had to reflect in the midst of the action without interrupting the situation, just to discover that tutees were actually experiencing problems other than the tutorial questions:

T: *It involves work and energy.*

Tutees page through book.

S: *It is … the force times this* (pointing at the paper or which formula?) *is* …? (Silence)

T: *Let me see the formula. I need the formula.*

S: *Is it not this one?*

[The tutee was uncertain which formula to apply to the physics problem. The tutors highlighted this uncertainly in their responses by asking for the formula. Also, the tutees were so fixated on the formula that they often failed to recognize the given information, which would guide them to the identification of the correct formula to use in order to solve the physics problem].

T: *Ya, something like this. But you don't understand this and what is this?*

S: *The total force.*

T: *And this?*

S: *Initial kinetic, potential energy, change in potential energy, change in kinetic energy.*

T: So why are you trying to subtract those two? (The conversation between the tutor and the student develops into a reflective conversation for the tutor).

T: *There is a simple general formula for this. And if you don't know this one you cannot do number two.*

Through the conversation the tutor established the weaknesses in the understanding of the tutees and had to develop an appropriate approach. The reflection-in-action by the tutors was thus activated and continuously stimulated, as there was no time to rethink an approach to address the misconceptions held by the student. The conversation was seldom reciprocal as the response of the tutees was minimal. The tutorial scenario stimulated not only competency and decision-making skills within the tutors, but also the ability to build their repertoires of skills and understanding.

A typical response of a tutor after a tutorial reads as follows:

The tutees are struggling a lot. They struggle with the concepts, firstly. And secondly, they struggle to see the relationship between that which they learn in the class and its application in the tutorials. Now they are in an environment where they have to integrate various concepts. This is typical of what a tutorial is. It takes concepts from this area and that, and combines them. So three or four things can be highlighted from the problem, but to combine all of that in one problem is very difficult for these tutees to do. How do tutors approach the level where the tutees can solve the problem themselves? He first got the tutees to identify all the forces involved in the problem. Then, how are you going to use these forces to solve the question? The tutees were lacking the ability to apply the information. For the tutor to get them to the level where they can solve this problem by themselves almost warranted an entire theory lesson again. If we look at the good job he did with the work energy theorem - there are two forces in this formula. On the one side is the difference in the kinetic energy and the potential energy, and the work done by all the forces on the other side. He asks them step by step what the work of each of the forces is, which is a very good approach. The other two are more difficult. If you don't have an idea of the concept of kinetic energy and potential energy, you will be stuck. In this case the student was confused between the potential energy stored in *a spring compared to that associated with height. It was most probably a temporary confusion. I would say he did a very good job, the rest will now be determined by how the tutees continue with the problem.*

Although the tutors were prepared beforehand by the coach and researcher on a strategy on problem solving, when assisting the tutees during the tutorials, the ability of the tutor to solve the physics problem was tested by the tutees. Through creative thinking the tutor had to identify the exact problem the tutees experienced, and then continue by developing a strategy that will assist the tutees in understanding how the physics problem should be solved, and why it is the appropriate method and thinking to use and apply. What the tutor picked up was thus incidental to the physics activity and tutees' understanding. The presumptions that the tutees brought into the tutorials, whether it was because they didn't understand the explanations of the lecturer or because of alternatives that they created to the physics problem they were struggling with (see chapter 2 on alternative conceptions), had to be addressed on-the-spot, by the tutor.

The video recordings also suggest that the tutors were successful in moving the ZPD (see section 2.3.3) of the tutees; i.e. the tutees were able to continue with the physics problems after their dialogue with the tutor, where the tutor guided the tutees in their problem solving skills. The data further suggested that the tutors lived out the various perceptions of the role they thought the tutees and lecturers held of them. That means that the tutors guided the tutees in their cognitive understanding and problem solving skills. However the next set of discussions on the PoTM suggests that, although the tutors lived out the expectations of the tutees and lecturers, they struggled afterwards to reflect on this process.

4.5.5.3 Cycle of reflection during Post-tutorial meetings (PoTM)

On the second day after the tutorials, the tutors were allowed the opportunity to reflect on their interactions, i.e. interactions between the tutor and the tutees. Findings of this data suggest a narrow and superficial reflection, i.e. a low order reflection. The tutors were able to engage in technical aspects and not in cognitive aspects. The tutors were thus able to communicate the physics content and guide the tutees through the process of problem solving, but struggled to reflect on those processes. The PrTM put high emphasis on the guidance process during the tutorial. Tutors managed to imitate that process, but subsequently offered a low status response to the physics problems from an education perspective. However, as stated previously, the rituals, norms and standards of teaching, tutoring or lecturing are not part of the formal education system of these tutors. Their theoretical knowledge on education is thus limited to what they were exposed to during the PrTM. The possibility exist that continuous exposure to the reflective practicum may ultimately lead tutors to a higher order of reflection on the deeper understanding of the tutees. If this process is not continued the tutors may continue to reflect at a lower order level. If the tutors cannot describe their own reflection-in-action, they may not be able to teach others to do it (Schön 1983, p. 243). In the extracts presented below the tutors identified problems which warrant further exploration from an 'educator/guide'. Although they identified specific problem areas they were not able to expand on these problems in their discussion, or to suggest ways to solve these 'ailments':

Tutees -:

Cannot do graph work, tutees are ill prepared.

Tend to follow method taught during their matriculation year.

Struggle with co ordinate system.

Don't chose directions, i.e. +y or –y.

Have difficulty in interpreting the questions.

Have difficulty with projectile motion.

Tutors were thus able to identify an area of dissatisfaction. They satisfy the first step of reflection (low order reflection), but fail to engage and give an accurate account about this area of dissatisfaction (higher order reflection). The tacit knowledge (reflection-in-action) needed by the tutors to engage with the area of dissatisfaction identified by the tutors, (reflection-on-action) were thus lacking. Tutors were thus alerted to something that was wrong, but lacked the knowing-in-action to explain the situation (see discussion on Schön, chapter 2, section 2.4.1). The exposure of the tutors to the practice of tutoring enhanced their knowing-in-action relating to physics (demonstrated by the overall positive responses earlier on), but failed to enhance knowing-in-action in terms of the tutoring of the physics content.

The coach, during the data collection process, happened to be one of the tutors during the initial phases of the study. His summary indicates the development in terms of his understanding of the problems tutees encounter, thus demonstrating the move from low order reflection to high order reflection:

Solving these questions now will not be a problem for us because we know exactly where the problem areas lie. In the pre-tutorial meeting we want the tutors to go through the same *process as the tutees, so that they can experience the problems that tutees may encounter. In the pre-tutorial meeting we are, however, more lenient to each other by giving the answers or guidelines more directly. For the tutees it is less easy, because you must guide them without ever giving them the answer. They must discover it for themselves. Work energy theory is anyway one of the most difficult topics for both student and tutor. You can use any tape of any year on this topic and you will have the same experience over and over. In the beginning of the year they do vectors, speed and acceleration, which are often the same of what they did in high school. But when it comes to forces it becomes increasingly more difficult. We actually have different problems here. Are we teaching to an already backlogged group, or are we teaching things to them which they anyway had difficulty with in high school.*

The coach was a tutor at the beginning of this study and through the development of the study, and the continuation from one academic year to another; he became the coach after three years. His exposure to the art of teaching and the interplay with pure physics knowledge led to a growth where he can verbalize very clearly how theory and practice in both domains of teaching and physics interact. The learning of the coach took place through action, i.e. learning through doing.

4.6 Conclusion

Schön (1983, p.275) argues that reflection-in-action in the context of artistry is characterized by intuitive knowing which allows the practitioner to express their own intuitive understandings. However, the data presented in this chapter does not conform to this notion.

The tutors mentioned that the tutees were expecting the tutors to help them (the tutees) solve the physics problems. These expectations were of a dependent nature, i.e. a need for demonstrations on how to solve the specific physics problems, to support in giving the actual answers. The tutors also viewed their own role to be more supportive contrary to their view on the tutees of acting out a demanding role. The expectation (according to the tutor) of the teaching-learning environment was for tutees to develop competencies and talents in physics problem.

The tutors could furthermore identify three areas of dissatisfaction (a starting condition for reflection) with the tutorial environment, namely a dissatisfaction relating to the physics problems, dissatisfaction relating to the feedback on tutorials from the lecturers, and dissatisfaction related to organization of the tutorial. However, the reflection-on-action abilities of the tutors were limited to contextual issues, i.e. they were not able to make inferences from their observations and interactions during the tutorials. Tutors thus aimed towards what they were taught, that is not depending on inspirations but on prescribed agendas of though (Bridgman, 1955). Freedom of thought was not allowed, i.e. not discovering an own method which may yield the correct answer. Tutors were expected to propagate equations which, even for the revolutionary discover, took years to discover (the subsequent consequences of such an approach can be viewed in the work of Govender, 1999). Tutors were thus trapped between the actual and the logical, whilst in reality the actual was more difficult to achieve than the logical. Furthermore, tutors lacked the ability to abstract and internalise experiences and reflection in the form of a theory which they could test every time they entered a new tutoring session.

The solutions of the physics problem also involve a familiarity with mathematics (which in itself is pulled between professional mathematicians and the rest of the uses of mathematics).

Furthermore, in the context of physics tutoring, intuitive knowing is not enough for higher order reflection in the physics tutoring environment. For reflection-in-action to be meaningful there is a prerequisite for knowing-in-action. The tutors cannot be meaningfully involved with the problem solving skills needed to solve the physics problem if they do not have the necessary knowledge on how to solve the physics problem, and on how to go about assisting the tutees in their problem solving skills. They need to prepare beforehand to be meaningfully involved in solving the physics problem in the PrTM. The same applies to the tutees. Although, the tutees received theoretical assistance from the lecturer beforehand, with the tutorial merely an extension of the theory, the tutees, if the tutees lack the theoretical knowledge on the physics problem presented, the tutorial becomes meaningless unless they receive assistance from someone, in this context, the tutor. It is, however, not the aim of the tutorial to present a theoretical understanding of the physics problem only, but to link theory and practice/application. Prior knowledge is thus of equal importance to both the tutor and tutee. With regard to the tutor this prior knowledge involves knowledge on the physics problem presented, and knowledge on how to guide a student towards problem solving in such a way that learning becomes meaningful. Not equipping tutors with the educational issues of physics tutoring is to fail to start and develop tutors' interest in tutoring.

In an effort to enhance the knowing-in-action of tutoring of the physics content, a reflective enhancement model is proposed. This aim of this model is to assist physics tutors in their reflective abilities as an attempt to make tutoring meaningful for the tutors. The reflective enhancement model is discussed in chapter five.

CHAPTER 5: SUMMARY AND CONCLUSION

5.1 Introduction

The aim of this study was to explore university Physics I tutors' conceptualization of physics I tutorials and their conceptualization on issues relating to observations and interactions during tutoring. The focus of the study can thus be summarised as an exploration of Physics I tutors' -

1. Views on becoming reflective practitioners;
2. Experiences whilst applying the Schönian model;
3. Meta-learning development and the effect of reflective practicums on other learning areas with the tutors.

A consequence of this exploration would be whether the Schönian notion of the role of reflection in the tutoring contexts was extended meaningfully to the tutor-student context.

This study was guided by the tutors' sense-making conceptualisation of the tutor-student situation; the tutors' conceptualisation of the impact of the process of reflection–in-action and reflection–on–action during and after the tutorials; the descriptive accounts given by the tutors of the strategies they utilized during student difficulties; and the descriptive accounts of the tutors' metacognitive development as a 'role-model'.

The study was introduced as a phenomenologically based study, i.e. an interpretive exploratory second-order study (see chapter 2 and 3). As a qualitative naturalistic inquiry, the study was carried out in a university setting over a period of two years.

The findings on the focus questions will now be summarised. Implications for reflective practice for tutors at the Physics department, UWC will be highlighted, upon which recommendations in the form of a reflective model will be introduced.

5.2 Tutors' conceptualization of the tutoring situation

The nature of the exploration of tutors' conceptualization of the tutoring situation involved two areas, namely that of coach-tutor and tutor-student. These conceptualizations developed through two forms of exposure, i.e. exposure to Physics I as a physics student (tutors' frame of reference as a physics student), and exposure to physics I as a tutor. The results of this exploration showed two definite views held by tutors. These views relate to both the perceived views of the students and that of the lecturers:

1. The tutors' role is to prepare students for examinations and tests. The high premium tutors put on the preparations for tests and examinations could be related back to the institution's aim that students must make the grades (Hendricks, 2001).
2. Tutors must assist students in problem solving skills. These 'problem solving skills' can be understood as the ability of the students to 'plug numbers into formulae thereby coming up with the correct answer'. Tutors subsequently considered the fact that students did not know their formulae as problematic, hence the need of tutors to present students with the formulae. According to Bowden (in Govender, 1999) it is 'inadequate to say that a student comprehends a concept if they can solve a quantitative problem'. Tutors intuitively sensed that students did not understand the

physics conceptually (confirmed through studies done by Govender, 1999), hence their need for a mathematical method to solve the physics problems. But presentation of a formula does not resolve conceptual problems. Two conclusions can be drawn from this, namely that tutors give in to students' demand, and tutors lack the repertoires available to advance towards development of conceptual understanding.

The next three perceived views of the students and lecturers were less prominent in the responses of the tutors:

1. Tutors must reinforce the knowledge of the students through discussions and applications.
2. Tutors must encourage and assist group work skills.
3. Tutors complement the work of the lecturers.

The focus of the tutors during the tutorials were mainly on the learning of pure physics, whilst the 'know how' of tutoring was less prominent. The same way that students resort to 'simplistic, elementary interpretations' of physics (Govender, 1999, p.277), the tutors' resorted to simplistic, elementary interpretations of the art of teaching. So, although tutors understood the importance of their role for conceptual development, they lacked the discourse to expand on their tutoring role from an education perspective.

Educational writers through the years developed a very firm basis on which its practitioners operated (see Chapter 2, Literature review). The only difference is the strong socio-cultural influence that makes any approach to a problem immensely uncertain. A standardised approach can never be applied to a unique teaching-learning situation and will not give a one hundred percent success rate. The same way that science-based professions (e.g. physicist) experienced an increase in professional knowledge and practice, the same way did the art of teaching develop in terms of knowledge and practice. However, outside the boundaries of the application of rigid scientific methods, a disregard for the teaching of the art of physics exists. By implication the teaching of a discipline includes the discipline, i.e. no teaching is independent of some 'subject'. So, although it may appear as if two apparently conflicting domains were merged, i.e. the art of teaching physics (which has a very strong socio-cultural influence), and the art of doing physics (an acclaimed specialised domain involving the application of rigorous scientific theory and technique), the study of physics as a domain can never be done with a disregard for the teaching of physics. The teaching of physics involves a variety of activities, i.e. the theory introductions, practicums, tutorials, tests, assignments, and examinations. Tutorials play an important role in the assessment of the cognitive skills of physics students. The tutors consequently play an important role in the enhancement of the outcomes set for the physics course, and in supporting the work done by the lecturer. It is thus not coincidental that tutors involve themselves in the art of tutoring, whilst being involved in the study of physics.

Increasingly experts in the area of teacher training motivate their students towards reflective practices. However, being involved in any facet of teaching does not necessarily probe reflection, as this study demonstrated. The results of this study indicate that existing knowledge is very important for reflection on an advanced level. Reflection can become intuitive only if a solid theoretical background is established. Reflection without prior knowledge is much more difficult to attain then 'intuitive' reflection. In intuitive reflection the tutors may be able to become aware of a problem, but may not be able to develop an informed repertoire about the problem, as were mentioned in the previous paragraph. Tutors experiences and approaches were also influenced by their own experiences, and their own need for change and continuation of that which worked for them.

Although the contexts in which the tutorials were executed, was authentic (that is a real life situation), it did not support the tutors movement 'from the periphery to the centre of the community of experts.' That is the tutors under investigation were never fully part of the community of experts (i.e. the lecturers). Although they were part of the community of tutors as constituted by them, they felt disempowered in their position. The professional practice of the tutors thus fell short of the boundaries of professional competence. Often professional development and competence are guided by the ability to reflect on the theory and practice of a domain. Criteria over and above those proposed by Dewey and later by Schön were needed in this particular study to encourage reflection. These criteria will be discussed next.

5.3 Extended criteria to enhance reflection in physics tutors

5.3.1 Reflection does not occur spontaneously

Schön (1983, p.182) states that reflection often occurs because a person relates one situation to another and through that develops a strategy to solve the problem, i.e. the 'seeing-as' concept. Linder et al (1997) based their study on this 'seeing-as' concept. That is, the tutors used their previous experiences to find a solution to current problems experienced by their tutoring group.

The tutors who took part in this study were initially very reluctant to participate in the reflection process. In fact they were reluctant to take part in any form of discussion during the PoTM. The tutors would proceed with the calculations associated with the problems despite attempts to involve them in discussion around the teaching aspects. The possibility exists that the tutors did not 'see any difficulties' during their interaction with the students as the students' reactions might have been familiar to the tutors, i.e. the tutors experienced the same kind of 'problems/difficulty', and it is therefore not a 'problem' to have those 'difficulties' as it is 'normal'. Often the coach and the researcher would be involved in a discussion for the entire session. Probing the tutors as encouragement towards active involvement was often unsuccessful. However, the coach and researcher continued their discussion, modelling to the tutors the process of reflection-on-action. The modelling was thus intended to demonstrate to tutors the process of reflection designed for this study specifically. Not only was the process of reflection modelled to the tutors, but they were also by choice observing participants. Identifying the problems experienced by the students and trying to find a solution to assist the students in solving the problems did however, not occur spontaneously with the tutors.

The conclusion can be drawn that this study does not confirm Schöns' notion that reflection occurs intuitively, at least not the kind of reflection needed in a pure science academic teaching and learning environment. In fact, a special effort is required by the tutor to solve a problem that was identified.

Also, according to the review on the work of Lave and Wenger (p.45) which suggest that knowledge and skill develop through active engagement with an activity, this study suggests the opposite. This study suggests that theoretical knowledge is important. From the theoretical knowledge will the practical knowledge and skill develop. The training for tutors should thus be built to expand and develop the existing knowledge and experiences of the tutors. The tutor thus needs a willingness to step into the problematic situation and impose a frame onto the problem in order to solve it. Thereafter may an error of interpretation be identified which may in turn, provoke reflection.

5.3.2 Reflection needs to be guided

The process of meaningful reflection is likely to occur if it relates to a specific context. Every context has its own aims, objectives, rules and standards. Given the position held by the tutors in the academic institution it is expected of them to move with the boundaries set by the institution. Whether the tutor and student are involved in a process of joint experimentation, follow-me or hall-of-mirrors the process will be driven by the aims of the context. These aims may, however, also be a negative border for reflection. The creativity of the tutor may be limited by these aims and objectives. However, without these boundaries, reflection becomes a borderless process of the mind. Thought processes may jump from one issue to another and pulling the strings together may be an exhaustive process, impeding meaningful reflection. For initial reflection, boundaries must be clear, and from there advanced reflection may follow. Within these boundaries various branches may exist. For instance, the success associated with good academic performance by tutees can never be reflected on outside the boundaries of the socio-cultural background of the tutees.

However, each session of interaction between a tutor and a coach has its own aims and objectives where specific outcomes are envisioned for that tutor. Reflection will thus be guided by specific tutoring aims, stretching wider to the overall aims and objectives set out by the department and institution.

However, the 'academic neglect' Hammersley (2005) refers to (see p. 46) was addressed to some extend by the modelling process between the researcher and coach. This became a familiar activity to the tutors and gradually, as the tutors gained more knowledge and started to model the unfamiliar on the familiar, i.e. as the knowledge on reflection developed through modelling, they could imitate the reflection process. As transfer became more successful improved participation started to develop (see p.44).

5.3.3 Reflection is knowledge dependent

A further important issue for reflection is knowledge of the issue being reflected upon. If a specific issue is of no importance to the reflective practitioner, meaningful reflection may take longer to occur. Although, according to Entwistle (1996), reflection is the decisive feature in facilitating the experiential learning process, knowledge formation cannot occur without the co-existence of theory and practice in tutoring.

From the data it is evident that the tutors reflected mostly on technical aspects such as the group dynamics, but lacked teaching descriptors to explicitly describe their observations and views (Van Manen, 1977). For the purpose of this dissertation 'technical aspects' refers to the tutors references of students' inability to, for example, draw graphs, and use formulas. Few references were made to the physics understanding of the students. The references that were referred to were of a low order. This can be ascribed to the fact that tutors had very little academic knowledge on the theory and practice of teaching, and were more focussed on the theory and application of physics. The tutors had no repertoire on teaching to draw on. The only repertoire that they could draw on was that developed from their own experiences. The knowledge on teaching the tutor brought to the situation (i.e. their knowledge-in-action) was limited, subsequently affecting their level of reflection. But not only that, it also affected the willingness of the tutors to enter into the process of reflection, as showed by this study. In this study it was the lack of a frame of reference which paralysed reflection by the tutors. The tutors needed some element of familiar repertoire to express their reflective abilities. Reflection is thus highly linguistic dependent (Schön 1983, p.276), where 'linguistic' in this context specifically refers to vocabulary that describes aspects of mental activity not commonly associated with everyday physics.

Secondly, the peripheral entry of the tutors into the world of experts (i.e. physicist) required very little involvement with the administrative part of tutoring. Value judgements and assumptions did not form an inherent part of the tutors' activity. Through continuous exposure to the teaching environment tutors may eventually gain enough practical knowledge to assist them, but it is highly unlikely for this situation as the turn over rate of tutors is too high. They are full time students who upon completion of their degree leave the university to find employment. Not enough opportunity thus exists for the tutors to develop a repertoire through experience. A broader theoretical knowledge on educational issues seems preferable for this situation. Therefore, unlike the reflective practitioner in a community of experts, the tutors cannot be assumed to act out knowledge-gain-through-experience, i.e. knowing-in action.

Relating the above arguments to the traditional notion propagating a conducive environment for reflection, a reflective enhancement model is suggested to encourage and support the reflective ability in physics tutors working with first-year physics students. This model will now be discussed in section 5.4.

5.4 Recommendations - The reflection enhancement model

The results of this study point towards the conclusion that the physics tutors involved in this study were able to reflect-in-action and reflect-on-action when certain conditions existed. These basic conditions are reflected in what the researcher calls the 'reflection enhancement model' (see Figure 5.1). The basic premise of the reflection enhancement model is that reflection is not an automatic process, but highly knowledge dependent and needs to be guided in its initial stages. This model suggests that there are three conditions which need to be met to enhance the reflective process, namely, context, dialectic and vision. These conditions are discussed in section 5.5.1, 5.5.2 and 5.5.3 respectively.

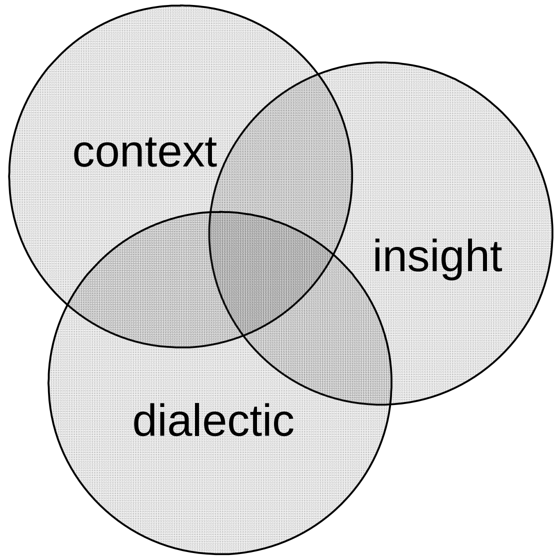

Figure 5. 1: The reflection enhancement model

5.4.1 Context

Weaknesses in education systems are often blamed on the lack of skills in various areas. However, the context of the education system is often ill-prepared, the logic for the process is not appreciated by everyone, and the vision is one-sided. The speech delivered by Ramaphele (2008) at the living newspaper symposium in Cape Town captured this notion beautifully:

'We have chosen the worst curriculum policy that you can ever imagine. Not a single country in this world…has succeeded. Canada tried it…The United Kingdom, the Netherlands and New Zealand tried it, they dumped it. Not us. No. If we make a mistake, we keep making it."

The context which reflections are often initiated in, are not necessarily conducive to or favourable for reflection, especially in a theory-driven context. Reflection-in-action is about the on-the-spot emerging actions, criticizing, restructuring and testing of intuitive understanding of experienced phenomena, often taking the form of a reflective conversation with the situation (Schön 1983, p.241). The unreflective way in which our education system has been allowed to become a betrayal of the education struggle; the sterile formalism of curricula, the constant ignorance of tertiary institutions about their own work that they put out there for publications, are but a few of the frenzied patchwork to a system we all helped to create. Hence the assumption that tutors will not be able to reflect meaningfully if they have to fear the consequences of their communication. Also exposing tutors to the practice of tutoring without any formal theoretical training on tutoring down plays the value of tutorials.

Reflection being a time-consuming process requires a vast amount of interpersonal interaction with the tutor and/or lecturer. In a tertiary institution bound by time constraints and dead lines in terms of tests and examinations, it is rather difficult to introduce a change in the system. However, unless the complications of existing systems are not addressed, very little hope exists for defining new vital directions.

For tutors to operate as reflective practitioners, requires of the context in which the tutors are involved, to move towards reflective practice. Working in a traditional environment in one module and in a reflective environment in another, may cause conflict and encourage tutors to develop a preference for one over the other. Their focus may become divided.

To be able to identify a problem and to take initiative in solving that problem, knowledge must develop and be brought to bear on the issue that involves the problem, which in turn requires basic knowledge of the issue. Reflection on the issue should occur so that new knowledge can develop. But we live in a period of disproportional change. Our context changes continuously, and is very complex in nature. The reflection enhancement model suggests a skill that is put to use by undertaking it in a complex dynamic context.

Reflective practice also encourages a responsible attitude. The reflective practitioner must be held responsible and accountable for his/her actions, i.e. for the task of guiding and supporting a student. The responsibility of a reflective tutor is not to assist the student in viewing the physics problem the way he/she (the tutor) sees it. The responsibility of the tutor is to assist the student in seeing the physics problem as it is in reality, that is, to broaden and deepen the visual imagery of the student so that the whole can make sense to the student. The forms of reflection of the tutors do not entirely represent the practice.

5.4.2 Dialectic

Academic institutions are often hesitant to test their own position against new or existing theories, with the aim to make changes to existing structures, if the need arise. Progressively and continuously developing formal methods of argumentation, whereby existing positions can be tested against new positions, is financially straining and time consuming. As was illustrated in chapter 2 of this research work, the arena of education is characterised by a vast number of theoretical perspectives on teaching and learning. Every education institution has its own theoretical perspectives to which it subscribes and rightfully so. However, if an institution assumes that reflection will take place merely because someone has been exposed to a tutoring environment inevitably limits the effectiveness of tutorials.

Drawing on Lave, the researcher argues that reflection (as with learning) is a product of the context, activity and culture in which it is developed and used. That implies that tutoring and reflection is fundamentally intertwined (situated). The researcher further argues that the influence of reflection is too often ignored in the context of tutorials by institutions. This position held by institutions is directly related to their reluctance to implement the research findings of their own scholars (that is the gap between what they know and how it is used (Brown, Collins and Duguid, 1989). Finally it appears that there is an academic ignorance of the learning and knowledge of tutors, from there the limit number of studies initiated by institutions on the tutoring environment in the pure science. There appears to be a mismatch in the intentionality for tutorials and tutoring.

5.4.3 Vision

Lastly, there needs to be clear vision and insight into the process of reflection and the way forward of the institution or department. More often than not a tertiary institution or department has clear vision of the aims and objectives for its participants, be it students or academic staff. However these visions are aligned with the theoretical perspective it holds for its teaching-learning environment. Reflective practice, unfortunately, is one of those approaches in which one cannot be involved in, without a clear understanding and vision of the outcomes. Many of the interactions between 'coach and apprentice' will be determined by the insight and understanding of the coach. Little room is subsequently left for the tutor to create a 'comfort zone' in which an approach is developed because of specific problem recurrences. Each and every situation will and must remain unique, as each interaction will be between two unique individuals carrying with them constant change and development as they interact with the content and with each other on a regular basis. This already underlines the conflict that already exists as highlighted above in section 5.4.1.

The reflection enhancement model in a true reflective scenario will always be in a state of flux. The system of reflective enhancement will always be reflected upon, new ideas will emerge and develop, or it may collapse and call for new reflection on action.

The reflection enhancement model further suggests a constant interplay between context, dialectic and vision. A change in one area will affect the other. The model suggests an emerging journey where new information and discoveries are constantly made that requires an adaptive approach. Technical change is also important which in effect will affect organisational effectiveness which is imperative when changes are proposed.

This study thus offers evidence that tutors do have the ability for reflection given the context, dialectic and vision are agreed upon. Through guidance, support and the development of a sound knowledge-base on the theory of education and the theory of physics, the reflective ability of the tutors has the potential to improve. The importance of judgement and skill and a clear understanding of phenomena are very important to develop a sound knowledge base, needed for reflection. These notions invariably put a high strain on the knowledge basis of our students entering universities, and on the institutions, if we consider the possibility of developing our students into reflective practitioners.

5.5 Conclusion

The findings of this study have practical implications for tutors and co-coordinators of tutorial programs. The physics tutoring program at UWC came a long way and a number of changes and interventions occurred. They have moved from the position of 'a total failure' (Hendricks, 2001) to a more structured and well-organized program.

The findings of this study suggest that the current tutoring program does not support tutors in their reflective abilities. Although tutors were able to identify areas of dissatisfaction, the nature of these dissatisfactions required more authority and autonomy for the tutor to successfully address those dissatisfactions (a potential area for further research). The study however suggests that, through support, physics tutors have the ability to become more reflective. Although Candy et al. (1985) alert us to the fact that the capacity to reflect is at different levels in different students, no reflection/ or the unreflective manner in which students approach learning in higher education seriously undermines the opportunities for developing conceptual understanding, highlighting the fact that there is a place for reflection within the tutoring environment.

This research also highlights the fact that tutors felt alienated in their position as tutors. A community of tutors is not well established at the university. The tutors thus view their tutoring positions in terms of the lecturing position of the lecturer. An exploration into the establishment of a community of tutors with their own unique culture aimed at mediating intellectual activity might be fruitful. Through such an establishment a platform is created whereby tutors can be equipped with basic tutoring skills, namely ‘reciprocity’ and ‘competence of service’ (Hendricks, 2001), as well as basic skills needed for tutoring.

As long as the final mark obtained by the student is influenced by amongst others, the tutorial mark, one cannot leave tutors to their own devices, thereby ignoring the responsibility the institution carries towards development of all societies involved in intellectual capacity building.

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Appendix A: Example of transcribed tutorial

An example of the physics problem that was dealt with during a video recording were presented as follow:

1. A transverse sine wave of amplitude 0.10 m and wavelength 2 m travels from left to right along a long horizontal stretched string with a speed of 1 $m.s^{-1}$. Take the origin at the left end of the undisturbed string. At time t = 0 the left end of the string is at the origin and is moving downward:
   a. What is the frequency of the wave?
   b. What is the angular frequency?
   c. What is the propagation constant?
   d. What is the equation of the wave?
   e. What is the equation of motion of the left end of the string?
   f. What is the equation of motion of a particle 1.5 m to the right of the origin?
   g. What is the maximum magnitude of transverse velocity of any particle 1.5 m to the right of origin?
2. Write the equation y(x, t) describing a travelling transverse wave that propagates in the positive x direction and satisfies the following conditions:
   a. The maximum disturbance from equilibrium at any point is 1 cm.
   b. The wavelength is 2 m.
   c. The period is 0.02 s.

d. At t = 0 and x = 0.5 m, the instantaneous particle velocity is $\pi/2$ $m.s^{-1}$ down (or negative).

Typical solutions to the above problems are-:

1. A = 0.10; m = 2 m; c = 1 $m.s^{-1}$. The wave propagates in the positive direction (to the right).

   a. $f = c/m = 1\ m.s^{-1}/2\ m = 0.5\ s^{-1}$

   b. $w = s\pi f = 2\pi\ (0.5 – 1) = 3.14\ rad.s^{-1}$

   c. $k = s\pi/m = 2\pi/2\ m = 3.14\ m^{-1}$

   d. The wave is travelling to the right

      y (x 1t) = +/-A sin (wt - kx)

      v = sx/2t = +/- Aw cos (wt - kx)

      but t = 0, x = 0

      v = +/-Aw

      It is specified that the velocity is downward

      V = -Aw

      y (x1t) = -Asin (wt – kx)

      thus y(x1t) = - (0.10 m) sin {π(t-x)}

   e. Left end: x = 0

      y (0,t) = - (0.10 m) sin (πt)

   f. 1.5 m to right of origin: x = 1.5 m

      y (t) = - (0.10 m) sin (πt – 3/2π)

      = - (0.10 m) sin (πt – 2π + 1/2 π)

$= -\ (0.10\ \text{m})\ \sin\ (\pi t + 1/2\ \pi)$

$= -\ (0.10\ \text{m})\ \cos\ (\pi t)$

g. $y(x1t) = -\ (0.10\ \text{m})\ \sin\ \{\pi(t - x)\}$

$vy = 2y/2t = -\ (0.10\ \text{m})\ .\ (\pi)\ \cos\ \{\pi\ (t\text{-}x)\}$

vy max when cos ( ) = +/-1

$vymax = 0.314\ \text{m.s}^{-1}$

2. positive x direction: $y = A\ \sin\ (wt - kx - ø)$

$y = A\ \sin\ \{2\ \pi\ (t/ - x/\ ) + ǿ\}$

t = 0.025 and = 2 m

A = 0.01 m

To determine ǿ, we calculate vy and evaluate it within the given conditions:

$Vy = 2y/2t\ (x\ 1t) = 2\ \pi/t\ A\ as\ \{2\ \pi(t/t\text{-}x/y) + ǿ\}$ at t = 0 and x = 0.5 m

$Vy = 2\ \pi A/t\ as\ \{-\ \pi/2 + ǿ\} = -2\ \pi A/t\ \sin\ ǿ = \pi/2$

$-\pi/2 = \pi\ \sin\ ǿ = ǿ = -30$ degrees $= -\ \pi/6$ radians

$y(x\ 1t) = (0.01\ \text{m})\ \sin\ 2\ \pi\ \{\ (505 - 1)t - (0.5\ \text{m} - 1)\ x - (1/2)\}$

Appendix B: Factual account of tutorial

There were five groups of four members each in the video recording room. The groups were positioned randomly in the room to ensure freedom of movement by the tutor. The researcher decided at random on which group to focus during the video recording of the tutorial, which is then referred to in this thesis as the focus group.

0-10 minutes:

The students walk into the video room and take their respective places at the various tables. The students chose their own seats at the tables. The tutor asks the students to write their names on the exercise page.

The focus group starts working on the problem immediately. The tutor walks between the groups, observing them. Students are busy orientating themselves. While the focus group is actively involved in problem solving, the tutor attends to group three. Although the initial problem statement indicates a time t = 0, the left end of the string is at the origin and is moving downward, the students still show on their graphical presentation the wave moving upwards from its point of origin.

Group five tries to get the tutor's attention. The tutor turns his attention to group two. He does not see that group five is trying to get his attention. One student from group three (with his girl friend who is not part of the class) enters the class ten minutes late. Group five still tries to catch the tutor's attention; he attends to the focus group (group one).

10-20 minutes:

Discussions between the tutor and the students in the focus group follow, the tutor works through the initial statement of the problem, explaining the meaning of the key concepts and information presented, addressing specifically the term 'downward'. An example of the tutor's explanation follows: "what don't you understand by downwards, a transverse sine wave what does that look like, you understand what a transverse wave is, and a sine wave where must it begin, what is the amplitude, do you understand what the wavelength is?" The tutor follows a leading approach by probing and clarifying to the students the meaning of the main concepts. He told the students they need to understand the information given to them to be able to understand the questions asked in the exercise. The students realize through this sharing of information that they have wrongly placed the direction of the origin of the wave on their graph. They continue working on the problem.

A second tutor, who is also the co-coordinator of the tutoring program for the first year physics students, walks into the room. He immediately attends to the focus group. The co-co-ordinator often enters the tutoring setting to help the tutors by assisting them during the tutoring sessions. The tutor is still assisting group five.

The co-ordinator probes the focus group on their understanding of the concepts. Students explain their understanding of the problem to the co-ordinator. The students are trying to establish the SI units of (k). The co-ordinator asks students for the definition of (k). Students reply that it is a constant. The co-ordinator asks the students on the definition of the wave number. The students cannot give the co-ordinator an answer. The co-ordinator explains that to know something, you must know the definition of it. The students are then told that their calculation of the problem was correct. They show their excitement when hearing this comment.

20-30 minutes:

The tutor attends to group four, whilst the co-ordinator attends to group two. The co-ordinator leaves the room. The focus group is still actively involved with problem solving. There is interaction between all four members of the group; they communicate through questioning and answering each other. They are trying to solve question 1(d).

The tutor attends to group three. The co-ordinator enters once more; speaks to the tutor and leaves the room again. Tutor continues to stay with group three. One of the students in the focus group shows signs of boredom, he tries to call the tutor by raising his hand, but the tutor is standing with his back to them and cannot see him calling. The student throws his pen on the table and sits back. Gradually the students in the focus group start to work on the problem again. The students manage to get the correct formulae to solve the problem in question 1(e), i.e. –A sin (wt-kx).

Tutor attends to the focus group. Students inform tutor that they want to discuss from question 1(c) onwards. Tutor follows the same approach as previously, but this time the students explain their reason for coming up with their specific answer. Through discussion, negotiation and clarification he leads the students to understand the next steps towards solving the problem.

The tutor left to attend to group three, then to group five, four and two respectively.

30-40 minutes:

In the focus group the students consult their notes for assistance. They go through all their various notes on transverse waves, trying to find formulae to solve the problem. Group two and five stopped working on the problem. The students in group five are each working at the problem on their own, there appears to be little or no co-operative learning taking place. In the focus group two of the students become distracted and start looking around in the room and to the other tables. One of the students is rewriting their answers on the sheet. All four students start to work on the problem co-operatively again.

The tutor attends to the focus group. The tutor guides the group through the question. The tutor tests the group's understanding of the various formulae being used so far, and the meaning of the formulae to them, through a process of questions and answers. Where students show misconceptions, the tutor would lead them by giving them the answer. Tutor left for group three.

40-50 minutes:

The students in the focus group are now really struggling with the problem, and increasingly become more distracted, especially two of the students.

One of the students in the focus group writes their solutions down on the exercise page. While he is doing that, the two other students (who were previously also distracted) are talking and singing songs. One of the students of the focus group explains his understanding of the next problem to his fellow group members. They look at the question again, trying to find a solution to the problem. In question 2 there are certain conditions given describing a travelling transverse wave. So they are trying to understand the conditions, but they misinterpret the question and use the conditions as part of the question being asked.

The tutor attends to the focus group – he indicates to them their misinterpretation of the question, which they then understood immediately. They ask the tutor about the meaning of maximum disturbance. He explained to them that it means the maximum displacement and told them that they are given the wavelength and period as well, as part of the conditions. The tutor does not get involved in the actual calculation of the problem, but focuses their attention on what they are given to assist in solving the problem. The students said 'OK' and the tutor left to spend time with group two.

50-60 minutes:

The tutor attends to group three. The focus group tries to solve question 2 co-operatively by explaining their understanding to each other. Group two packs up to leave and one of their members attend to the students in the focus group. He explains to them how to solve question two, they listen patiently, occasionally posing a question. This student from group two goes straight into the calculation of the problem, showing the group how the formulae are derived and how the calculations should be done. The student left and the focus group continues working on question 2 and manages to solve it. Whilst one of the students is writing the answer down, the other two students (the same one's who were distracted previously) are singing and talking. Occasionally the 'scribe' struggles to substitute the symbols with numbers and then his fellow students assist him.

Group four are done and one of the students starts to play with the microphone. The tutor attends to group four and three respectively, whilst the focus group completes their final write up of their answers.

Session ends.

Appendix C: Tutors' view on students perception of the role of tutorials

The results of the post-interview are given below.

S: *It seems like they think we are there to give them answers, but as we go on they understand that we are there to help them. At first they are not so keen on the idea of having a tutor around. They think we're looking to find what's wrong, but afterwards they become quite comfortable.*

At first they expect you to give them answers and after that you become a support for them. The problem is that some students take it beyond that, and others don't care, and then you get some very dedicated students who believe you are there as a support for them.

S: *The problem is that we only have until the end of the first year and sometimes they become to dependent on one tutor.*

S: They always look for one of us whenever they are afraid to say something in class or approach the lecturer in class so they expect you, the tutor, to teach them or lecture them again. They seem to become more comfortable with the tutor than with the lecturer or even trying to understand the work. As I said some students expect you to lecture to them.

Appendix D: Tutors' view on the lecturers perception of the role of tutorials

S: *For me, I enjoy doing it. It's a matter of helping and broadening knowledge so I think most of our tutors have that idea, they view it as a means to help other students.*

S: *I think so; I mean I read a lot. The tutorial for me is are that important in the sense that if you come up with the understanding of something, that is more important than you being able to complete the task. So, if they can cover the question here, most often it's going to come out in the exam, the same way and if you can tell them there and then they will get something right.*

S: *Yes, it is a preparation for the exam. That's why I say, for me it's not important that you finish, but more that you understand.*

Appendix E: Tutors' view on students perception of the purpose of tutorials

S: *To give students a better understanding of the work.*

R: *And how does it make you feel to see that they do not really understand?*

S: *It doesn't bother me anymore. I kind of learned over the years that some students will work and some won't and you kind of learn after a while that if they don't want to learn you can't force them and you move on.*

Appendix F: Tutors' view on the lecturer's perception of the purpose of tutorials

S: *Sure, they expect you to help the students understand the basics, to help them to solve problems or find the solutions and to kind of help them, its more to guide them towards a better understanding and overall view of the tutorial.*

Appendix G: Tutors' view on the concept of understanding

S: *It is when they come to you the second time and you ask them something and they can recall or they can get to a certain point where you know OK I covered this work with them before and I can see they can get to that point and maybe there is something new or ya, I would say if you ask them something about the last time and they still remember that after a while they can still apply that then I know they understood something. Sometimes, not all the time, I say it because they learn things off by heart and sometimes you mistake that for their knowledge and understanding, so what I try to do is ask them a few different ways to check whether they still understand or you apply it to other areas to see if they understand.*

Comments referring to the focus group

S: *Compared to the rest of the … they were quite … they were able to figure out things for themselves. They weren't … they started up being dependent while they were waiting for me, but as you look through you see that they got something, and there wasn't too much.*

S: *It's just that they drew my attention; otherwise I would just sit around. And if you ask them 'are you OK?' they would say 'yes'. Now you're not sure. They seem to be busy when you walk around, when you turn your back they do nothing more. They haven't gotten as far.*

S: *The weaker group. If you ask them if they are OK, or if you explain to them, and you said are you ok now , are you sure, and they'll say 'yes'. But when you come back to them they are still at the same place Yes, I mean, I already spend like 15 minutes.*

S: *If I have time I try to start from the basics. We've been taught not to lecture, so I can only take it to a certain point. If you don't understand … In the video you can see they don't understand the basics and I couldn't help them with that, because we were taught not to lecture.*

S: *Yes, we are not encouraged to teach them, we can guide them but not to teach them.*

Appendix H: Tutors' view on the management of tutorials

S: *I haven't done it for the past couple of tutorials. I was just getting back from (inaudible) and I didn't have enough time to prepare for this tut, and the day before I was just trying to contact Dr X, but he wasn't around, so I couldn't and I didn't know where I was going to be for that week. I think it was the usual.*

From the video it seems that you don't get the chance to spend enough time with everybody and students might be waiting for your help, but you don't see that because you're to busy with somebody else.

Not actually, because you have your back turned to them and you may be busy and they don't call you out they just raise their hand or something, so you don't know what's happening. I think I actually…the thing is that I didn't work with that group too much, or I might have worked with a few of them from the group, but as a whole I haven't worked with the group so I don't know who is the weaker…and in the end I find out that the weaker ones that I should spend more time with and the stronger groups I have spend too much time with.

We realize that when we you're going through the tut. As I said it was difficult, because you didn't know if you helped the other groups get to where they were or whether they were doing it on their own. The video helped me see that.

We don't want them too become to dependent … that's the thing, we only have an hour at most, and with five groups its like 12 minutes per group, so if you start from the basics its going to take 10 minutes that's 2 minutes left for them to actually do their work, so your contact time will then be involved.

If I have the same group today it will be to spend more attention today to the groups that I felt were weaker. So next time I will, look, I'm not based at UWC so I can't follow their lectures the way I used to, so I don't know where they are.

Appendix I: Tutoring style identified by the tutors

S: *That's difficult you can't do it all the time. You can go in with an idea and then … the students, you go with the idea that, OK, you've done their work in class and the students must have an idea, I mean they've done their and you find some student that can do this, they don't need much help in certain sections and then you find some that are totally clueless and that's been the problem. You need to … you come up with an idea but then you need to change it and ... sometimes when you come with preconceptions that they would understand it or you expect them to be weak and sometimes they surprise you in their understanding. After a while yes, me personally … I mean, I've done it for 3-4 years now. For me yes, but it's not always so easy to recognize.*

Ya, I guess we do, we are quite prepared, and we always have to do something you never expected. We try to cover most of the aspects. We have guidelines that we follow. We did a course with Mr X.

S: *I don't think so; it may seem like that on the video, because I also noticed that it seems that I did spend a lot of time. The problem in their case was that they did the work, but their calculations were wrong, so you had to come back and go through that with them. And sometimes you get caught up in that and you can't now leave in the middle of something because the rest depends on that. So you do get caught up in that. And then they usually ask you a lot. They are more interactive than the other groups … more time with them because you can't just break away from them.*

S: *Group three, I've worked with a couple of them, I mean I've worked a lot with that group, or with the members of the group. They are quite strong, they know their work and they keep you busy. If you are with them they lead from one question to another. Group one, they've got quite strong students in there, it's just that they … sometimes they become to dependent. Instead of working things out for themselves they will wait for you to come. And you will see if you watch the video, if you leave them for quite a while they will start working it out by themselves. So sometimes they do wait but they don't have to; in time you see if they wait too long they start to do that by themselves.*

S: *Group five … when you work with them they tell you they understand and you get an indication of ok, they now what to do. And what I try to do is I always go through it again, just to make sure and when you leave and you come back you find that they haven't always moved on from where they were, although they said that they understood it, it seems as if they did understand.*

S: *We found that that is one of the big problems in the exams, and I believe if you don't understand the question what you are trying to answer. There is no point in trying to answer something if you don't understand the question. Where you find that most often they get stuck is the information is already given, and now they are trying to find stuff that is already given, because they haven't read properly.*

S: *Yes, and that wastes a lot of time, because they are all confused because they don't know what to do, where it is already given, just that they haven't read it.*

R: *Your overall management of the class. There is this cooperation aspect which means that the students need to work together as a group. Do you think that you manage that well?*

S: *For me it is difficult sometimes, it is difficult sometimes. There is this tendency that one person writes, one person answers and the other person just checks. That's how the group usually works. So what we try to do is to get everybody involved, that's why I ask questions, then I usually ask somebody. And if they don't know than their friend, or someone, is always there that can help.*

Appendix J: Tutors' view on the Schönian model

S: *It works, I really think it works. The problem is that we're not dealing with students from the same background.*

S: *Ya, so you get students that come here that have quite a good background … educational background. I mean you can see the difference between students so the model works. I do think it works but it's just the way you apply it. You can't take the model and just apply it directly and then it wouldn't work, but there are a lot of good things you can take out of it.*

S: *Isn't it a co-operative learning model?*

S: *When it comes to tutorials, I really think it works. If you apply it properly, it works.*

Appendix K: Tutors' view on group work

S: *Don't allow students to dictate what happens in the group, don't let one student dominate, don't let people feel they're out, you can control by getting involved then it will work.*

S: *Uh, sometimes you allow one student to do, but I mean you only allow that after you know the ability of the student, you have an idea what the student is able to do, you can allow a student to do that, well basically in a group you need three or four so if one student is working by himself or herself you still have two of the other people to make up the group, but we do try to get everybody in the group involved.*

S: *There seems to be some … there is progress … again in my case I try to approach a group, sometimes you stop and you move on, you ask everybody, when you done to explain that back to you and I tried to get that right.*

R: *I saw that group five didn't work together at all.*

S: *There is time that you … as I said my back was turned so I don't know what's happening and when you turn around they all seem to be working, and when you get there they all try and help each other out, but when you turn around again they've gone back to the same thing. That's why it's nice to have two people working with the group. But we can't afford to do that, we don't have enough people.*

S: *I should try very hard to get students; I mean I spend lots of time. I spend a whole afternoon helping them but the second year you decide, the students aren't interested, why should I? … and I'd rather spend more attention to some, although they are strong, but they are willing to work and you'd rather give them your time, then to* *somebody that comes there just for answers. After a while you realize that it's not worth the effort.*

S: *For me personally I try not to, I never give answers. Copying … I never write, I'm to lazy to do that stuff, uhm, there are times when you have to give them the answer, I mean there is no way … I mean you think what more can I do. To them you think, do I give them the answer or do you lead them to that point and ask them to figure it out by themselves. But most of them copy, sometimes you get to a point where you have to give them the answer, because you are running out of time now or you're close to exams and you want to do other work, so you kind of give them the answer.*

S: *In the tutorials you try, OK, you go through the problem and I'll come back to you or you give them that key to help and see how far they can get. There are those students who are not very comfortable to do the work or they haven't been to lectures. Those are the one's who want you to lecture to them. You tell them you can't do that now. At some point I feel I have to give you an answer now, as you're not going to get anything done.*

S: *Yes, I do believe that the model works. There is not always time, that's where the problem comes in. For one you don't have enough time to be as precise as the model spoke. You kind of pull on whatever you can get at that time. I made a mistake in the last tutorial, that's why I had to come back to explain something to them. It's usually when you do something with them and when you go over to another group and then it strikes you that you didn't do this properly then you need to go back and that means that you spend another five minutes there, putting things right and sometimes that happens.*

Appendix L: Tutors' ability to reflect in action

S: *You find that sometimes you've explained something but when you interact with another group something else creeps up and then you realize 'no wait, wait, I was wrong or I could have been wrong in the way I put something across' or sometimes you find that with one group you suddenly found a simpler way to explain that. So I try and go back and then sometimes its tedious and it gets a bit long and half-way through they lost interest so you need this new dynamic approach and they, kind off, understand easier.*

S: *I think it's from the experience of the years. Personally, if I find I make a mistake I try and go back. What we used to do, we used to mark the stuff ourselves so if I did make a mistake then you I don't penalises the students, because it was my mistake. If I told them something and I would mark that and then I always go back and correct that.*

S: *It will be nice, but as I say time would be the problem. We probably don't have somebody to do it with us. We can't expect. We can't expect Dr X is the only one that works with us and he is in charge and doesn't have the time for it. Our meetings don't have the time for something like that. Apart from us volunteering to do something it won't happen at this stage. So there isn't time for that.*

S: *Individually we could find time but as a group it wouldn't be possible.*

S: *Yes, I understood more working with them then when I did. I learned more of the stuff now. There is no understanding.*