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USING PHENOMENOGRAPHY TO EXPLORE THE RELATIONSHIP BETWEEN STUDENTS' PERCEPTIONS OF THE LEARNING CONTEXT OF THEIR FIRST-YEAR ENGINEERING COURSE AND THEIR APPROACHES TO LEARNING.

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A research report submitted to the Faculty of Humanities, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Education.

Johannesburg, 2005

ABSTRACT

Phenomenography is an area of research which focuses on identifying and describing the qualitatively different ways in which people understand phenomena in the world around them. In this research, a group of first-year chemical engineering students at the University of the Witwatersrand were interviewed in order to explore their perceptions of certain aspects of the learning context of their compulsory engineering course, Introduction to Process and Materials Engineering. The findings comprise descriptions of their different perceptions concerning the organization, content, teaching and assessment practices in the course as well as their perceptions of certain aspects of constructivism on which the course is based. Students' perceptions which influence their approach to learning are categorized according to whether or not they encourage a deep approach to learning. Finally, the implications of these findings for future course development are discussed.

KEY WORDS

Learning approaches
Phenomenography
Students' perceptions
Engineering education
Learning context
Constructivism
Metacognition
Motivation
Social mediation
Active knowledge construction

DECLARATION

I declare that this research report is my own unaided work. It is submitted for the degree of Master of Education (in the field of Curriculum Studies), in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination in any other university.

Lesley Henning

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CHAPTER ONE

1. INTRODUCTION

1.1 A brief description of the context of the study

The University of the Witwatersrand (Wits), like many other tertiary institutions in South Africa, has expended much effort in addressing the problem of the under-preparedness for tertiary studies of its first-year students.

In the areas of Engineering at Wits, both privately-funded and institutionally-funded academic development programmes have been implemented to help those students who are at risk of failing their first year and of being excluded from re-entry to the university. However, many students remaining in the mainstream under-perform and struggle to cope academically.

In the School of Process and Materials Engineering, the primary efforts to develop the academic competency of these students is concentrated in the course Introduction to Process and Materials Engineering (referred to as PRME 1002) which introduces first-year chemical and metallurgical engineering students to their chosen disciplines.

Since 1999 a number of changes have been made in PRME 1002. These include changes in the learning environment of the course, a focus on the improvement in design of the learning tasks and materials presented to the students, an emphasis on the different levels of mediation of learning provided and changes in the nature of the assessment practices. Many of these changes are consistent with constructivist theories of learning in that they have been introduced to facilitate the active construction of knowledge and the development of cognition.

A more detailed description of the context of the study follows in Chapter 4.

The development of PRME 1002 and an evaluation of its effectiveness are under continuous review, while some aspects of the course are the focus of specific research questions posed by the three teaching assistants, who are all Masters students, and who have been deployed for this particular course.

1.2 My position in the study

As one of these three teaching assistants in PRME 1002, I was involved in the development of the course in 2002 and 2003. I have no background in engineering studies, but for many years I have taught and, more recently, examined matriculation mathematics for the Independent Examinations Board. My time at Wits gave me the chance to work alongside first-year students and to realize their various degrees of under-preparedness for university studies.

I was consulted in the preparation of the Course Manual and on many issues relating to the curriculum, pedagogy and assessment practices in PRME 1002. I was present during most lectures and tutorials and I tutored and marked students' work, especially their portfolio submissions, on a regular basis. The students accepted my limitations in engineering knowledge and skills, but realized that I was able to support them in their attempts to conceptualise situations and to solve basic problems in the engineering context.

For many PRME 1002 students, the course is perceived to be different from their other first-year courses mainly because its content is new and specifically geared to the engineering context.

But what exactly are their perceptions of the learning context of PRME 1002? They came to university with a set of learning approaches which had generally served them well through secondary school and their matriculation

examinations. Do the students see their previous approaches to learning as appropriate for PRME 1002? In what ways do the students' perceptions of the course's learning context influence their approaches to learning?

It will be useful to the future development of PRME 1002 to know whether or not certain aspects of the course are seen by students to be sufficiently significant to warrant a change in their learning approaches or perhaps just a refinement of their previous approaches.

In this study the perceptions of the learning context of PRME 1002 of seven students were explored using individual semi-structured interviews as part of a phenomenographical research methodology. Through a process of reflecting on their approaches to learning, these students considered the possible influence of their perceptions on their learning approaches.

1.3 My research questions

The specific research questions addressed in this study are:

- What are the students' perceptions of the learning context of their first-year mainstream course, Introduction to Process and Materials Engineering (PRME 1002)?

- In what ways, if any, do the students' perceptions of the learning context of PRME 1002 influence their approaches to learning?

- What are the implications of these findings for future course development?

The last of the above questions highlights the intended significance of this funded research.

CHAPTER TWO

2. THEORETICAL FRAMEWORK

2.1 Introduction

This study is based on two theoretical perspectives, constructivism and phenomenography. The former will be considered as a theory of knowledge and a theory of learning. Phenomenography proposes a constitutive view on learning which differs from the constructivist view on learning, but which provides a research methodology which is appropriate in an exploration of students' perceptions. This study adopts what Ramsden (1988) has termed a "relational" view on learning which is characterised by an emphasis on the relation between educational research and practice.

2.2 Constructivism

In this discussion of constructivism, I have relied heavily on the work of Doolittle (1999), a text which, in my opinion, is accessible to those whose interest does not extend to the details of the variations of constructivism as an epistemological theory, but who need to understand the basic tenets of constructivism as a learning theory.

Constructivism is not a single, unified theory of learning (Gravett, 2001). The term is used to denote a cluster of related views that all rest on the assumption that learning is an active process of constructing knowledge or meaning, and transforming understandings in interaction with the environment (Gravett, 2001). Further fundamental tenets of constructivism include the importance in the construction process of both individual and social experiences and the acknowledgement that the knowledge constructed will vary in its degree of validity as an accurate representation of reality (Doolittle, 1999). The

emphasis placed on each of these fundamental tenets varies, resulting in a continuum of different types of constructivism (Doolittle, 1999). A brief discussion of the different types of constructivism as identified by Doolittle (1999) follows.

From the cognitive constructivist perspective, knowledge is external in nature; an independent reality exists which is knowable to the individual. Learning is the process of constructing accurate internal models that reflect the external structures existing in the "real" world (Doolittle, 1999). Cognitive constructivism is thus typically associated with information processing and its reliance on the component processes of cognition. It has led to many significant empirical findings regarding learning, memory and cognition, such as schema theory, as well as various instructional applications, including concept maps and problem-solving strategies, like the IDEAL Problem Solver of Bransford and Stein (1984), mentioned in Bransford, Sherwood and Sturdevant (1987). Doolittle (1999) makes the point that knowledge construction in cognitive constructivism is mainly a technical process of creating mental structures but has little bearing on the nature of subjective knowledge within the mind.

Radical constructivism is at the opposite end of the constructivist continuum to cognitive or "weak" constructivism (Doolittle, 1999). From a radical constructivist view, the nature of knowledge is internal and while it is acknowledged that an external reality may exist, it is unknowable to the individual (von Glasersfeld, 1991). The individual's mind is experientially-based since external forms are mediated by our senses which are not able to accurately reflect reality. This implies that no two people are able to experience reality in exactly the same way or in a way which is independent of individual perceptions. Radical constructivism is increasingly recognising the role of social interactions as an additional source of knowledge (Doolittle, 1999). As personal meaning forms part of the individual's internal knowledge, radical constructivism involves two planes of construction, structure and meaning, and not just structure, like cognitive constructivism.

Social constructivism lies between the two extremes previously discussed. The social nature of knowledge is emphasised - knowledge results from social interactions and the use of language within a socio-cultural context. Truth to the social constructivist is socially constructed rather than being objective or experiential (Doolittle, 1999). Meaning is more important than structure to the social constructivists.

These differences in degree of the fundamental tenets aside, Candy (1991:272) generalises that a constructivist view on learning can be considered to have two foci: "how learners construe (or interpret) events and ideas, and how they construct (build or assemble) structures of meaning". Candy explains further that there is a dialectical relationship between these two actions - learning is an active process of constructing meanings which can be used to interpret situations; interpretation, in turn, has a feedback effect on the set of meanings.

It is not my intention to position this study within any single form of constructivism, but rather to follow Donald, Lazarus and Lolwana (2002) as they examine a set of key concepts extracted from the main constructivist theories and which relate specifically to the processes of teaching and learning in the Southern African context. These concepts include:

(1) active agency
(2) social construction of knowledge
(3) mediation
(4) metacognition and strategies
(5) tools of cognition.

2.2.1 Active agency

Donald et al. (2002) use the theories of Piaget, Vygotsky and Bruner to support the notion that people actively construct their world of meaning and their knowledge in particular. Piaget (1968) maintained that people, from birth, actively and continuously organise and re-organise information and experiences so that they can adapt to their world in progressively more effective ways. Vygotsky's concept of the zone of proximal development portrays the learner as actively constructing knowledge with the help of a mediator through social interaction processes. Bruner sees the learner as an active explorer/strategist who constantly devises plans of action which s/he perceives as the most effective ways of constructing, understanding and acting on his/her knowledge.

2.2.2 Social construction of knowledge

Knowledge is constructed and reconstructed at different times and in different social contexts. Vygotsky (1978) claims that the construction and transmission of values, information and understanding through social interaction processes contribute to both the development of cognition and the social construction of knowledge itself. Donald et al. (2002) draw on the work of Bakhtin (1981) to add that, in particular, the language (or the discourse) of the social interaction shapes the way the learners construct their knowledge.

2.2.3 Mediation

The contribution of Vygotsky (1978) to the concept of mediation is considerable. He identified the zone of proximal development as being the critical space where a learner cannot quite understand or do something on his/her own, but has the potential to do so through the close interaction with someone else who does have the capacity. The mediator then intentionally helps the learner to think forward into this space to construct a new level of understanding. A basic

assumption of Feuerstein's theory of structural cognitive modifiability is that the individual's level of cognitive functioning is directly linked to the quantity and quality of the mediated learning experiences (s)he has received. Instrumental Enrichment is an intervention programme which seeks to overcome deficiencies caused by insufficient or inadequate mediated learning experiences and to enhance the individual's capacity to learn through direct exposure in formal and informal learning situations (Feuerstein, M Hoffman, Rand, Jensen, Tzuriel and D Hoffman, 1986).

Closely related to this is Bruner's notion of "scaffolding", in which the mediator provides help and suggestions but gradually withdraws as the learner reaches a level of constructing his/her own internalised understanding (Bruner, 1977).

2.2.4 Metacognition and strategies

One of the first descriptions of metacognition comes from Flavell (1976 : 232) who describes it as "one's knowledge concerning one's own cognitive processes and products or anything related to them". Later he asserts that metacognition includes "the active monitoring and consequent regulation and orchestration" of information processing activities (Flavell, 1976; 232). Simply stated, metacognition refers to what we understand about how we think, plan and remember or what we are aware of concerning what goes on in our minds (Donald et al., 2002). It is the degree to which learners are conscious of what they do and why they do it that reflects their metacognitive understanding of their cognitive strategies. The more conscious they are of their own strategies, the more they can examine them critically and adapt or refine them, if necessary. In constructivist terms, metacognition refers to a higher level of active engagement that people can develop in relation to their own thinking and understanding (Donald et al., 2002).

2.2.5 Tools of cognition

Students who are actively involved in the construction of knowledge and meaning construct mental signs, or psychological tools, to represent concepts and relationships, tools which are used to mediate “intermental” cognition (Vygotsky, 1978). Piaget theorised that students mentally reflect on the use and nature of objects and then construct new knowledge by generalising, or abstracting, new relationships. In short, Donald et al (2002) concludes that humans use tools of cognition like language, mathematics and other symbol systems to enable them to shape, transform and reflect on their experiences.

These five key concepts translate into principles of practice that are applied in the critical areas of teaching/learning, assessment and motivation. These applications will not be discussed here; instead the discussion will move to the other theoretical construct on which this study is based, namely phenomenography.

2.3 Phenomenography

To Säljö (1988), the underlying rationale of phenomenographic research in general is that people act on their interpretation of the situations in which they find themselves. In order to understand the activities that count as learning in educational settings, Säljö (1988) maintains that it is not enough to have a firm knowledge of the objective characteristics of the learning situations (if it is at all possible to establish these characteristics) - researchers need access to the learner's perspective on what s/he is trying to accomplish. The phenomenographers' object of inquiry is said to be within a second-order perspective in that the phenomenographer seeks to describe the variation in the ways learners experience phenomena or situations in their educational context as the learners themselves experience them, rather than from the researcher's own perspective (a first-order perspective) (Marton and Booth, 1997).

According to Marton and Booth (1997), phenomenographers seek the totality of ways in which people experience a phenomenon/situation. They then describe the totality as a set of a limited number of groups of ways which are usually hierarchically ordered to show that some groups are more advanced, complex and powerful than others. Individuals' quotations may be used to exemplify the defining features of the identified categories.

To phenomenographers, to describe 'experience' or 'ways of experiencing' does not mean describing the mental representations, short- and long-term memory, retrieval processes and the other cognitive apparatus of the cognitivists. When a person does something, phenomenographers argue that the person experiences the situation in which s/he is acting and the relation to whom or what s/he is acting, but s/he does not experience any conceptions (like thinking) as guiding his/her actions. Thinking is inferred (Marton and Booth, 1997). 'Describing experience' is thus not describing what is happening in the nervous system or describing what the person is doing - it is an "autonomous level of description that cannot be reduced to other levels of description and it describes how the world appears to people" (Marton and Booth, 1997; 114).

If thinking is inferred, assumed or a fiction (Marton and Booth, 1997), then what is 'learning' from this perspective? Psychological processes, like learning or solving problems are legitimate subjects for phenomenographic research i.e. for exploring how different people experience learning, but learning cannot be explored independently of its object - there is no learning without something being learned. Entwistle and Marton (1984) say that phenomenography is a view of learning described in terms of changes in a person's conceptions of aspects of reality. Säljö (1988) explains that the conception of reality is the notion which is the "what" of thinking, the meaning people see in and ascribe to what they perceive.

In original research at Gothenburg in Sweden, the phenomenographic research method demanded that student learning should be described in terms of realistic content and everyday tasks as experienced by students; it should be 'grounded' in perceived reality and not interpreted from the theoretical frameworks of the researchers. This research emphasised the important role of both intention and of organising principles in influencing the outcomes of learning and showed the importance of analysing these outcomes in terms of the actual content of the learning task (Entwistle and Marton, 1984).

No person can ever describe experience in its entirety; the researcher is constrained to look for and describe critical differences in people's capabilities for describing the experience of the phenomenon in which the researcher is interested. The objective of a phenomenographic study is to reveal variation and when s/he describes the different ways of experiencing a phenomenon, s/he is describing the phenomenon, but again only partially. The researcher presents a system of categories which is not exhaustive, but which is complete in that nothing in the individual's disclosures or in the collective experience are left unspoken (Marton and Booth, 1997).

The objective of this study is to reveal the variation in the ways in which students experience the learning context of their introductory course to engineering and to further explore whether the students see their perceptions/experiences as influencing their approaches to learning in that context and to capture these in qualitatively distinct categories.

CHAPTER THREE

3. LITERATURE REVIEW

3.1 Introduction

In this section, I have reviewed the literature on research conducted using a phenomenographic methodology and which provides insight on the following topics which are considered pertinent to this study:

(1) Students' approaches to learning.
(2) Students' perceptions of the learning context.

3.2 Students' approaches to learning

Eizenberg (1988) uses the term 'learning' in two different ways. In one sense, learning is regarded as an outcome - the learning that has occurred as defined by phenomenographers (for example Dahlgren, 1984), to mean the changes in a person's conception of aspects of reality. Learning may also be considered as the means to that end or how the change between qualitatively different conceptions takes place. Describing how such a change in conception takes place also characterises an approach to learning.

Marton and Säljö (1984) identified two main approaches to learning - the surface and deep approaches. As a surface approach focuses on the 'signs' and not on 'what is signified', inadequate understanding inevitably results; changes in conceptions can occur only when a deep approach is adopted (Marton and Säljö 1984). A deep approach involves the organisation and structure of content within a meaningful frame of reference and the linking of new material to previous experience, so that understanding and long-term retention are facilitated.

According to Biggs (1986), an approach to learning is a congruent motive-strategy package. He maintains that the strategies involved in the deep and surface approaches describe ways in which students engage the task itself and he suggests the introduction of an ‘achieving’ approach to describe the ways in which students organise the temporal and spatial contexts surrounding the task. The achieving approach can then be used in conjunction with either the deep or surface approaches. In the deep-achieving approach, the student is motivated by both intrinsic interest and high marks and so approaches work through an organised and strategic search for meaning (Biggs, 1986).

Svensson (1984) used a different procedure to Marton and Säljö, but reported a similar distinction in students' approaches to learning. He described the variations in the categories of approaches based on qualitatively different ways of organising the content of a text when reading and remembering it. In the holistic approach, various principles are used to integrate the parts into an organised whole. In contrast to this, the outcome of the atomistic approach shows no evidence of any organising principle being used to delimit or order the parts (Svensson, 1984).

Marton (1988) combined the original characteristics of the deep and surface approaches with the holistic and atomistic approaches to derive a new framework representing the 'referential' and 'structural' aspects of approach to learning and their reflections in the outcome of learning. The deep/surface dichotomy stresses the referential ('what') aspect of the students' experiences and the extent to which they search for meaning and the holistic/atomistic dichotomy is concerned with the structural ('how') aspect or the way in which students organise the content of the learning task.

Eizenberg (1988) conducted research to find out how these different approaches to learning manifested themselves in the field of anatomy. His phenomenographic study involved analysing interviews with second-year medical

students at the University of Melbourne; he produced the following hierarchical set of descriptions of the ways they attempted learning tasks:

(1) Search for meaning by organising the content into an integrated whole, prior to and while analysing it [using a deep approach holistically].

(2) Search for meaning by analysing isolated items of information without organising them into an integrated whole until much later, if at all. The content is 'horizontalised' as distinctions between principles and examples are missed [using a deep approach atomistically].

(3) Memorise or rote-learn a ready-made organised whole eg. an essay plan, flow-chart, diagram, algorithm, mnemonic. The content is 'technified' or drained of meaning [using a surface approach holistically].

(4) Memorise isolated items of information. This 'hyperintending' of the content often happens paradoxically when the student is trying too hard [using a surface approach atomistically].

(5) Avoid or not actively engage in the task (Eizenberg, 1988).

Approaches (2) to (4) are generally considered to be undesirable because they prevent the student from gaining full understanding and the changes in conceptions needed for learning to take place. A capable student could argue that these approaches are quite appropriate for avoiding failure or for achieving high marks in the short-term, showing that surface approaches are not used by 'poor' students only (Eizenberg, 1988).

Although the same student may adopt different approaches in each of the many learning tasks involved in a course of study, Ramsden (1984) uses the term 'orientations' to refer to the general tendencies of students to adopt a particular

approach. He identifies four orientations - meaning, reproducing, strategic and non-academic. Students who adopt the meaning orientation, approach their learning with the intention of understanding the meaning of the work. Their learning approach is quite different from other students who aim to reproduce the content as it has been presented to them or who try to analyse what they think the teacher would like to see or hear so they can achieve good results. With the non-academic orientation, the student's learning approach is unsystematic and haphazard. Ramsden (1984) maintains that these learning orientations and approaches to learning are influenced by the students' perceptions of the learning environment or context.

3.3. Students' perceptions of the learning context

Ramsden (1984 :145) makes the point that there is nothing new in the realisation that university teaching contexts might have unintended consequences for learning - "they might discourage students from coming to grips with the fundamentals of their subject and encourage them to use tricks and strategies to pass examinations". On the other hand, he cites the work of Whitehead (1932) and Rogers (1969) to show that an appropriate mixture of imaginative teaching, choice and structure in the curriculum and suitable assessment methods can help students achieve greater personal meaning in learning.

The concern in this study is with the ways in which the students' perceptions of assessment, teaching and the curriculum may influence their approaches to studying and learning. Ramsden (1984) formulated a set of interconnected levels at which students' perceptions of an educational context can be conceptualised. It includes the students' interest and experience, assessment and teaching and course design.

The student who lacks interest in the material studied or fails to perceive any relevance in the material is likely to adopt a surface approach to learning. While

interest in the material is related to a deep approach, inadequate background knowledge of the relevant field frustrates attempts to understand the material especially where the learning task demands a firm grasp of fundamental concepts.

Throughout Marton, Hounsell and Entwistle's book *"The Experience of Learning"* (1984), reference is made to the strong influence of perceived assessment requirements on the approach to learning adopted by students when tackling an academic task. For example, assessment of an overwhelming amount of curricular material pushes students into surface approaches and an incomplete understanding of the subject matter (Dahlgren, 1984). Morgan (1993) draws on the work of Miller and Parlett (1974) who identified 'cue-consciousness' as an important aspect of how students negotiate the assessment system.

Laurillard (1984) also found that the students' approaches to problem-solving are related to their perception of marking. Where students perceive the assessment situation as being threatening, they are more likely to adopt a mechanical, rote-learning approach (Marton and Säljö, 1984).

Ramsden (1984) claims that a positive influence on deep approaches to learning seems more likely to come from good teaching and greater freedom for the students to choose both content and ways of learning. He urges university lecturers to make a determined effort in their course planning and in their setting of examination questions, to avoid presenting a learning context which is perceived by the students as requiring or rewarding surface approaches to learning.

3.4 Motivation

“Everyone knows that motivation is the key to student learning. We know this as a result of our own school experience as well as through observing our friends

and family. Research merely confirms the fact" (Spaulding, 1992; iii). In this section, no attempt is made to review the research supporting existing theories of motivation. Instead the two generic types of motivation, extrinsic and intrinsic, will be described, with more attention being devoted to the latter.

3.4.1 Extrinsic motivation

Extrinsic motivation exists when individuals are motivated by an outcome which is external or functionally unrelated to the activity in which they are engaged (Spaulding, 1992). They hold some desired outcome as a goal, they recognise that a particular way of behaving is an appropriate means to that end and they modify their behaviour in such a way that they are likely to achieve the goal. An impressive array of rewards and punishments are often used to promote an extrinsic motivational orientation.

3.4.2 Intrinsic motivation

Intrinsic motivation exists when individuals work because of an inner desire to accomplish a task successfully, irrespective of its external value (Spaulding, 1992). They actively seek opportunities to take part in the related activity and may well become engrossed in it. Spaulding (1992) explains further that according to Deci and Ryan (1985), people tend to be intrinsically motivated in situations in which they perceive themselves to be both competent and self-determining.

In the former, the individuals perceive themselves to be capable of performing successfully in a given situation. These perceptions are often only moderately related to measures of actual competence (Spaulding, 1992). In the latter, the individuals perceive the situation as being one that they can control in some meaningful way. These overlapping self-perceptions change as they are situationally-related. Spaulding (1992) maintains that individuals will never

perceive themselves as having any real control unless they have some level of perceived competence.

3.5 Conclusion

The construct of approach to learning reviewed in this section has been shown to be a powerful construct in describing the qualitatively different ways in which students go about their learning and provides an explanation for learning outcomes of differing quality. For the purposes of this study, the validity of the general construct of approach to learning has been assumed, but not the particular approaches (e.g. deep and surface) which might be applicable in the PRME 1002 context.

These approaches to learning are assumed to depend fundamentally on the particular educational context and are assumed to be influenced by the students' perceptions of these contexts. In this review it has also been shown that a consideration of students' perceptions of the learning context is a useful construct for understanding student learning.

By exploring the internal relationships between how students perceive course demands and how they approach learning, the complexity of student learning may be better understood.

The theme of motivation seems to weave a clear thread through the maze of influences which contribute to success and failure at university and while it is not the main focus of his research, its impact cannot be ignored.

CHAPTER FOUR

4. THE CONTEXT OF THE STUDY

The focus of this study is on students' experiences and perceptions of a particular educational context, the PRME 1002 course in 2003. This chapter provides a detailed description of that context and has been included to give the reader sufficient information about the context to be able to understand the interpretations of the research data. This description of the context of PRME 1002 is divided into two sections, namely the course content and the course structure.

4.1 The content of PRME 1002 in 2003

PRME 1002 is the code for the course entitled 'Introduction to Process and Materials Engineering'. Students often refer to it simply as 'Process'.

At the beginning of the Course Manual for the first quarter of 2003, a copy of which was given to each student, the course objectives and outcomes were listed as they pertained to each of the following sub-divisions:

- "Professional and academic skills.
- The disciplines of materials and process engineering.
- Engineering calculations.
- Material balance calculations.
- The engineer in society.
- Computer literacy".

  (The Course Presenter, 2003: 2-3)

This was followed in the Manual by a broad overview of the course for 2003:

"First Quarter:

General theme: Introduction to engineering.

Communication skills: Accurate reading of complex technical English.

Content:

- Introduction to engineering.
- Strategies for academic success.
- Unit conversions.

Second Quarter:

General theme: Learning as a development process.

Communication skills: Computer literacy and writing engineering reports.

Content:

- Issues of personal and professional development.
- Conceptualisation.
- Stoichiometry and chemical reactors.

Third Quarter:

General theme: Developing higher-order thinking skills.

Communication skills: Data literacy and discernment.

Content:

- Reasoning and problem-solving skills.
- Material balances I: mixers, separators and recycles.

Fourth Quarter:

General theme: Developing higher-order thinking skills.

Communication skills: Communication of engineering solutions.

Content:

- Issues of speed and accuracy.
- Problem-solving continued.
- Material balances II: involving reaction and purge streams; matrix methods." (The Course Presenter, 2003: 4)

The focus of the first four weeks of the academic year in PRME 1002 for 2003 was "Strategies for Academic Success", which included:

- Get yourself organized.
- Get the most out of class time.
- Take notes effectively.
- Read effectively.
- Manage your time effectively.
- Study effectively.
- Use learning resources effectively.
- Develop good exam technique.

Appropriate engineering texts and materials formed the content in which each of these strategies was dealt with in class and homework assignments. Details and explanations of the strategies, quick tips, exercises, resource materials and reflective questions were included in the Course Manual.

Also included in the Manual were the details of the VICTOR approach to problem-solving. This is similar to the IDEAL Problem Solver of Bransford and Stein (1984), in which five components of thinking that are applicable to a wide variety of situations are emphasized. The IDEAL Problem Solver includes the ability to:

- I = Identify problems.
- D = Define and represent them with precision.
- E = Explore possible strategies.
- A = Act on these strategies.
- L = Look at the effects.

  (Bransford and Stein (1984) in Bransford, Sherwood and Sturdevant, 1987: 163-169)

The course presenter of PRME 1002 developed the VICTOR approach to problem solving in an attempt to help students to effectively solve engineering problems using a step-by-step approach. These steps are:

- "Visualise the situation (draw a diagram).
- Interpret the information (unpack the English, observe accurately).
- Clarify the problem (what is given, required, relevant).
- Tackle the problem (starting points at the beginning, middle or end of the solution path – the path from the given information to the statement and explanation of the resolution of the problem).
- Organise the presentation of the solution.
- Review the solution."

  (The Course Presenter, 2003: 118-125)

Students were encouraged to pay attention to each of the six stages of VICTOR, but not necessarily in the sequence suggested by V,I,C,T,O and R. This VICTOR approach was not meant to be a simple recipe for success in problem-solving – for example, the processes of interpreting the information and clarifying the problem are more complex than the few words would suggest; so much more than the acronym is needed when the student gets stuck and cannot see a way forward. The Course Manual included some additional advice for these students and another acronym, APPLAUSE, to be used when reviewing a possible solution.

- “A = Answered the question?
- P = Problem identified correctly?
- P = Procedure OK?
- L = Logic OK?
- A = Arithmetic OK?
- U = Units OK?
- S = Seems reasonable?
- E = End!!”

(The Course Presenter, 2003: 125)

In conclusion, the content of PRME 1002 was chosen to include those sections which were generally considered to be appropriate in serving as the context for developing academic skills and competencies - an important outcome of the course, (see page 29).

4.2 The structure of PRME 1002 in 2003

4.2.1 Contact time

Wednesday lecture:	09:00 – 09:45
Thursday lecture/tutorial:	10:15 – 12:00
Friday lecture:	12:30 – 13:15
Friday tutorial:	14:15 – 17:00

The venue for the Wednesday lecture was a formal lecture theatre for most of the year. The other lectures and tutorials took place in a large flat-floored venue.

4.2.2 Tutoring system

This system operated on Friday afternoons when fifteen tutors, who were either postgraduate or senior students, and five academic tutors worked together to give students:

- assistance in doing tutorial problems;
- an opportunity to discuss any problems/issues with them;
- feedback on work that had been handed in.

Each tutorial unit comprised an academic tutor, three tutors and 22-28 students. In effect, each tutor tended to the needs of 6-12 students, who sat in groups of three or four. Groups did not change much in the course of the year and students generally kept the same seats all year.

4.2.3 Teaching strategies

A combination of different teaching strategies were used by the course presenter in PRME 1002. Strategies included lecturing, a problem-solving strategy and teaching using group work.

Lecturing was used for the transmission of information which had been selected and ordered by the lecturer and which was conveyed to students using visual support – Powerpoint presentations on a computer or the blackboard. Concepts, functions and procedures were explained to students who were involved visually and auditorially in mostly individual cognitive efforts to attend to, process and remember the information.

To encourage students to develop and refine their thinking skills, extensive use was made of problem-solving. Students were advised to attempt to solve the problems on their own first, and then to discuss their progress with the other

members of their group. In this way, students were required to think, reason and communicate – activity and social interaction were promoted. They were also encouraged to engage in metacognitive processes.

Study projects were group projects comprising sections to be answered by individual members of the group as well as a group section. The success of these projects depended largely on the extent of the cooperation and collaboration between group members. Study project questions were sometimes open-ended, allowing students to pursue their own interest within the bounds of their chosen engineering discipline.

4.2.4 Assessment

In PRME 1002, in 2003, strong emphasis was placed on the continuous assessment of the students' performance in various types of activities, including assignments, portfolios, study projects, tests and exams.
The weighting of the marks in 2003 is as follows:

November examination:	30%
June examination:	10%
Portfolios:	25%
Study projects:	10%
Year mark:	25% (assignments, spot tests, class work and group work)

- Assignments (homework and/or class work) were submitted on a weekly basis; some were intensively marked, others merely checked.

- In an example of a portfolio item used in 2003, students were asked to describe their progress in the mastery of unit conversions. They had to identify the kind of errors they had tended to make in these calculations and

to use examples from their own work to illustrate their answers. Details were provided for them to conduct a self-test on their speed and accuracy when doing unit conversion calculations. Finally, students had to rewrite a given empirical formula in SI units and to devise a test to check that their re-written formula was correct.

- Study Project A, used in 2003, was entitled “The Impact of Technology on Society”. Each group member had to select one article produced by a technical process and write a report on how the article was made, how it impacts on society and how society was impacted on by the manufacturing process used to make that article. The group report had to address the question “How does technology impact on society?” and needed to use examples from their individual reports to illustrate the group’s argument.

- Prepared tests included conventional tests, ‘prep’ tests which were written just before the Friday tutorials to assess whether or not students had prepared for the tutorials and learning tests. In learning tests, students were asked questions on a text which they had studied for perhaps 30 minutes before the test. A number of unprepared or spot tests were also written.

- A three-hour examination was written in June and another in November.

CHAPTER FIVE

5. RESEARCH METHODOLOGY

5.1 The phenomenographic research methodology

In the chapter on the theoretical framework of this study, phenomenography was discussed in some detail. As an introduction to this section, it is appropriate to summarise the basic ideas of phenomenography which impact on the methodology used in this research.

The difference in ways people experience phenomena in their world is of prime interest in phenomenographic studies and phenomenographers aim to describe that variation. They seek to uncover the ways in which people experience the object of interest and then to interpret them in terms of distinctly different categories that capture the essence of the variation and that are described from the second-order perspective. Such categories are often arranged hierarchically and their defining features are exemplified by the inclusion of suitable respondent quotations.

The second-order perspective has to be explicitly adopted when research problems are being posed, when material is being collected and when data is being analysed. This means that the researcher takes the place of the respondent and tries to see the phenomenon and the situation through the respondents' eyes. The respondents' experiences are used to illuminate the ways in which others are talking about the phenomenon, experiencing it, understanding it and working with it.

For the sake of convenience, the two stages of data collection and analysis will be discussed separately, but in reality they occur simultaneously. During the gathering of material, whether through interviews or otherwise, analysis takes

place so that the early phases of analysis are likely to influence later data collection.

5.2 Validity and reliability

Lincoln and Guba (1985) make the point that in a phenomenographic paradigm, the traditional constructs of internal and external validity, reliability and objectivity of results need to be reconsidered. They suggest the replacement of internal validity by the criterion 'credibility' which they define as the extent to which the researcher has accurately represented the multiple views that are held by the participants. Credibility is likely to increase when the researcher is engaged and persistently observes the research context over an extended period of time and uses multiple methods and sources of data where possible for triangulation (Lincoln and Guba, 1985).

External validity concerns the generalisability of results. In a phenomenographic study, the strategy of purposive sampling of subjects is appropriate to maximise diversity in the group. In so doing, there is no intention of forming causal links from the data or of generalising the findings to a broader community.

Lincoln and Guba (1985) suggest that consistency and neutrality, which are aspects of reliability, could be replaced with dependability (a measure of the quality of the research process) and confirmability (an assurance that the research findings are rooted in 'real' contexts and people are not figments of the researcher's imagination). These qualities are likely to be increased if the researcher keeps a detailed record of the research process in a reflexive journal which is available for scrutiny by any independent observer (Lincoln and Guba, 1985).

5.3 This study

In this study, the students' perceptions of the learning context of PRME 1002 are first described, but not categorised in any way. After further analysis, some of these perceptions are grouped into three categories based on their perceived influence in encouraging students to adopt a deep approach to learning PRME. Pertinent quotations of students are included to justify the categorisation. On the basis of this data, the implications for future course development are discussed.

In short, this study is an in-depth, small-scale study in a naturalistic setting using qualitative methods and a human instrument. Semi-structured interviews were used as the primary method of data collection; other sources of information included portfolio submissions and answers to reflective questions in assignments.

5.4 The student sample

In order to achieve the required depth in findings, a small group of seven PRME 1002 students were chosen with whom a series of three individual interviews were conducted. The strategy of purposive sampling was appropriate for selecting the students for interviews as it was considered advantageous for the participating students to be as diverse in salient characteristics as possible. Criteria which were considered in participant selection included mid-year examination results, matriculation points, race, gender and educational backgrounds. No repeat students were eligible for selection.

5.4.1 Details of the seven students participating in this study

Gender	Males : 3	Females : 4

Race	Blacks : 3	Whites: 2	Coloured : 1	Indian : 1

Home Language	English : 4	Zulu : 2	Venda : 1

School Background: Province: State Schools: Independent Schools:	 Gauteng : 5 3 2	 Limpopo : 1 1 0	 Kwa-Zulu Natal : 1 1 0

Matriculation points according to the University of the Witwatersrand's admission scale:[1]	22 – 40 points

PRME 1002 mid-year examination marks:	19% - 86%
University resident : 2	Non-resident: 5
Bursaries: Company : 3	University : 4

In deciding on purposive sampling, there was no intention of forming causal links from the data or of generalising the findings of the study to the broader community of first-year engineering students. However, readers of the research report may consider the possible implications of the research findings in their own context.

Participating students were assured that every effort would be made to ensure their anonymity at all times. Raw data was used by the researcher only and will be destroyed when the final report has been examined. Pseudonyms that are true to both ethnicity and gender have been used so that the diversity of the group could be retained for the benefit of the reader.

[1] Admission scale: English (FL) HG C and above = +2
Mathematics HG C and above = +2

	HG	SG
A	6	4
B	5	3
C	4	2
D	3	1
E	2	

5.5 Data collection

A series of three interviews were conducted by the researcher with each of the seven students on an individual basis in the period 22 September to 17 October 2003. The interviews each took about 30 minutes and were audio-taped (with the students' permission) and transcribed as soon as possible after each interview.

The interview protocols were designed with the research questions in mind and were aimed at exploring the perceptions of aspects of the learning context of PRME 1002 and how they thought these perceptions influenced their approaches to learning. Questions were formulated around incidents, portfolio topics and reflective questions in assignments or tests but as the course of the interviews depended on the responses of the interviewees, actual questions could not be planned in detail in advance. However, the interviewer had a set of questions in mind for use when appropriate. The interview protocol for each round of interviews is included as Appendix I.

5.6 Data analysis

Data analysis took place in various stages. The first stage involved a process of identifying common themes in student responses as well as any emergent issues which might have been useful for further exploration. A preliminary set of categories describing students' perceptions of the learning context was identified and the data from each student coded accordingly. Areas needing further elaboration were flagged for inclusion in follow-up interviews. After these interviews, the recent data was fitted into the preliminary categories which needed refinement. In the next stage of the analysis, all the data was recoded from scratch using the categories and subcategories that had been developed in the previous stages of the analysis. The similarity within each category was illustrated with the help of the actual words of significant statements of students.

In the second part of the analysis, the perceptions which could influence the student's approach to learning were identified. These perceptions were then categorised according to whether or not they encouraged the adoption of a deep approach to learning. Some perceptions influenced the students to adopt either a deep or a surface approach to learning and this complex interrelationship was described.

The students were not always explicit in linking their perceptions of aspects of the course context to their approach to learning. This meant that the researcher had to make links based on the evidence in front of her. Every attempt was made not to read more into the students' responses than they had originally intended.

CHAPTER SIX

6. DISCUSSION OF DATA FROM STUDENT INTERVIEWS

6.1 Introduction

In this chapter, the data gathered from the individual semi-structured interviews of the seven participating students are discussed. In each case, the student is introduced to the reader before his/her perceptions of the learning context of PRME 1002 and their possible influence on the student's approach to learning the subject, are described.

Aspects of the learning context which are examined include the organisation of the course, the content covered in the course, and the teaching and assessment practices in the course.

Finally, the students' perceptions of learning in a constructivist environment are described. The features under consideration include metacognition, the active construction of knowledge, social mediation and motivation.

6.2 Julie

6.2.1 Introduction

Julie attributes her success at high school to a sense of feeling very comfortable in that environment. She worked hard for her final matriculation examinations by trying to "understand the whole process of what happens" rather than by just working through many past papers. She explained how she had made up what she considered to be possible questions (some were quite "tricky") and had then tried to answer them. She achieved 32 points on the university's admission scale.

She had been very uncertain about her future career until she visited Sasol where she was told about chemical engineering. Julie's father also told her more about the work of his colleagues who were chemical engineers. She then applied and was accepted to study chemical engineering at university.

At university, she was initially totally overwhelmed by her new-found freedom. She missed lectures and her marks reflected her general lack of effort. She achieved 41% for PRME 1002 in the June examination, after which she said she tried to change her approach to learning the subject. Julie failed her final PRME 1002 examination, but managed to pass overall by virtue of having good marks for projects and her portfolio work.

6.2.2 Julie's perceptions of the learning context of PRME 1002 and their possible influence on her approach to learning the subject

Organisation

The inclusion of the word "introduction" in the name of this course was perceived by Julie to mean that the course content would consist of "minor things" which "won't be that bad". This expectation of PRME 1002 set her on the road to using a surface approach to learning.

Julie perceived the course as being disorganised. While students had been provided with a course outline, she felt that this was incomplete and lacked detail. She maintained that with PRME:

> "You never know what you are going to do …… all those things that just come in all of a sudden, so you can't really expect anything and you can't prepare in advance either because you don't know what you're expecting."

In Julie's mind, a lack of preparation ahead of lectures precluded the possibility of learning at a deep level during those lectures.

Julie also said that she “hardly ever” looked at the Course Manual, the document containing the course outline.

When asked to give her perceptions concerning the aims and objectives of PRME 1002, she said:

> “It seems to me like we’ve been the guinea-pigs of future ‘Process’ students; we’ve been trying all these different things to see how future (PRME) students can succeed or whatever. We have to be just put there for his (the course presenter’s) experiments and stuff, but it doesn’t matter what happens to us…..”

With this sense of a lack of care and interest in her well-being, Julie was finding it hard at that time to motivate herself enough to learn PRME 1002 at all.

Content

Of the course presenter’s inclusion of a section at the beginning of the year on appropriate study methods in the university environment, Julie could see no purpose or relevance. According to Julie, her study methods had stood her in good stead for the previous twelve years at school, and if any changes were to be made now, they would be minor adjustments and not major alterations designed to “match a heading in a textbook on study methods”.

In a later interview she said she was still working on study methods. “I don’t have a set study method, I just try to study and understand. I visualise most of the time …..”. By visualising, Julie meant that she would memorise a page of formulae, for example, and as long as she could “see” it in her head, she believed that she had learnt the work. Other students who were interviewed said that there was very little content in PRME 1002 which could be learnt by rote.

Julie said that interest in the content of a course was important to her. She said she tended to ignore a subject if she did not “like” it, and that it was more exciting

for her to learn something that she enjoyed learning. Her assurance to me that she was interested in the content of PRME 1002 was not convincing.

Teaching

Very important to Julie, were her perceptions of the teaching in PRME 1002. She said:

> "We never seem to get to the point where everything comes together, like when we're doing problems, we never get to a point where the problem is solved. It's always OK, we'll get back to that one, let's go to this one now – it's always like 'finishing off on your own' type of thing and we never get to a solution that's set. If there is a solution, it's always 'I might be wrong – check me on it' and I never check. I try to but ……. (she trailed off)."

Julie said that her notes consisted of numerous unfinished problems or more-or-less complete solutions where explanations of steps or the correct answers had not been provided.

From the interviews it was difficult to say whether Julie was unwilling to make the necessary effort to complete her notes and make them more meaningful or whether she lacked the ability and/or the motivation to do this.

Julie had enjoyed the few lectures in which the course presenter had used Powerpoint presentations to illustrate his explanations of topics like distillation – the visual stimulation had helped her to take notes and to learn from them.

Assessment

> "I don't particularly enjoy coming to 'Process' based on the fact that I don't know what to expect and …. It's so easy for us to come here and OK we're going to write another test, because we do that all the time and we're going to get something where it has nothing to do with what we were doing but we have to know how to do it ….. The Prof will say it's easy, don't worry, it will take you ten minutes. Most of us struggle (like what's going on?) and we end up taking half an hour …. We weren't expecting something like this."

Julie added that she often found PRME questions “ambiguous, you don’t know what you want, what do they want from you …. and it’s very depressing.”

To Julie it was not helpful to be given extra time in tests or to have the time allocated to an assignment increased as this did not help students who were trying to manage their time effectively.

Continuing on the topic of assessment, Julie questioned the purpose of writing tests which did not count for marks, but which would help to see where the students were going wrong. She said that students who received no feedback on such “tests” never knew what they had done wrong. She recalled that Project A had not been returned to students despite having been submitted by them about six months previously. Julie maintained that she had “never” received constructive feedback on any piece of work. “No” or “what’s this?” were examples of typical comments and the grading system of A+ to D- was meaningless to her. With no feedback and no model solutions, Julie said “you never know if you’re correct or totally incorrect”.

Julie did not mention whether or not these perceptions of the assessment in PRME 1002 had influenced her approach to learning.

6.2.3 Julie’s perceptions of aspects of constructivism in PRME 1002

Active construction of knowledge

Julie emphasized the importance to her of understanding the basic concepts of a subject if these concepts have to be applied in many diverse situations.

She said:

> “I don’t understand what’s going on most of the time. If I can’t understand the lecturer, I’m not going to try and stay there and think OK, maybe,

> somehow ….. I'd rather go over it myself and use a textbook or read the notes or something so that I can get into it."

However, in a later interview she said:

> "We look at it (a class work problem) and we try it, but we're not exactly going to spend the whole time saying OK let's really try and figure this out – we just wait for the lecturer to tell us what's going to happen anyway."

To Julie, the lecturer's attempts to "force" students to actively process the work were ineffective.

The section on stoichiometry presented Julie with her first real difficulties in PRME. She recalled that she thought she had understood stoichiometry when the section had been covered in chemistry, but when it was explained in PRME "it sounded like it was totally different". Julie did not try to remedy the problem – she entered the PRME examination room in June saying "I have a problem with stoichiometry, I know that, but I've covered enough (to pass)……" The stoichiometry question "was awful"; I didn't know what to do, I was lost, I just kept reading the question, nothing came to me, no information, …. I was so angry."

A little later in the same interview, Julie explained her difficulty in the mid-year examination:

> "I based all my calculations on feed and I told myself, Julie, give me the feed and …. they didn't give me the feed and I was lost, I didn't know what to do and that's when I realized you can't just think of a problem and if you can do one problem, you can do them all."

In support of this argument, Julie said that she did not use the VICTOR problem-solving approach because she thought that no "generalized" method could work for all kinds of problems.

Then, in apparent contradiction, she said:

> "I'm open to ideas of different types of problem-solving methods …. but my way of thinking is just straight forward and I understand it and I'm not going to make room for anything else at this point in time, because it's too late to try and understand another method all of a sudden."

Julie provided little evidence of actively processing the material in PRME 1002 in order to achieve the understanding which she had claimed was necessary for success.

Social mediation

According to Julie, she had worked with four different tutors in the course of the year – she said that she did not even know the name of her tutor at the time of the interviews. She had not experienced her tutors as being particularly helpful; they either told her what they "thought" she should do, and this then turned out to be the wrong advice or they looked at their worked solutions before telling her what to do, and then offered her no explanations.

When Julie needed help, she asked the members of her group, who, she said, were more helpful.

> "For those of us who struggle, it's nice to work in a group of people, that we all put something in and all get to the same answer eventually."

She explained:

> "…. you come up with different things and then you like, oh yes, why don't we try this and that and it's better for us to interact that way than by asking someone who has maybe been through it or doesn't know either."

Metacognition

Julie provided little evidence of any attempt on her part to reflect on her own cognitive processes or to actively monitor her information processing activities.

From the negative nature of some of her responses, it would seem that she would not be willing to adapt or change these activities or her approach to learning even if they were found by her to be inadequate.

Motivation

Julie's level of motivation at the time of her interviews was low. Her last comment was:

> "……. it's easy for me to say I can't do Process, I'm going to leave chemical engineering and I'm gong to do electrical engineering, because it doesn't involve Process, and that's what other people are thinking …."

This option was not mentioned by any other students involved in this study.

6.2.4 Conclusion

Julie thought she was adopting a deep approach to her learning when she contended that it was important for her to "understand" the work. Many of her comments indicated that her approach was more surface in nature. Rather than accepting responsibility for her slow progress in the course, she saw herself as the victim in a learning situation which she perceived to have many faults.

6.3 Lesedi

6.3.1 Introduction

> "I have to admit, I didn't do much studying last year. I relied on cramming stuff at the last minute because the things that we were doing were kind of easy. So since they told us that in order to get a matriculation you need about 4 E's and I had them, so I thought to myself let me not stress myself to get those A's and B's."

These were Lesedi's opening words during our first interview. From these comments it would seem that Lesedi had adopted a surface approach to his

learning. He had been satisfied with mediocre marks as these were all that had been needed to pass and “cramming the work” into his head “at the last minute” had been sufficient for him to achieve mediocre marks.

Lesedi matriculated with 22 points on the university’s admission scale, which was insufficient for automatic acceptance into chemical engineering. On the basis of the results in a selection test for engineering, he was allowed to register for engineering at the university.

He thought he would have to study chemistry and mathematics in chemical engineering – no physics or mechanics – and PRME 1002 “was a surprise”.

Lesedi was quite relaxed during the interviews; his answers to my questions were spontaneous and straight, though at times provocative.

He did not pass his final PRME 1002 examination, but he passed the course overall by virtue of having good marks for his projects and portfolio items.

6.3.2 Lesedi’s perceptions of the learning context of PRME 1002 and their possible influence on his approach to learning the subject

Organisation

Lesedi commented that he never knew what to expect when he came to PRME lectures - “everything is a surprise ….you just get there and you pray that it is something that you’ll understand”.

When asked how useful he had found the Course Manual for PRME 1002, he answered that he had not looked at it yet; all he had done at that stage was to attempt the required tutorial questions which were included in the Manual. He had not read the sections of the Manual on the course organization or its objectives.

Lesedi said he thought that the lecturer's aim in PRME was to try to show the students the "simplest way of solving problems" so that they would develop their minds "to think like engineers" – to Lesedi this was the aim of the course.

Content

Lesedi considered the first section of work on strategies for academic success to be a "waste of time". He had never used cognitive maps (or mind-maps) before and he was fairly sure that chemical engineers did not use them either, so they had to be "a waste of time".

To Lesedi, the workload in PRME 1002 was heavy. He said that in almost every lesson, new material or new methods were introduced. Lesedi did not seem to see any connections between consecutive lessons and he provided no evidence of integrating new material with the old.

Lesedi had this to say about the VICTOR problem-solving approach suggested in the course:

> "Everyone's got their own way of solving the problems… It (VICTOR) doesn't work for me, because I think for me it's a waste of time when you have to think of the 'visualise', 'interpret' and everything like this."

Teaching

With regard to the teaching in PRME 1002, Lesedi said that the pace of the lectures was just right for him and that the lecturer "wants you to understand what he's talking about". He added that the lecturer sometimes showed "signs" that made him (Lesedi) think that the lecturer was "also confused". He explained that he was able to follow the steps in a solution as they were written on the board, but that all he needed to do was to take his "eyes off the board and when you put them back on, he's on a different path and you don't know what he's talking about … you are confused".

Lesedi expressed his reluctance to ask the lecturer a question – "if he explains, maybe that will make me more confused".

He added:

> "The only time we get involved is when Prof asks us questions, but most of the time we usually tell him that we don't know the answer or when we try to speak or are actually speaking, he cuts in and then he says his own answer."

Lesedi had appreciated the lecturer's use of Powerpoint and the computer in his lectures earlier in the year as the visuals had helped him remember the work.

Assessment

Lesedi said that at the beginning he had not learnt at all for PRME 1002. He had found the early sections "easy" – he had his own way of doing the work and provided his answers were close to the correct ones, he had been satisfied. However, his own methods let him down in the June examination in which the questions asked seemed to him to be completely different from those he had done in class. He did not pass this examination.

After this, the work became harder and his own method continued to produce wrong answers. He resolved to increase his effort to concentrate on the methods suggested by the lecturer and to try to understand the work in a step-by-step way.

Lesedi later said:

> "……since we were taught the thing in class, I am expecting the marker to be looking for the things that he taught in class …. So when we're writing tests, I try to write what I've learnt in class, what the marker expects me to do ……"

The reality of failing PRME 1002 in June caused Lesedi to make some changes in his approach to learning in that subject – he thought that if he could reproduce the work in the way the marker would want to see it, he must surely pass.

Lesedi said that there had been times when this had not been possible. When there was time pressure or when the "situation was complicated" he would say "I don't care, I just write to see if the answers are right".

He added that he usually rushed to finish writing tests; he said that many of his answers ended up being vague and lacking detail. If he was then given extra time, he said this "kills something inside him" and he seemed unable to answer the rest of the test properly. Extensions in the due dates of projects allowed him to go over his work with the aim of improving it.

Lesedi's perceptions on the feedback he had received on work that had been assessed were generally negative. He said that it did not help him at all to be told that he could "do better" without giving him any indication of how he could improve.

6.3.3 Lesedi's perceptions of aspects of constructivism in PRME 1002

Active construction of knowledge

Lesedi tried to describe the way of solving problems which he used instead of following VICTOR.

> "First, when I get the problem, I look at what's given, then from what's given I work it from there – I try to write down every equation that is needed or relevant to the problem that's been asked, so I solve the problem like that. Most of the time I don't use diagrams, so when I don't use diagrams and I see that I am failing, I start using diagrams."

Problems in PRME 1002 often involved chemicals or reactions of which some of

the students had no previous experience. Lesedi said:

> "I feel a bit lost. At first I attempt them, but when I see it's not working out, sometimes I just give up. Then maybe later I might try a new path in order to form the equation, but then if it still doesn't work, so I just give up."

It would seem that Lesedi made certain changes only when he could not get the right answers and then he gave no indication whether these changes were in line with a particular plan of action, or whether they were made on a haphazard basis.

To Lesedi, getting the right answers showed that he knew the work, while being able to follow a worked solution from one step to the next indicated that he understood the work.

Social mediation

Lesedi enjoyed the mutually beneficial working relationship which had developed with one of the members of his group of four. He explained:

> "….. when I'm stuck, I ask him for advice and he tells me, and then when I see that I think he's made a mistake, I also say 'look you've made a mistake here, so why don't you try this out' and maybe together we might solve the problem."

Lesedi welcomed the clues his tutor gave him when he was stuck with a problem; he did not expect her to give him answers.

Metacognition

Lesedi mentioned a couple of times in his interviews that he was not used to thinking about his way of thinking, that he would usually just write. He explained:

> "I just write down without thinking, but then after writing, I look at the paper and then I'll ask myself why did I do this and it won't come back to my mind why I actually did this. As long as it is right, it doesn't matter."

When his tutor had the chance to discuss his work with him, Lesedi said she asked him “why do you do this?” Lesedi could never give reasons for his actions – he had done the best that he could have done at that time.

He commented that he had noticed that some students seemed to know exactly why they were doing what they were doing when they were doing it and that they achieved good results. He said:

> “….. so then you kind of question yourself …. maybe if I can also do the same thing, maybe it might work for me.”

Motivation

Lesedi said that he was interested in PRME “because it’s a challenge – you know sometimes you feel excited when you get a challenge”. However he gave no indication as to how he went about rising to these challenges – a number of times he mentioned “giving up” when the work became “complicated”.

6.3.4 Conclusion

Lesedi was adopting a surface approach to his learning, but was trying to make certain changes especially when he realized that his way was inadequate. His understanding of the work was more instrumental than relational – he experienced difficulty in connecting concepts which were related to each other in some way.

6.4 Laura

6.4.1 Introduction

Laura said that she had not been very interested in school. She had completed all the work required, but had done nothing extra until after her preliminary matriculation examinations. After many hours of extra lessons in mathematics and science, she matriculated with a score of 29 points on the university's admission scale.

She said that at school she had no idea what she wanted to study – she had decided on chemical engineering the day before submitting her application form to the university. She recalled:

> "When I first got here, I didn't know anything, I didn't know what to expect …. I didn't know what I was getting into at all."

Laura's easy-going nature allowed her to "go with the flow, whatever happens, happens".

She achieved 69% in the final PRME examination and a promotion mark of 77% with some excellent marks for her projects and portfolio work.

Laura was relaxed during her interviews. Her responses were frank, though at times guarded.

6.4.2 Laura's perceptions of the learning context of PRME 1002 and their possible influence on her approach to learning the subject

Organisation

Although Laura had no expectations of university or PRME 1002, she said that the latter was different from her other courses, because it was "more of an interface subject", people cared whether or not students were at lectures and students were required to work regularly and to submit their work for checking.

According to Laura, the explanations given in the Course Manual were "very good" and had helped her a lot to prepare for the mid-year examination.

When asked what she thought the course presenter had been trying to achieve in PRME 1002 in 2003, she said:

> "He's trying to get us to think in the right way, in a specific way – the way of an engineer."

Content

Laura's level of interest in the content of PRME 1002 was particularly high at the time of her interviews – she saw this as a huge motivating factor. She said:

> "…. If you're interested in the work, you want to know what is going on, you want to know how it (mass balances) works; basically you get into it."

This was the first indication that Laura gave of her approach to learning – with a deeper approach, she would be able to "get into it".

Teaching

Of the teaching in PRME Laura said:

> "… when Sir is trying to explain something, he also sometimes gets himself mixed up, so that does kind of get you to try and understand it in your own way."

She adopted a similar attitude when the lectures were boring and she "switched off". She turned these incidents into positive learning experiences – she knew that the onus was on her to ensure that the classwork was understood and properly integrated with her existing knowledge.

Laura added that computer-aided lectures caused students to be lazy, as they did not need to structure their notes to aid their understanding of the work – the material was structured for them by the lecturer.

These perceptions of the teaching in PRME influenced Laura to adopt a deep approach to her learning in the subject.

Assessment

Laura explained that at the beginning of PRME 1002 it had been possible to study their worked examples to find similarities in the "twists" in the questions. To learn PRME then meant remembering how to approach each kind of "twist" with the aim of "matching" test questions to the questions experienced in class. She soon realised that

> "….if you don't find any match to what you have done before, you have to understand what you are doing else you are not going to get it right at all."

Laura said that the students had been given no idea of what to expect in the June examination – "we did not know what the examiner wanted" and past papers were not relevant to the changing content of the course. She considered the examination questions to be much harder than anything she had seen before, but because of her understanding of the basic concepts, she achieved 67%, which she considered to be "impressive". She knew then for sure that to understand PRME was going to be crucial.

Laura said that the only way to cope with spot tests was to make sure that "you know what you're doing" at the end of every day. Sometimes the course

presenter handed out notes for the students to study for thirty minutes, after which they had to write a test on the work covered in those notes. Laura said:

> "You've just got to try and understand – it motives you, pushes you to study and understand as quickly as possible."

She added that if she had been allowed to take the notes home to prepare for the test the next day, she did not believe that she would achieve better results.

Laura explained that for some homework assignments which had to be submitted the next day, but only for checking, she did what she could, saw whether she could get the right answers and handed them in. However, in the case of homework in preparation for tutorials, she made sure that she was able to answer all the questions properly, so that she could achieve good results in the prep tests written prior to the tutorials. In other words, knowing the way the work was going to be assessed, influenced Laura's approach to that work.

Time extensions in tests were normally welcomed by Laura, who considered herself to be "a slow worker". She said "I always struggle to finish on time". For projects, Laura budgeted her time so that her work was always ready for submission by the due date. Given extra time, she did no further work of any kind on that project.

Laura recalled just one occasion when the feedback from the marker of her work had been constructive – she was told to write down the problem statement before starting her calculations. She tried to ensure that her work was correct by the time she submitted it, so that feedback was usually just ticks and a grade. She mentioned that project A had not yet been marked or returned to the students.

6.4.3 Laura's perceptions of aspects of constructivism in PRME 1002

Active construction of knowledge

In the previous sections it was noted that to Laura it was most important to understand the work in PRME. Answering test questions successfully for Laura needed more active processing of the information than simply matching the test questions to previous examples. To Laura, active reading was necessary for success in learning tests. For Laura's notes to be useful to her the material needed to be structured in a way which was meaningful to her, again implying the active processing of the material.

Laura said that the work in PRME at the time of her interviews involved:

> "just pure logic, hard thinking and understanding. You don't need much theory or things like that; you'll get your problem and you just have to concentrate on it and think clearly."

Social mediation

Laura said that she had not benefitted much from her tutor. Her perception was that he knew the work, but that he could not or would not explain properly.

Her group members preferred helping each other when they experienced difficulties; they did not give each other the answers, but tried to explain the work to each other. This was particularly beneficial when the work was new to them. Once again, Laura and her group tried to make sense of the work themselves.

Metacognition

Laura said that she found metacognitive questions difficult to answer. She said she could not concentrate on two things at the same time – if her focus was on solving a problem, she could not worry about the cognitive steps she was following, let alone interrupt her thinking to describe them. She said that

monitoring her cognitive processes was not beneficial to her – “to me it doesn’t make too much difference – to some people it could, but me, not really”.

Laura’s self-knowledge was increasing as she realised that she was not as lazy, slow or apathetic as she had considered herself to be in matric. She was still finding out how capable she was in PRME. She seemed surprised when she related how her solutions to problems often seemed to her to be more clear and concise than those of the lecturer.

Motivation

As mentioned earlier, Laura was motivated to find out more about PRME because of her interest in the content of the subject. She also found the experience of preparing for learning tests as motivating in that she tried to understand as much as possible in the short period of time allocated to this.

6.4.4 Conclusion

Laura gave a number of indications that she was trying to adopt a deep approach to learning PRME. She had not been accustomed to doing this at school, but seemed to want to actively process the new information in a way which allowed her to apply her knowledge in many diverse situations.

6.5 Nirisha

6.5.1 Introduction

Nirisha attributed her success in the matriculation examinations to two main factors – she had time to prepare thoroughly for the examinations and this preparation consisted of working through as many past papers or suggested model papers as she could lay her hands on. Contributing to her success was the importance she had always placed on understanding the work. She claimed

that to understand the work at school was not always easy as the teachers tended to

> "just give you what you need to know, they don't explain, they don't fill in the titbits that help you to understand."

At university she found the lecturer's "gave" her more understanding and in turn they set harder questions because they expected their students to think at a higher level.

Nirisha scored 36 points on the university's admission scale and was accepted to study chemical engineering. She realised that her response to PRME 1002 was going to play a crucial role in helping her to decide whether or not to stay in chemical engineering because it was the only course in the first-year curriculum which was unique to chemical engineering.

6.5.2 Nirisha's perceptions of the learning context of PRME 1002 and their possible influence on her approach to learning the subject

Organisation

Nirisha perceived the course presenter's aims of the course as being to "instil" in his students the value of understanding the material and to teach them how to think at the level of an engineer.

She considered the Course Manual to be a particularly useful document.

Content

Nirisha had found some aspects of the first part of PRME 1002 on strategies for academic success beneficial. From the outset she had liked the engineering content of PRME 1002 as it had held her interest. This was really important to Nirisha as it meant that she wanted to devote more time to the subject, so that

even if she got stuck with the calculations, she would see this as a challenge and would persevere until the problems were solved.

She said:

> "It's hard to balance that with other courses, you need a lot of time, especially if you want to understand ….. if you can't put enough time into what you're doing, you don't get that understanding."

She continued:

> "…..ever since the second term, I have definitely been struggling to cope with the volume (of work in PRME)…. Sometimes I really feel that I didn't attempt it well enough……"

It would seem that while Nirisha had every intention of adopting a deep approach to her learning, she found that the volume of work in PRME and in the curriculum overall meant that she had insufficient time to devote to processing the material as she would have liked.

Teaching

The teaching in PRME 1002 was such that Nirisha was often able to grasp the work in class, but felt happiest when she had enough time to consolidate classwork at home.

In comparison to other subjects Nirisha said students were more actively involved in PRME lectures than in most other courses. She felt that this activity in the form of answering the lecturer's questions, either orally or in writing, helped her to gain as much understanding as possible during her contact time with the lecturer.

Assessment

After the first few class tests in PRME 1002, Nirisha knew that an understanding of the work was going to be crucial if she was to achieve good results. Test

questions seemed at the surface to be quite different from the questions worked through in class and tutorials, but with an understanding of the concepts involved, she found that she could cope.

Nirisha appreciated the attempt that was being made in PRME 1002 to assess the students' progress on a continuous basis as this helped her to work regularly on the subject.

Nirisha was an anxious student who tended to be nervous in test situations. This anxiety was exacerbated when she felt that her preparation for the test had been inadequate. Her anxiety became so all-embracing that she sometimes failed to read the questions properly.

She described how she had "struggled" to solve a tutorial problem at home. She had reached a point where she said:

> "I was scared, what do I do? You're expected to do the tut but if you don't understand what you're supposed to do, obviously you do the wrong thing, so … (in the prep test) I didn't read the question, I was too nervous, I was freaking out, I didn't understand, I could just remember my problem."

When a lack of time prevented Nirisha from preparing properly for tests, she said she "had to look for other ways to pass"; for example, in tests, she would try to write down what she thought the marker would want to read.

On the issue of being given additional time in tests, Nirisha said she was usually grateful for any extra time as time management in tests was one of her weaknesses in examination technique. Extra time for projects was also welcome. She said:

> "I'm not a perfectionist, but I like to improve all the time, because I don't think you ever do your best …. If I have the time, I would definitely want to improve on it."

Nirisha was not particularly unsettled or tense about writing learning tests for which students were given about half an hour preparation time. Experience had taught her that these tests questions were not usually too demanding.

Nirisha claimed that she had received very little feedback on the work she had handed in for marking. Her work was usually "just marked"; she recalled only one instance when the marker had explained why he had marked her work in a certain way – she had found this helpful. Nirisha had been looking forward to seeing how she had fared with Study Project A (which had not yet been returned), because she wanted to know how to improve her report writing skills before submitting Study Project B.

6.5.3 Nirisha's perceptions of aspects of constructivism in PRME 1002

Active construction of knowledge

Niriha approached all her learning with the intention of understanding the work. She said that understanding comes from the learner herself, nobody can teach someone else how to understand something. For Nirisha, the time it took her to process the material until she felt that she understood it, often presented a problem. She explained that you could not say:

> "I am going to set aside thirty minutes and after thirty minutes I am going to understand it. Sometimes you can understand something in two minutes, and others like days …. You can't, it's only the problem with time, definitely."

Having no background in process and materials engineering had also strengthened Nirisha's resolve to understand the basic concepts involved in the work.

Nirisha said that students were actively involved in PRME lectures. She said:

> "(the lecturer) goes around the class and ask questions … he makes us write stuff down, to see how we understand …. More of us ask questions as individuals than in any other (subject) … considering there's so many people, it's quite good."

With respect to problem-solving, Nirisha said that she "used most of the things of VICTOR" but not as a conscious step-by-step process. She said:

> "it's all happening at the same time … you develop a strategy, it's built in you … it just comes naturally after a while."

It was also typical for her to vary the starting point of her solution path depending on the way she understood the problem best.

Nirisha was prepared to persevere with a difficult concept until she had clarified it, but this often took her longer than she had anticipated and added to her anxiety.

Social mediation

Nirisha preferred working on her own. She said:

> "I don't like learning with people, but I know when it comes to new stuff, working in groups helps a lot, especially in 'Process' – sometimes you try and grasp things and the other person, even if they don't understand it, they tell you why they don't understand it and then it helps you understand a little bit better."

In her projects Nirisha often achieved lower marks in the group sections than in the individual parts.

Metacognition

In the context of the learning tests, Nirisha said they:

> "help you to know in a certain amount of time how much you can learn by just reading … so it helps you to understand yourself better."

Nirisha was aware that her anxiety and difficulty with budgeting and managing her time were adversely affecting her chances of achieving top results; she said that she would continue to try to manage these factors.

Motivation

Early in her interviews, Nirisha said:

> "I want to do well, I have a bursary and I need to do well … I know what I want, I want to do well."

According to Nirisha, motivation came from interest; "you cannot be motivated if you don't like something". From the beginning, she had been interested in the engineering content of PRME 1002 and had been sufficiently motivated to persevere with challenging questions until she had worked them out.

For Nirisha, motivation was "not the issue" – the issue for her was understanding the work within certain time constraints.

6.5.4 Conclusion

It was apparent that Nirisha's perceptions of having insufficient time to understand her work as she would have liked, was a major concern to her and was to some extent preventing her from adopting a deep approach to all her learning.

6.6 Frankie

6.6.1 Introduction

Frankie matriculated at an independent school, achieving 40 points on the university's admission scale. At school, Frankie experienced a number of job-

shadowing stints in engineering; his interest in chemistry motivated him to choose to study chemical engineering at university.

Frankie considered himself to have a quick mind. He said that he did not respond well to routine, drill-type exercises – "I want to get things done – I do not like to spend too long on one thing". Of one of the latter topics in PRME he said "I grasped it straight away, and I've been bored". Frankie said that he was stimulated and motivated by doing projects in which students were encouraged to pursue their own avenues of interest; his effort knew no bounds and he delighted in his feelings of satisfaction when he considered his work to have been well done.

Frankie was keen to participate in this research project; during the interviews he was relaxed and chatty and his responses were frank.

6.6.2 Frankie's perceptions of the learning context of PRME 1002 and their possible influence on his approach to learning the subject

Organisation

From the outset, Frankie had expected university lecturing to be very different from school teaching. He had also been cautioned by senior students that PRME 1002 was not a "pushover".

Frankie said that he was "enjoying" the way the course had been organised – "portfolio items spread out during the year" and the study projects were "working well" for him. He added that the prep tests were also "working like a dream" for him. The course had "direction and focus" for Frankie. The Manual for him was "very good".

To Frankie, the aim of the course was to teach the students to become engineers and successful people in industry.

Content

Frankie said that his interest in the engineering content of PRME 1002 was the most important factor contributing to his "enjoyment" of the course and his ability to sit down and work on it for long periods of time.

A turning point in Frankie's PRME 1002 course came when he thought he had mastered the section on empirical formulae only to find that the question on this section in the June examination had been the main reason for his mark of 58%. He realised that his understanding of that work had been incomplete and that a deeper approach to his learning of PRME 1002 would be necessary. He finally passed PRME 1002 with 77%.

With reference to the early section on study methods, Frankie said:

> "… here is something new, and here's what I have, so this is basically just a variation of what I have that's more efficient and yields better results, fine – so let's start incorporating it, but let's not throw the old away, 'cos that's your foundation."

Incorporating the new with the old "definitely helped" Frankie to study effectively.

Teaching

Frankie said:

> "It seems to me that I need to do a great deal more to understand what's going on in 'Process' (PRME) than in other subjects."

Although he said that this could probably be attributed to many factors, he felt that the frequent changes in the lecturer's approach to solving a particular problem caused confusion which was exacerbated by what Frankie saw as the lecturer's inconsistent (and sometimes even contradictory) explanations.

Frankie's frustration increased when he asked the lecturer a question to help him to clarify his thinking, and the lecturer's response left him "no more clued up" than he had been before asking. The lecturer seemed to Frankie to have little or no time for what he (the lecturer) perceived as trivial.

Frankie contrasted these occasions with the many times when the lecturer's explanations had been so good that he had "picked it up straight away". He was grateful too that he was sufficiently motivated to go home and spend time trying to achieve a deeper understanding of his work.

Of the lecturer's effort, Frankie said:

> "… he tries very, very hard to make us understand what is going on; sometimes he is overbearing because he's trying so hard to force us to understand the concepts."

Assessment

An issue which Frankie raised with me concerned the lecturer's readiness to allow extensions of time in both tests and in the due dates for the submission of projects. Frankie made an impassioned plea for these extensions to be stopped, saying:

> "I know how much effort I put into meeting a deadline and then he says … another week. I know that some people would not have done it, I know it, and it's not like he doesn't give us sufficient time to do those assignments, there's plenty time …."

After a few unhappy test experiences, Frankie convinced himself that every question in PRME 1002 had "a sneaky twist" and that he should not expect any straight-forward questions. He explained:

> "Often when I look at the question, I think I know what's going on and then I think to myself, but wait this is Process – there is always a sneaky twist here, and then I go looking for that thing, and it takes me nowhere … It

> becomes very, very difficult to approach a problem without overcomplicating it, which I think is a major issue for a lot of people."

Later in the same interview, he said:

> "Fortunately, I've been able to control this urge to find the killer twist …. Now I say 'exactly how you thought of it the first time, do that!"

Frankie made a determined effort to control his nerves before writing unprepared tests. He realised that these tests allowed him to find out exactly how much of the work he understood without special learning and which sections needed more attention.

Frankie's perceptions of the feedback he received on work submitted for assessment have influenced his approach to learning in PRME 1002. He said he preferred it when the marker marked his work as being right or wrong and included some comments which helped him to understand his mistakes. With this information, he would revise his work to rectify the misunderstandings.

He learnt that work that was returned to him with just one large tick or with no evidence of any marking at all, did not necessarily mean that the work was correct.

The fact that students had submitted Project A early in the year, but that it had not yet been returned to them caused Frankie to say:

> "I don't know, I'd love to see Project A, even if it is the end (of the year) so that I know where I've gone wrong. Ja, I'd like to see how all my effort has paid off, if it has …. (long pause)."

For a student like Frankie who was very mark-conscious and unashamedly competitive, this lack of feedback was unacceptable.

6.6.3 Frankie's perceptions of aspects of constructivism in PRME 1002

Active construction of knowledge

At school, Frankie had found it very easy to learn History off by heart and to regurgitate it in tests, using some discretion as to which details to include and which to omit. On occasion, particularly when lacking the necessary motivation, he had chosen to produce what he believed the marker would want to read or hear. Frankie realised that this was risky.

> "…it's dangerous, and you never really do know what they want to know."

For Frankie, it had always been essential to understand the concepts in Mathematics and Physics. In PRME 1002, he had needed to reflect on the meaning of "understanding" in the context of empirical formulae. A deeper or relational understanding of the material would result from more active processing of the material. In the case of PRME 1002, in which students had no background in the engineering content of the subject, Frankie knew that he would need "to dig the foundations first, go down before you can go up".

Frankie tried to search for both meaning and structure in his work in an organised and strategic way.

Social mediation

Frankie was, to a large extent, academically self-sufficient. He preferred working on his own, so that he was not dependent on others – he was very well-organised and planned his use of time effectively. I observed that in a group situation, Frankie tended to dominate and displayed some measure of impatience with the others in the group. When he was stuck, he appreciated the input of his tutor.

Frankie had high praise for his tutor, who was a postgraduate student. She did not give Frankie direct answers to his questions but allowed him to explain his difficulties to her. She suggested possible ways for him to continue when he was stuck, but he had to explain to her his reasons for choosing a particular option.

> "By the end of the problem, I know exactly what is going on, I know how I got the solution, why the solution is what it is, and so I go home and feel like I've accomplished something ….."

Metacognition

Frankie perceived the reflective questions that formed part of the portfolio work as contributing towards his personal development. After considering his own study methods, for example, he had been able to incorporate new ideas with his old tried-and-tested methods to form a more effective and flexible set of study options which, in turn, helped him to learn more productively.

He also commented on how useful he had found the experiences of reflecting on how he had prepared for a test, what he thought he had done correctly and where he thought he had erred. He said that this "definitely gets you thinking".

Motivation

Frankie described himself as being goal-orientated and self-motivated. He was of the opinion that if he was to succeed in South Africa as a White male, he would need to achieve results which were at least 20% better than his competitors.

He also described how he shuddered at the thought of disappointing his parents by producing second-rate results.

He added:

> "For me at the moment, I don't like that – doing it for anyone other than myself – it's for my mom and dad, but it's definitely for me at the moment, because of all the things going around in my head ….."

Frankie said that his interest in the content of PRME 1002 lay behind his determination to master the work. He enjoyed the feeling of accomplishment which followed a work session during which he had battled and succeeded.

6.6.4 Conclusion

Frankie's approach to learning could be classified as a deep-achieving approach (Biggs, 1986). He was motivated by extrinsic and intrinsic interest and high marks so that he approached his work through an organised and strategic search for meaning.

6.7 Thabo

6.7.1 Introduction

Thabo attributed his success at school to his physics teacher and a group of friends. Their teacher had realised that, as a group, they were "capable of something"; he had encouraged them to apply to the university and had shown them "some good stuff about being there (at university)". He had stressed that students did not have to be rich to go to university. Thabo and his friends had been motivated to do their best so as not to disappoint this teacher – they also enjoyed achieving good results.

Thabo related how he would go home after school and do his work on his own and then return to school in the late afternoon, where his group met in a classroom to discuss the same work. Learners were of mixed ability and no teachers had been involved. The group discussions of past examination

questions “really, really helped” Thabo to achieve 36 points on the university’s admission scale.

Thabo formed a similar study group in residence at university. Prior to the June examination in PRME, they tried many questions from many sources and got correct answers, so according to Thabo, their confidence grew. Thabo achieved 86% in this examination and 71% in his final PRME examination. He was very motivated to succeed at university.

6.7.2 Thabo’s perceptions of the learning context of PRME 1002 and their possible influence on his approach to learning

Organisation

Thabo recalled that when he arrived at university he was cautioned by senior students that PRME 1002 was a very demanding course.

A number of times during his interviews, he mentioned that he considered himself to be slow to understand the work in PRME 1002. he found the Course Manual a very useful substitute for a textbook. To compensate for his perceived slowness, he tried to answer the tutorial questions in the Manual ahead of time. The fact that he did not always know which topic and questions were coming next, prevented him from doing this. This meant that he did not derive full benefit when the lecturer modelled the solutions to tutorial questions on the board – it took him all his time to follow what was being written on the board and to copy the work down; he had no chance to consolidate his knowledge to see what, if anything, he did not understand. He contrasted this with his preparation for Friday tutorials, which was very thorough; he arrived at the tutorial knowing exactly which questions to ask his tutor or his group members.

According to Thabo, the course presenter had aimed and tried very hard to “make us understand just the basics – understand our thinking and also try to

change our way of thinking if possible". He said his thinking had changed and that he could "see a difference in other courses as well".

Content

At first, Thabo had not particularly liked PRME. He explained:

> "… if the crowd is going this way, something must be right in that direction, so you move with the crowd … this guy is saying this about the subject and this guy is passing, let me try and apply it and then you find that it works … if you don't try to like it, you won't like it and you end up in a very bad situation … I ended up being attracted to it".

To Thabo, it is not possible to be interested in something if you don't like it.

Thabo was quite satisfied with the volume of work in PRME.

Teaching

Thabo said that the pace of the teaching in PRME 1002 was slow and the quality of the explanations given was good. He had found the lecturer's use of the computer and Powerpoint most beneficial as it had helped him to understand the movement of the liquids.

Assessment

Thabo did not enjoy writing unprepared tests, but was advised by a fellow student to use these tests as a guide as to whether or not he was keeping up with the work.

With regard to the learning tests, Thabo said that his perceived slowness to grasp new material prevented him from achieving good results in these tests. He could not learn effectively under time pressure.

Time extensions in tests were not appreciated by Thabo. He said that his mind simply could not focus for longer than the time allocated for the test. He had tried to use this extra time to check his work, but he had found this to be a waste, as

he had not even recognised the mistakes in his work. Extending the due date of an assignment gave Thabo the chance to go over his work and make the necessary changes to improve the final product.

Thabo regularly questioned his tutor about the written feedback he had given Thabo when he had marked his work. He said that some feedback, especially that on portfolio items, was particularly helpful. He said he was "not impressed" at not getting any feedback at all on study Project A.

6.7.3 Thabo's perceptions of aspects of constructivism in PRME 1002

Active construction of information

This was Thabo's response to a question concerning the importance to him of understanding the work in PRME 1002.

> "You must always be in the class, understanding the material yourself, try to understand, you can ask the other guys what is going on here … usually it is not easy to understand it, but you can understand it, but I know at the end I must try on my own to understand it … No-one teaches you how to understand, it's in you ……"

To emphasise the active nature of this construction of knowledge, Thabo said:

> "…actually you try and dig up for more, dig up for more, why are we doing this and where is this going to apply, to try to dig more down than what the stuff is actually saying … so if you try and dig for more, you actually …. succeed."

Social mediation

Thabo was very group-orientated. He was an active member of a study group based in his residence and he readily helped and received academic support from his PRME group of three members.

Other PRME students had encouraged him to try to like PRME at the beginning when he had not enjoyed the lectures. He was constantly urged to achieve top results by the students with whom he regularly associated.

Thabo agreed that the students in PRME 1002 relied quite heavily on each other for academic support. He added that many students copied other students' work so that they would not be seen to be failing.

He said that while most students were willing to help each other, the exceptions were the top students who were reluctant to help those they perceived as their competitors in the race for top marks.

Thabo's tutor had made a huge impression on him. He said his tutor was "a good guy" who patiently helped him to understand the work, step by step. Significantly, this tutor was Thabo's role model. He said:

> "This guy is doing his PhD, so one day I'd like to be like him".

Thabo derived great benefit from the social process of negotiating meaning with others in the PRME community.

To Thabo, it was more important to "compete with yourself" than to compete with others, and collaboration with others helped one to achieve to the best of one's ability.

Metacognition

For Thabo, answering questions which required reflection on his own thinking processes was very difficult. He explained:

> "… because many thoughts go through the mind, start from here, start from here, from here you can go there, from here you can go there, do this, do this, so I ….. to me, it's just not helpful at all."

Motivation

Thabo responded to those who warned him that PRME 1002 was a very demanding course by saying:

> "If they say it is bad, go and have a taste yourself, give it all you have to do that particular task, not just say PRME is difficult, without even taking chances … if you take a chance, it gives you power, focus, which is everything."

Later, he added:

> "… people say it's difficult, but some other guys are getting A's, one is getting B. What can stop me from getting an A? If one person does PRME and he kicks it, you just have to push yourself beyond the limits you put."

He went on to say that if a student sets for himself a high target mark, he might not be able to achieve that goal, but he would be likely to achieve a mark significantly better than the usual goal for first-year students, namely the pass mark of 50%. Throughout his interviews, Thabo frequently mentioned how important it was for him to have academic goals. His positive attitude and high level of motivation set him apart from many other PRME 1002 students.

Thabo was mainly intrinsically motivated – he had an inner desire to discover just how well he could do. However, he perceived his slowness to grasp some new concepts as being problematic as he did not always feel in control of the learning context. He derived much pleasure from a job well done.

6.7.4 Conclusion

As Thabo did not always feel in control of the learning context of PRME 1002, he did not appear to be as confident as Frankie had been, but his approach to learning could also be classified as deep-achieving.

6.8 Tumiso

6.8.1 Introduction

Tumiso matriculated in Limpopo Province at a school where she "studied very hard" to achieve 33 points on the university's admission scale. It had been important for Tumiso to be able to "follow everything" so that she could claim to "understand" the work. She had made a point of consulting her teachers whenever she had experienced any difficulties with the work – they had willingly and successfully helped her to solve her problems.

Tumiso's home language was Venda and she had passed English Second Language in the matriculation examination. She said:

> "I don't know if it (English Second Language) has an effect, but sometimes I really fail to understand the question, I fail to understand the language that is being used, I find it very difficult … so it makes everything worse."

During her interviews, there were times when I needed to explain my questions to Tumiso and sometimes she had difficulty expressing herself.

Tumiso tried to assure me that, at the time of her interviews, her marks were not a true reflection of her ability. She said "I know myself – I've got the potential".

Tumiso achieved less than 20% in her mid-year PRME 1002 examination. There was no question in her mind that change of some kind was necessary, but she said:

> "I don't know what to do next, what is it that is really needed from me. I don't know what I am supposed to do, I tried everything … you don't know exactly what to change."

Tumiso achieved a distinction for PRME 1002 in the November examination. The limited scope of this study has precluded further investigation of her success in PRME 1002 – her experiences could have provided a valuable model for other first-year engineering students.

6.8.2 Tumiso's perceptions of the learning context of PRME 1002 and their possible influence on her approach to learning

Organisation

From the outset, Tumiso expected PRME 1002 to be hard as she had been told how people "struggled" with it. At the beginning she had experienced difficulty with the frequent change of topic. This did not allow her to form an overall picture of what PRME 1002 was about.

Tumiso said that she did use the Course Manual but that she found it "confusing" and usually "got stuck".

Tumiso's perception of the course presenter's aims in PRME was that he was trying various ways of improving the course for future students. She said that first-year students needed to know the basics of PRME 1002, so it was right for the course to serve as a filter in the chemical engineering programme.

Content

Tumiso had been receptive to the early section on strategies for academic success. She felt sure that if she could help herself with time management, for example, she would be able to improve her academic record and do more than just pass.

She was quite adamant that she liked PRME 1002 and was interested in the content and that this made her worry even more when she found it so difficult to make progress in the subject.

The fact that there were relatively few topics to be covered in PRME 1002 indicated to Tumiso that depth of study was required. She explained that many concepts were included in any single problem and that this made PRME 1002 both difficult and time-consuming.

Teaching

Tumiso said that in tests she seemed to:

> "see something different, different from the examples I learnt … it's not that I don't understand – I fail to arrange things in a different way than I learnt (sic)."

She added that the students were not taught how to do this. She said:

> "We need that thing to make us understand – it's not like people don't have the potential, or whatever, they are not being given the background to support them to know what's going on."

On further questioning, Tumiso said that she experienced the same problem in other courses too.

> "It seems like we are rushing … It doesn't matter whether you have understood or not, it's just putting things on top of the other (sic) …."

Assessment

Tumiso's perception was that in PRME "deep thinking" would be required to answer at least some of the questions in every test, prepared or unprepared. An exception could be made in learning tests.

She did not find the feedback from her markers particularly helpful.

> "They will keep on saying 'you need understanding, get deeper into it' … It's something I know I need … but they are not telling me how."

Tumiso was disappointed that study project A had not yet been returned to them. She felt that she had learnt very little from doing this project and that it was quite likely that she would repeat the same mistakes in study project B.

Tumiso found it very helpful to be given extra time in tests. With these concessions, she could relax and answer the questions properly. A lack of time could not be blamed for poor results. She did not welcome extra time for projects – this was "boring".

6.8.3 Tumiso's perceptions of aspects of constructivism in PRME 1002

6 Active construction of knowledge

> "I make sure that I understand whatever's going on, because without understanding you can't do anything. You cannot just go out there and cram – it doesn't work."

From the outset, it was clear that Tumiso's intention in learning was to understand the work. To her this meant being able to follow the work. She described her efforts to understand in PRME.

> "Let's say at the beginning of a new topic, I will follow and follow and follow and then as time goes on I lose … I fail to understand – somehow, something, I don't really know what happens – I don't know …"

Tumiso realised that her conception of "understanding" as being able to follow from one step to the next in a worked solution was insufficient and that to answer test questions properly, a deeper understanding was necessary. She had reflected on her difficulties and in the problem-solving context she thought that her inability to rearrange the given information to increase the flexibility of her thinking was to blame. She knew that new information needed to be integrated with existing knowledge, but she was waiting for someone to help her to do this.

At the time of Tumiso's interviews, it was clear that she was extremely concerned about her lack of progress in PRME; she was disheartened, frustrated and desperate to change her approach to learning, if only she had known exactly what to do. In the meantime, she continued to associate her predicament with outside factors – poor feedback on her work, the fast pace of the lectures, the lack of background in engineering matters, and so on.

Tumiso found the VICTOR problem-solving approach useful in that it helped her to know where to start on the solution path – visualising the problem usually helped her to get started.

Social mediation

The assistance Tumiso was given when she asked the academic staff for it, was perceived by her to be insufficient. In PRME in particular, she found that the students in her group helped her more that her tutor, because they were at her level and could explain the work to her in a way that was easy for her to understand.

She said that she could not read the Course Manual on her own as she would usually get stuck with it and would need a "friend" to explain the work to her. Tumiso's perception was that most students relied on each other for academic support.

Metacognition

At the time of her interviews, Tumiso was clearly concerned and "worried" about her lack of progress in PRME 1002. She had given her problems much thought, but had not developed any plan of action for rectifying the problem. She felt that her situation was beyond her control at times.

She readily answered the prescribed reflective questions asked of all the students. She said that in trying to answer these questions honestly, she was

finding out more about herself. She was trying to ask herself reflective questions and in the problem-solving context, she thought that her difficulty lay in her inability to rearrange the given information to increase the flexibility of her thinking.

Of one thing Tumiso was certain. “I know myself – I’ve got the potential.”

Motivation

Tumiso was motivated to succeed in PRME 1002, and by this she meant to achieve more than just pass the course. She remained determined to remedy the situation, if only she had known how.

6.8.4 Conclusion

It would seem that, at the time of her interviews, Tumiso’s approach to learning in PRME 1002 was in a transitional phase; she knew that her approach to learning was not helping her to achieve the results of which she felt she was capable, and was then trying to make some changes.

CHAPTER SEVEN

7 7. RESEARCH FINDINGS

7.1 Introduction

In the radical constructivist terms of Von Glasersfeld (1991), the experiential world of the students is not a given, but is constructed by them, as thinking subjects, from elements of the manifold or raw material on which their constructive perceptions and reason operate.

In this research, the students were required to reflect on and describe their perceptions of certain aspects of their learning experiences in PRME 1002.

According to Candy (1991), the constructivist view of learning has two foci, namely how learners interpret their ideas and events and how they build their structures of meaning. The relationship between these two foci is dialectical – learning is an active process of constructing meanings which can be used to interpret situations and the interpretation in turn feeds back on the meanings.

The underlying rationale of phenomenographic research in general is that people act on their interpretations of the situations in which they find themselves (Säljö, 1988).

The phenomenographer's object of inquiry is within a second-order perspective as (s)he seeks to describe the variation in the way learners experience phenomena/situations in their educational context, as the learners themselves experience them (Martin and Booth, 1997).

Phenomenographers then try to describe the totality of these ways as a set of a limited number of groups which may or may not be hierarchically ordered.

Two points need to be made which are pertinent to this research:

(1) In recording the various ways in which the students have experienced phenomena/situations in the learning context of PRME 1002 as they themselves experienced and described them to the researcher, the researcher is required to formulate interpretations based on her perceptions of the students' language and actions as well as on her own theoretical constructs.

(2) As the interviews progressed, it became clear that when two students were present at the same time in the lecture room and were subjected to the same phenomena, their perceptions and interpretations of these perceptions, as well as the meaning they ascribed to these situations varied. Each student's experiences and descriptions of them were partial or incomplete.

Students' responses to their perceptions differed, depending to some extent on their individual differences in levels of motivation and the effort they were prepared to make as they reflected on their experiences. While students responded as individuals in their interviews, the influence of the social nature of the student interaction in their learning environment cannot be ignored.

This chapter has been organised in order to answer the first two research questions. In Section 7.2, the students' perceptions of certain aspects of the learning environment of PRME 1002 are discussed under the following sub-headings:

7.2.1 Course Organisation
7.2.2 Course Content
7.2.3 Teaching
7.2.4 Assessment

Section 7.3 consists of a phenomenographic report on the three categories of possible influences of students' perceptions of the learning context of PRME 1002 on their approach to learning.

7.3.1 Perceptions which discourage a deep approach to learning.

7.3.2 Perceptions which have complex and diverse influences on students' approaches to learning.

7.3.3 Perceptions which encourage a deep approach to learning.

The students' perceptions concerning aspects of the constructivist learning environment of PRME 1002 are discussed in Section 7.4.

7.4.1 Students' thoughts about metacognition.

7.4.2 Active construction of knowledge.

7.4.3 Social mediation.

7.4.4 Motivation.

The implications of these findings for the future development of PRME 1002 will be discussed in Chapter Eight.

7.2 The students' perceptions concerning aspects of the learning context of PRME 1002

7.2.1 Course Organisation

The students, with the exception of Tumiso and Julie, perceived the course presenter's aim in offering PRME 1002 as helping them to "think like engineers." To Lesedi, this meant finding the easiest way of solving problems; Thabo thought that this could mean a change in their way of thinking, while Nirisha felt that in 'Process' the students' need to understand the work was emphasised.

Tumiso and Julie perceived an objective of the course as finding ways of improving the course for future students. Julie did not enjoy being one of the “guinea-pigs” in a string of “experiments” during which, as an individual, she felt neglected and consequently demotivated.

The students who commented on the course outline perceived it to be incomplete and lacking detail. To them, the outline included in their Course Manual was of little use in guiding them to prepare in advance for their lectures. Every lecture, to Lesedi, was a “surprise”; Thabo would have liked the opportunity to try to solve the next set of problems before the lecture and to Julie this lack of advance preparation in ‘Process' precluded any possibility of adopting a deep approach to learning. Tumiso thought that the frequent change in topic in PRME prevented her from forming an overall picture of what the course was about.

The students’ perceptions varied on the usefulness of the explanations of the work presented in the Course Manual. Laura, Nirisha and Frankie agreed that these explanations were very good. Tumiso found them “confusing”, while Julie said she “hardly ever” looked at the Manual. Lesedi said that he had not yet looked at the explanations in the Manual.

Frankie said that he was “enjoying” the way the portfolio items and study projects were spread out during the year; this organisation was giving him “some sort of direction and focus”.

7.2.2 Course Content

The students concurred that their interest in the content of PRME 1002 was an important factor in motivating them to achieve good results in the course. They perceived themselves as persevering more to understand interesting work and spending more time trying to master its challenges than they would do with other

less interesting work. Laura perceived her interest in mass balances as motivating her to find out “how they work”.

Julie and Lesedi saw no purpose or relevance in including the section on “Strategies for academic success” at the beginning of the year. Lesedi commented that this was a “waste of time’”. Thabo said he had not liked PRME at first. On the other hand, Nirisha, Tumiso and Frankie found aspects of this section beneficial. Frankie’s repertoire of study skills increased and Tumiso found the section on time management particularly helpful.

Perceptions also varied with regard to the volume of work in PRME. Lesedi saw the topics as being largely unconnected – to him every lecture seemed to cover “new” work and the overall workload was deemed to be heavy.

Nirisha had difficulty finding enough time at home to consolidate her work in PRME – at times this prevented her from “understanding” the work as she would have liked. On the other hand, Thabo found the volume of work “just right”.

7.2.3 Teaching

Five of the students interviewed perceived the lecturer’s explanations in PRME to be confusing, but this perception influenced their approach to learning PRME in different ways.

Frankie described the explanations given in class as “inconsistent” and sometimes even “contradictory”. Laura commented that the lecturer sometimes “got himself mixed up” and that she “switched off” at times. Nirisha said she was often able to grasp the work in class, but that she needed time at home to consolidate her classwork. Both Laura and Frankie had to make a determined effort at home to try to understand the work in their “own way”. This meant that these three students perceived that if they were to succeed in “Process” they

would need to play a more active role in constructing their own knowledge. They tried to adopt a deep approach to their learning in PRME.

Julie said that she did not understand what was “going on most of the time” in class and that her notes consisted largely of incomplete solutions to problems. She ignored the lecturer’s suggestions to the class that they should finish off, on their own, the solutions he had started on the board and that they should check the correctness of his solutions. Julie made no attempt to sort out her difficulties in stoichiometry.

Lesedi mentioned that he was reluctant to ask the lecturer to explain the work again, as his second attempt might be more confusing than the first had been. Frankie agreed that he had been no better off when he had asked questions. Like Julie, Lesedi made little or no attempt to understand the work on his own.

Tumiso said that she was not being taught how to reorganise the given information in a problem so that test questions seemed to her to be different to classwork. She added that they were not being “given the background” to support them to understand the work. The word “given” shows her passive response to her difficulty at the time of her interviews.

Opinions concerning the pace of the teaching varied. Thabo and Lesedi deemed the pace to be “right” whilst Tumiso felt that all of her lectures, including ‘Process’, seemed to be of a “rushed” nature.

Thabo, Lesedi and Julie commented that the lecturer’s use of the computer and Powerpoint in some of his lectures had helped them to visualise the movement involved in processes like distillation. Copying from the computer screen did not help Laura to actively process the material herself.

7.2.4 Assessment

The students agreed that no two problems or questions in PRME were ever the same. This meant that those who did not understand the material had very little chance of passing the course. Laura realised early in the year that it was not going to be possible to “match” test questions to classwork questions by looking for similarities in the “twists” in the questions. Her understanding would need to go deeper than this.

Frankie explained how he had to learn to control his urge to find the “killer twist” which he had expected to find in every question in “Process”. He realised that he was just over-complicating the questions which were already difficult.

Like Laura and Frankie, Nirisha and Thabo tried to adopt a deep approach to their learning in PRME. However, there were times when Nirisha became so anxious in test situations that she was not capable of reading the questions properly. Nirisha and Thabo experienced difficulty in writing tests under the pressure of time constraints. Anxiety and time pressure mitigated against these students achieving their academic goals.

For Lesedi, Julie and Tumiso, whose approach to learning was more of a surface nature, the test experiences were different. Lesedi had realised that, if he was to pass, he could not just write without thinking, or rely on his own way of solving problems – his next alternative had been to try to reproduce what he thought the lecturer would want to read. Julie found the wording of the questions ambiguous and Tumiso did not always understand the English used in the questions.

Unprepared and learning tests were not popular with the students, but Frankie, Thabo, Nirisha and Laura saw these tests as opportunities to find out exactly how much they knew about the work and on which sections they would need to

concentrate their learning efforts. Continuous assessment in “Process” helped Nirisha to work continuously and regularly.

The students’ perceptions of the feedback they received on the work they submitted for assessment varied. Frankie explained that he benefitted most from a comment which could guide his further learning of that work. In PRME, he seldom received any comments. He had learnt that one large tick or no markings at all did not mean that his work was necessarily correct. He wondered what it did mean. Thabo found it useful to discuss the marking of his work with his tutor and not to depend on written feedback only.

Lesedi, Tumiso and Julie did not find the comments they received as feedback to be constructive. Julie added that the grading system of A+ to D- was meaningless to her. Laura and Nirisha could recall just one occasion each when the feedback they had received had been helpful.

Laura mentioned that she allowed the way in which her work was going to be assessed to influence her approach to that work. For example, she would do what she could, if the work was just going to be checked and not properly marked. She ensured that work done in preparation for tests or work that was to be intensively marked was properly done.

All the students were disappointed that Study Project A had not yet been returned to them. There had been no chance for them to learn from their mistakes before having to submit Study Project B.

The students were very divided in their perceptions of the lecturer’s tendency to give them extra time in tests and to extend the deadlines for the submission of projects.

7.3 The possible influence of students' perceptions of the learning context of PRME 1002 on their approach to learning

From an analysis of the students' perceptions as previously described, three different categories of perceptions were identified. In category one, perceptions which discourage a deep approach to learning, are discussed. The perceptions included in category two have complex and diverse influences on students' approaches to learning, depending on a number of individual differences in the students. In category three, perceptions which encourage a deep approach to learning are described.

7.3.1 Category One: Perceptions which discourage a deep approach to learning.

The course outline included in the Course Manual was perceived to be incomplete and lacking in detail. This implied that the students could not prepare in advance for the lectures – this had a detrimental effect on their approach to learning from the start.

> "You never know what you are going to do…all those things that just come in all of a sudden, so you can't really expect anything and you can't prepare in advance either because you don't know what you're expecting".

> "Everything is a surprise…you just get there and you pray that it is something that you'll understand".

Prepared tests were perceived by the students to be opportunities for the course presenter to ask questions with "twists", and they spent more time and energy, both before and during the tests worrying about these "twists". This detracted from deep learning.

> "Often when I look at the question, I think I know what's going on and then I think to myself, but wait this is "Process" – there is always a sneaky twist here, and then I go looking for that thing, and it takes me nowhere…it

> becomes very difficult to approach a problem without overcomplicating it, which I think is a major issue for a lot of people".

The feedback on written work submitted for assessment was perceived by these students to be meaningless and vague; comments were not constructive and provided little, if any, guidance for the students as they tried to learn from their mistakes.

Without feedback or model solutions

> "you never know if you're correct or totally incorrect"

> "They (the markers) will keep saying 'you need understanding, get deeper into it'…It's something I know I need…but they are not telling me how."

Study Project A was not returned to the students at all.

> "I'd love to see Project A, even if it is the end (of the year), so that I know where I've gone wrong".

Some students who were committed to trying to adopt a deep approach to their learning found that they had insufficient time to spend on PRME 1002. The heavy workload of all the courses together and the quick pace of the lectures were perceived as encouraging a more surface approach to learning.

> "You need a lot of time, especially if you want to understand…if you can't put enough time into what you're doing, you don't get that understanding".

> "Ever since the second term. I have definitely been struggling to cope with the volume (of work in PRME)…sometimes I really feel that I don't attempt it well enough".

> "It seems like we are rushing – it doesn't matter whether you have understood or not, it's just putting things on the top of the other".

The students who felt neglected and insignificant as individuals indicated reluctance to adopt a deep approach to learning.

> "It seems to me like we've been the guinea-pigs of future 'Process' students; we've been trying all these different things to see how future (PRME) students can succeed or whatever. We have to be just put there for his (the course presenter's) experiments and stuff, but it doesn't matter what happens to us".

7.3.2 Category Two: Perceptions which have complex and diverse influences on students' approaches to learning.

The course presenter's explanations of the work and solutions to the problems were perceived by the students to be confusing, inconsistent and contradictory.

For some students, this meant that their notes and solutions were incomplete or incorrect, as they either did not know how to make sense of the work themselves or they did not have the motivation to make the extra effort which deep learning required.

> "We never seem to get to the point where everything comes together, like when we're doing problems, we never get to a point where the problem is solved. It's always OK, we'll get back to that one, let's go to this one now – it's always like 'finishing off on your own' type of thing and we never get to a solution that's set. If there is a solution, it's always 'I might be wrong – check me on it' and I never check, I try to but…".

> "We look at it (a classwork problem) and we try it, but we're not exactly going to spend the whole time saying OK let's really try and figure this out – we just wait for the lecturer to tell us what's going to happen anyway".

For other students, this lack of clear explanations and correct model solutions meant that they had to put in much more time and effort, usually after lectures, trying to understand the work properly and to construct their knowledge on their own.

> "When sir is trying to explain something, he also sometimes gets himself mixed up, so that does kind of get you to try and understand it in your way".

> "It seems to me that I need to do a great deal more to understand what's going on in 'Process' than in other subjects".
>
> "No-one teaches you how to understand – it's in you".

7.3.3 Category Three: Perceptions which encourage a deep approach to learning.

An interest in the content of the course was perceived by the students as an important factor motivating them to understand the work and to achieve good results in the course.

> "If you're interested in the work, you want to know what is going on, you want to know how it (mass balances) works; basically you get into it".
>
> "(I am interested) because it's a challenge – you know sometimes you feel excited when you get a challenge".

No two problems in PRME 1002 were perceived by the students to be the same. This meant that they had to understand the concepts involved in the work if they were to enjoy any success at all. Some students found that they had to reflect on what "understanding" meant and that they needed to try to adopt a deeper approach to their learning.

> "If you don't find any match to what you have done before, you have to understand what you are doing, else you are not going to get it right at all".
>
> "You can't just think of a problem and if you can do one problem, you can do them all".

For most of the students, the course presenter's use of the computer and Powerpoint helped them to process and retain the information.

> "The movement of the molecules – you can review it, just picture it…when you try to read the notes, you can…oh, and the molecules moved there

and the arrow comes up there, so you can picture the image afterwards – they were cool (sic)".

7.4 Students' perceptions concerning aspects of the constructivist learning environment of PRME 1002.

7.4.1 Students' thoughts about metacognition

Thomas and McRobbie (2001) make reference to the work of Sternberg (1998) who was of the opinion that when students have become accustomed to and have been rewarded over the years for passive and somewhat mindless learning, they will not be likely to jump at the chance to take a more thoughtful approach to what they are doing. Garner (1990), also quoted in Thomas and McRobbie (2001) maintained that unless students can be convinced of the fruitfulness of changing, they will not be sufficiently motivated to expend the time and effort necessary to engage in deliberate, reflective self-dialogue. This means asking themselves questions about their learning processes and monitoring and evaluating the efficiency of their cognitive performance.

Julie presented no evidence of any metacognitive activity. She commented that her study methods had been good enough for her to achieve good matric results and that any changes she would consider making at that stage of her student life would be just minor adjustments. Her lack of motivation to succeed in PRME mitigated against her making any significant changes to what had now become habit.

Lesedi said that he was not used to thinking about his thinking. He could see no reason for involving himself in metacognitive activity; he would just write and if his answers to problems were correct, that was all that mattered to him. Towards the end of his third interview, he commented that possibly it would help if he was able to explain his reasons for writing certain things in problems solutions – he had noticed that this seemed to be helping others.

In the context of problem-solving, metacognition involves an awareness of one's own cognitive processes and the regulation of these processes in order to achieve the goal of solving the problem correctly. In regulating these processes, the students are required to plan their overall course of action, select their specific strategies, monitor their progress in solving the problem, assess the results of their work and revise their plans and strategies, if necessary (Goos, Galbraith and Renshaw, 2002).

When solving a problem, Lesedi said that he did not usually use a diagram, but when he saw that he was not making much progress, he would draw a diagram. Another alternative for him was to "try a new path in order to form the equation". These give some indication of Lesedi's regulation of his cognitive processes.

Thabo and Laura found thinking about their cognitive processes very difficult. For Thabo, there seemed to be too many connections in his thinking for him to keep track of their patterns. However, he did engage in a self-dialogue when he asked himself questions like "Why are we doing this?" and "Where is this going to apply?" The answers to these questions helped him to better understand the work.

Laura explained that her difficulty lay in trying to solve the problem on one hand while simultaneously thinking about her cognitive steps and stopping her thought process to describe them. It was easier for her to focus on what she was doing than on how or why she was doing it. She said that the monitoring of her own cognitive activity was not beneficial to her, but her self-knowledge seemed to be increasing as she gave her recent achievements more thought.

By participating in metacognitive activities, Nirisha said that she was getting to know herself better and had realised that her weaknesses lay in her budgeting and management of time and her anxiety in test situations.

At the time of her interviews, Tumiso was spending much time reflecting on her lack of progress in PRME 1002. She knew that she had the potential to succeed but was desperate to know what to do and how to do it to change her approach to learning. She was engaging in a continuous self-dialogue, which was not made any easier by her lack of the language appropriate in a discussion of thinking and learning processes. As a result of her reflection on her difficulties in solving problems, Tumiso thought that her inability to rearrange the given information was at fault.

Frankie attributed his personal development to his engagement in reflective and metacognitive activities. His current study methods had resulted from an integration of his old successful ways with new options, considered by some to be useful in the tertiary education context. He questioned himself about his test preparation and as a result of his reflection on his tendency to look for “sneaky twists” in questions where none existed, he was able to formulate a plan of action to help himself.

In conclusion, with the possible exception of Frankie, the students interviewed were generally new to the idea of thinking about their thinking or learning processes. They were used to focussing on what they had to learn and not on how to understand or retain their knowledge in long-term memory.

7.4.2 Active construction of knowledge

According to the radical constructivist, Von Glaserfeld (1987), the meaning of a word or concept is the individual’s own subjective construction, “a compound of abstractions from the individual’s own experience” (page 5). During the interviews, the students all glibly contended that it was important for them to “understand” the work in PRME 1002, if they were to enjoy success in the

subject. It became apparent that the word “understand” did not necessarily have the same meaning for each student.

Each version of the meaning of “understand” implied that a different level of activity would be required of the individual before their state of “understanding” could be reached.

In a subject like ‘Process’ where the students had little or no background in the engineering content, Frankie said it was important for him to understand the basics before trying to apply them. He said he needed to “dig the foundations first, go down before you can go up”. His analogy of the steps in the building process indicates the kind of activity he was envisaging.

Thabo also used the “digging” analogy when he said “actually you try dig up for more…, why are we doing this and where is this going to apply, to try to dig more down than what the stuff is actually saying…”

Laura’s original view of understanding proved to be inadequate when she tried to devise some rules for matching test questions with those they had practised in class. She was forced to develop her idea of “understanding” , just as Frankie had done when he thought he had understood the section on empirical formulae only to fare badly in these questions in the mid-year examination.

Tumiso and Lesedi thought that they were understanding the work if they were able to “follow” from one step to the next in a worked solution. Tumiso had the idea that she needed to be more active in integrating the new material with the old, but she was waiting for someone to help her to do this.

Julie also mentioned that she would rather wait for the lecturer to tell her “what was happening” than to spend time trying to process the information herself. She also made no effort to clarify the concepts in stoichiometry.

Nirisha found that time constraints sometimes prevented her from persevering with new concepts until she felt that she understood the work properly.

7.4.3 Social mediation

Vygotsky's (1978) concept of the zone of proximal development (ZPD) focuses on the phase in the child's development in which (s)he has only partially mastered a task but can participate in its execution with the assistance and supervision of an adult or a more capable peer. In the context of PRME 1002, the tutorial system was in place to ensure that every group of three or four students had its own knowledgeable adult, the tutor.

The tutors had been encouraged by the course presenter not to simply answer the students' questions, but they had received little formal training in any alternatives to this process, like scaffolding or mediation.

When asked how helpful they perceived their tutors to be, the students' responses varied considerably depending on whether or not the tutors met their expectations. In those cases where students expected the tutors to provide them with the answers to their questions, both explanations and solutions, they were invariably disappointed, saying that their tutors were not useful. Julie's tutor had changed frequently, but she recalled that one of these tutors had either given her the wrong advice or he would consult the worked solution provided by the lecturer, give her the answer but offer no explanation. Laura said her tutor either would not or could not explain the work to her. Tumiso found the tutor's help insufficient.

Nirisha did not interact much with her tutor but found that he was helpful when consulted. Lesedi appreciated the "clues" he was given by his tutor when he was stuck. Thabo thrived on his tutor's step-by-step explanations of the work. Frankie

praised his tutor for allowing him to explain his difficulties to her first, before suggesting certain options to him, and then insisting that he gave her reasons for choosing one of them.

Wertsch (1979) refers to Vygotsky's postulation that mental functions like thinking, reasoning, problem-solving and logical memory, occur first between people in social interaction, i.e. on the interpsychological plane and then within the individual on the intrapsychological plane. Goos et al (2002) mention that Vygotsky also analysed the zone of proximal development in terms of equal status partnerships, which in an educational setting suggests that there is learning potential in peer groups where students have incomplete but relatively equal expertise – each partner possesses some knowledge and skill, but requires the others' contributions in order to make progress. In their own research on small group learning, Goos et al (2002), use the term "collaborative ZPD" to emphasise the distinction between expert-novice and equal status interactions with their bi-directional ZPD's.

All the students interviewed, with the exception of Frankie, said that they benefited from the academic support given to them by the members of their group. Even Nirisha, who said on more than one occasion that she preferred working on her own, agreed that when they were doing new work, it was helpful to discuss the work with others in the group. She explained that as they tried to tell her why they did not understand the work, she seemed to understand better. Laura concurred with this.

Tumiso said that the explanations of others in her group were at her level, which made it easier for her to understand. She could not read the Course Manual without the assistance of a peer. Lesedi described the mutually beneficial relationship he had developed with another student in his group, although this did seem to involve the checking of answers more than an exploration of each other's reasoning.

Julie said that she found group work very helpful particularly when solving problems, as all the group members interacted by contributing to the development of a satisfactory solution.

Thabo was a member of a study group in his residence as well as the one in the PRME course. He mentioned the disagreement which sometimes occurred in his PRME group as the students tried to negotiate meanings. He added that sometimes collaboration was manipulated to include copying other students' work. On the other hand, he said that competitive students were less collaborative with each other than with other less capable students. This could perhaps explain why Frankie saw himself as being academically self-sufficient and derived no benefit from group work.

7.4.4 Motivation

Although student motivation was not the focus of this research, an analysis of the data collected in the interviews shows that motivation is a key factor influencing the learning processes of students. A lack of motivation mitigates against the student making any substantial changes to his/her approach to learning or indeed to the learning process.

Bereiter and Scardamalia (1989) in Thomas and McRobbie (2001) claim that without a significant level of motivation to succeed in a particular course, students are not likely to make a prolonged effort to conduct both intra- and interpersonal metacognitive dialogues in order to become more self-directed and intentionally in control of their learning processes. Without this self-directedness and sense of managing their own learning processes, irrespective of any perceptions they may have of aspects of the learning context of the course which may not be conducive to learning, students will have difficulty making progress in their studies.

Julie's level of motivation was low during the interviews. She was achieving poor results and while she continued to wait for aspects in the learning context of PRME 1002 to change, she was increasingly losing control of her learning processes. To her the only way out was to change from chemical to electrical engineering, where PRME 1002 was not compulsory.

Lesedi said that the challenges in the content of the course "excited" him. When he managed to arrive at the correct answer to a problem, he felt motivated to continue, but when his answers were consistently incorrect and his list of options became depleted, he would "just give up".

Tumiso felt confident that she had the "potential" to do well in PRME 1002, but at the time of her interviews her lack of progress in the subject was a source of worry to her. She spent much time reflecting on what was going wrong and on what she could do to gain control of her learning processes. She was willing to try anything, if only she had known what to do. She continued to say "I know I have the potential".

Interest in the content of PRME 1002 was a significant motivating factor for the students. Laura was motivated to find out how mass balances worked and in preparing for learning tests, she motivated herself to find out how much she could learn and remember in a short period of time.

Nirisha was interested in the work, but the source of her motivation to do well was the bursary which she had been awarded. The anxiety she experienced when time constraints did not allow her to prepare properly for a test adversely affected her performance and put some strain on her level of motivation.

Thabo and Frankie were both highly motivated to achieve good results in PRME 1002. Frankie was extrinsically motivated to achieve at least 20% more than his

nearest competitor as he saw this as being the only way of ensuring employment as a white male in the new South Africa. Frankie was thus very mark-orientated and highly competitive. He was also intrinsically motivated to do well in PRME 1002 – he thrived on the feeling of having been mentally challenged, perhaps struggling, and then mastering the work. Frankie was confident that he would succeed.

Thabo was intrinsically motivated – he said he was goal-orientated and believed that he should always set for himself very high academic goals, goals which might have been too high for him to achieve, but which would spur him on to achieve the very best results of which he was capable. Thabo thought that his perceived slowness to grasp new concepts was a stumbling block to his successful achievement of his own goals.

7.5 Conclusion

In this chapter, the students' perceptions of the organisation, content, teaching and assessment practices of PRME 1002 were discussed.

Some of these perceptions did not appear to influence the students' approach to learning in any way, while others had a significant effect in either encouraging or discouraging them from adopting a deep learning approach. It was noted that individual differences in students sometimes resulted in them responding in different ways to similar perceptions.

Finally, the students' thoughts about aspects of constructivism in PRME 1002 (metacognition, the active construction of knowledge, social mediation and motivation) were discussed.

In the next chapter, the implications of these findings for future course development will be considered.

CHAPTER EIGHT

8. IMPLICATIONS OF THE RESEARCH FINDINGS FOR FUTURE COURSE DEVELOPMENT

8.1 Introduction

This research was funded in order to explore the students' perceptions of aspects of the learning environment of PRME 1002 and the influence of these perceptions on their approach to learning the subject, with a view to using the findings to further develop the course.

The findings of this study suggest that the students' perceptions of some of the changes that have been implemented in PRME 1002 are encouraging them to adopt a deep approach to learning (and should be developed) while others are not. Many of the changes which have been implemented are consistent with constructivist principles and are considered by some students to be worth pursuing, while others could be reviewed.

In this chapter, the implications of these findings for future course development in PRME 1002 are discussed in the following sections

- Clear curriculum documents
- Challenging and fair tests
- Active construction of knowledge and social mediation.

In making these suggestions, it is not envisaged that structures themselves should necessarily be changed, but that attempts could be made to enhance the students' perceptions of these structures.

8.2 Clear curriculum documents

Some of the students expressed the need to be provided with detailed course documents for PRME 1002. A course outline could list all the topics to be covered in the course of the year together with the approximate time allocation for each topic. This would help the students to see the relationship between the topics (some of which are perceived by them to be unrelated at the moment) and to deduce which sections are meant to enjoy more coverage and which deserve just cursory attention. This would also help students who wish to prepare ahead for lectures, to do so.

In addition to this, a study guide describing the learning outcomes for each section could be issued to the students at the start of each section. With detailed outcomes including both the content to be learnt and the skills to be mastered, as well as the date of this anticipated achievement, students would know more of what is expected of them and the level at which their performance would be considered acceptable. Mention could also be made in these outcome statements of the so-called “soft” skills, such as communication (both oral and written) and teamwork skills as well as the higher-level problem-solving skills. Students could then anticipate projects, assignments and tutorials consistent with these outcomes and tests, which are set to assess the level of achievement of these outcomes. These suggestions are consistent with the outcomes–based approach in education which is being implemented in South African schools.

PRME 1002 could then be perceived to be a well-planned, organised course.

8.3 Challenging and fair tests

Just as tests can motivate students to study, they can also lead to student demoralisation and hostility, if they are perceived by students as being unfair (Felder, Woods, Stice and Rugarcia, 2000).

Included in this category are tests that are too long and tests that contain surprises (Felder et al, 2000). Students may feel resentful when they have learnt hard and prepared thoroughly for a test, but they perform poorly because they were not given enough time or opportunity to show their understanding of the work. Students may also be indignant when their tests include problems with twists unlike anything they have seen before or problems that involve skills that were not taught in class or practised in classwork or homework assignments.

Felder et al (2000) make the point that there is no empirical evidence or logic to support the argument that long and tricky tests assess the students' potential to be successful engineers. They suggest that thinking and problem-solving skills and speed in problem-solving are developed only through practice and constructive feedback. They urge lecturers to set high standards but to teach and assess in such a way that students who have the ability to meet the challenge can do so.

The detailed curriculum documents referred to in the previous subsection, could serve as useful guides in providing students with instructional objectives for tests well in advance of the test date. These could be in the form "In order to do well in this section, you should be able to…". The more challenging questions which test conceptual understanding should count for no more than 15% of the test (Felder et al, 2000).

In accordance with the overall aim of showing that PRME 1002 is a well-planned, organised course, it is suggested that the course presenter do the test himself before giving it to the students. He could then focus on setting an appropriate level of difficulty with problems, which are not ambiguous and not over- or under-specified. Felder et al (2000) claim that the lecturer should take ¼ to 1/3 of the time allocated to the student to complete the test.

Just as the students are encouraged to reflect on their preparation for and performance in a test, the examiner could also reflect on the test experience and if necessary accept some responsibility for the results.

8.4 Active construction of knowledge and social mediation

According to Felder et al (2000), the challenge for lecturers is to involve most or all of the students in productive activities without sacrificing important course content or losing control of the group. They cite the benefits of active learning as facilitating the long-term retention of information, developing and improving thinking and problem-solving skills, stimulating an interest in the subject and motivating students to adopt a deep approach to learning.

In the context of PRME 1002 lectures, the course presenter could persevere with the practice of interspersing in each lecture a number of brief exercises, each lasting from 30 seconds to 3 minutes, to be completed by groups of 2-4 students. It would be beneficial for the students to understand that in this time, they will not be required to produce a complete answer, but rather to think about the question and to start formulating an answer and that any group or individual in the group could be invited to contribute towards a class solution. An additional advantage of using many short exercises is that feedback from the lecturer on each answer is immediate and could encourage further discussion.

In view of the finding of this research that some students did not know how to think about their thinking processes and to monitor their cognitive progress, some consideration could be given to the work of Kramarski, Mevarech and Arami (2002) who taught students organised in small groups to formulate and answer four kinds of self-addressed metacognitive questions to help them to activate their metacognitive processes.

According to Kramarski et al (2002), comprehension questions prompt students to reflect on the task or problem before solving it. This involves reading the problem aloud and describing it in their own words to try to understand what it means. Connection questions require students to focus on similarities and differences between this problem and other problems that they have already solved. Strategic questions stimulate students to consider which strategies are appropriate for solving the problem and for what reasons. Finally, reflection questions require students to reflect on their understanding and feelings during the solution process. By asking and answering these questions and, in general, articulating their ideas in a small group, students' ability to reflect on their assumptions and thought processes is enhanced (Bitzer, 1999).

In emphasising the importance of interpersonal and team skills in engineering, Felder et al (2000) maintain that the image of an isolated engineer working on his/her own has never been realistic. By its nature, engineering is a co-operative enterprise, done by teams of people with different backgrounds, abilities and responsibilities. To Felder et al (2000), the skills associated with successful teamwork may be more vital to the success of a project than technical expertise.

In adopting any form of collaborative learning, it is suggested that students be informed what they will be required to do and the reasons for changing from a matric system based largely on individual performances to a system in which the individual student is still required to accept responsibility for his/her own learning, as well as that of the group in which the student finds him/herself in a spirit of positive interdependence.

This raises the issue that the students, in particular, may lack group process and facilitation skills, so that some form of training for the students (and the tutors) in these skills may be necessary in addition to the provision of the rationale for the change (Bisker, 1999).

Students would also need to know in advance that just one effort per group is to be submitted for assessment – while there is just one group grade, individual adjustments are possible for exceptional contributions to the group effort (or alternatively for very little work). Group grades could serve a useful purpose in a system in which individual academic achievements are traditionally emphasised and teamwork skills are seldom recognised or rewarded. Students could also be required to submit some form of self-assessment on the success of the team-functioning skills of their group.

Felder et al (2000) recommend that the lecturer should form the groups him/herself on a heterogeneous basis, particularly if prestructured techniques of co-operative learning are to be used. Strong students may find gaps in their understanding as they try to explain their thoughts to the others in the group; weak students are encouraged by the others not to give up. All teams need time to develop, so the composition of the groups must not change too often (Felder et al, 2000).

The intention of the course presenter to use co-operative or collaborative learning strategies could also be included in the curriculum documents for the course, so that the method of teaching is seen to be part of the organisation of the course and is not used on a haphazard basis.

8.5 Conclusion

In this chapter, possible implications of the research findings for the future development of PRME 1002 were considered as they pertain to the organisation of the course, the formal testing practices and the active and social nature of the construction of knowledge in the course.

Weaving its way through these suggestions runs the thread that no matter which decisions are made in the future, the students in PRME 1002 remain first-year

students who are, in most cases, expecting university studies to be different from school studies, but who would, benefit from any attempts made to help them to adapt to the changes.

This could be facilitated if the course expectations, and the rationale for these, were to be communicated to the students, on an ongoing basis, by all those connected with the course, both academic staff and tutors.

To paraphrase an old adage, students may find it easier to reach their destination if they know where they are going in the first place.

CHAPTER NINE

9.1 APPENDIX 1

Protocol for the first round interviews

For me:

Don't:

- Talk too much
- Interrupt
- Judge responses

Introduction

(1) Thanks for your time and for agreeing to be part of my study.
(2) What the research is about (already described in the letter).
(3) You are free to withdraw at any stage – I hope this won't happen
(4) Are you happy to have the interviews audio-taped? The alternative is for me to take notes.
(5) Confidentiality is guaranteed – use of pseudonyms.
(6) No right/wrong answers – your experiences only.
(7) Do you have any questions?

My questions

- What would you say was the secret of your success in the matriculation exams?

- What were you expecting from PRME? What had you heard?

- The course presenter said at the start of the semester. With reference to the mid-year exam results “If you go on doing what you have been doing, you will go on getting what you have been getting”.

  - What did this mean to you personally?
  - What had you been doing in the first semester?
  - What did you get? What changes, if any, have you made since then? What are you getting now?

- If you were asked to tell somebody about PRME, using say FIVE words, which words would you choose? Why?

Protocol for the second round of interviews

My questions

(1) Consider these learning orientations/approaches:

(a) Searching for meaning and understanding.
(b) Reproducing enough work correctly.
(c) Writing what the marker wants to read i.e. “playing the marks game”.
(d) A haphazard/non-academic approach.

- Which one of these would you say you use most of the time in PRME?
- Would you consider using another approach? Why?

(2) In what way(s) do you see each of these factors influencing your approach to learning in PRME?

(a) Your interest in the content.

(b) Your lack of background knowledge.
(c) The assessment procedure.
(d) The feedback on marked work.
(e) The volume of work.
(f) The allocation of time in tests/for assignments.
(g) The nature of the teaching.
(h) The organisation of the course.
(i) Reflective questions.

Protocol for the third round of interviews

My questions

(1) How would you respond to these perceptions of a visitor to the PRME 1002 lectures and tutorials?

(a) PRME is a student-centred course.
(b) The PRME students are actively involved in their lectures/tutorials.
(c) PRME students rely on each other for academic support.
(d) PRME students follow strategies when solving problems.
(e) PRME students are conscious of their own thinking processes.

(2) What would you say the course presenter has been trying to achieve in PRME 1002 this year? How successful would you say s/he has been?

(3) Do you think PRME 1002 should be used as a “filter” for second year? Why?

9.2 LETTER TO STUDENTS

University of the Witwatersrand
School of Education

August 2003

Dear

As you will know, I am present at most of your PRME 1002 lectures, where my role is that of a teaching assistant. In fact, I am also a Wits student, working for a Masters degree in Education (MEd). I have passed the coursework and am preparing for my research project.

In my research, I am going to explore the first-year PRME students' perceptions of the educational context of this course and the possible influence that these perceptions may have on their approaches to learning in the course. My findings may well influence the future development of PRME 1002.

A range of students are presently being asked whether they are willing to be part of my study. Each student would need to agree to be interviewed individually for about 30 minutes on three separate occasions. Interviews will be audio-taped and transcribed for later analysis. As a participating student, you will be assured of your anonymity at all times – pseudonyms will be used so that your identity will be known to me only; the source of material used in the research will be kept confidential and once the research report has been examined, the raw data will be destroyed.

I would be most grateful if you would agree to participate in this research project and I look forward to developing a sound "working" relationship with you.
Yours sincerely

CHAPTER TEN

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