FACTORS INFLUENCING THE ACADEMIC SUCCESS OF FIRST-YEAR STUDENTS IN CHEMISTRY AT AN AGRICULTURAL TRAINING INSTITUTION

By

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DECLARATION

By submitting this thesis electronically, I declare that the entirety of this work contained therein is my own, original work, that I am the authorship owner thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any other qualification.

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March 2016

SUMMARY

Learning is a multi-layered concept which depends on many different role-players, complex factors and different historical and contextual factors. In view of the many factors that may influence the learning environment, a need was identified to investigate the aspects of learning that are related to chemistry education. In basic chemistry, a variety of factors influence learning and academic performance as well as the strategies to learn chemistry in order to minimise the factors that have a negative influence on students' learning and their academic performance.

Several authors have highlighted possible factors that may influence the academic performance of students. Only a limited number of studies have investigated teaching and learning in chemistry education and in agricultural training in particular. Factors that were found to potentially influence students' academic performance were incorporated in Astin's input-environment-output model that was used as a framework to interpret the data generated for the study. Such knowledge may provide valuable information to first-year students, lecturers and the planners of foundation programmes at the Elsenburg Agricultural Training Institute and similar agricultural training institutes.

In this study, the aim was to investigate the possible academic factors that influence the success of the BAgric students who study Chemistry (PAS) 111 in their first year. Three data sources were used: PAS 111 curriculum documents, the opinions of 2013 BAgric first-year students and the opinions of lecturers involved in the first-year courses and in PAS 111 in particular. These data sources contributed to determining to what degree, if at all, academic factors influence learning in Chemistry (PAS) 111 and how these factors are perceived by the main constituents. The main question addressed in this study was thus: *Why do students at Elsenburg Agricultural Training Institute not perform well in Chemistry (PAS) 111*?

In conducting the study, a pragmatic stance was taken and a mixed-methods research design was used. The findings of this study indicate that language, admission requirements, student interest, and student support had a considerable influence on student academic performance for the 2013 PAS 111 student group. Implications flowing from the study for the Elsenburg Agricultural Training Institute as well as possibilities for future research are pointed out.

Keywords: student learning; learning chemistry; teaching chemistry; agricultural training; academic factors; academic performance

OPSOMMING

Leer is ŉ veelvlakkige begrip wat van baie verskillende rolspelers, komplekse faktore en verskeie historiese en kontekstuele omstandighede afhang. In die lig van die vele faktore wat die leeromgewing kan beïnvloed, is ŉ behoefte geïdentifiseer om ondersoek in te stel na die aspekte van leer wat verband hou met chemie-onderrig. In basiese chemie word leer en akademiese prestasie deur 'n verskeidenheid faktore, asook die strategieë om chemie te leer, beïnvloed ten einde die faktore te minimaliseer wat ŉ negatiewe invloed op studente se leer en akademiese prestasie uitoefen.

Verskeie outeurs het moontlike faktore uitgelig wat die akademiese prestasie van studente kan beïnvloed. Tot dusver het slegs 'n beperkte aantal studies ondersoek ingestel na onderrig en leer in chemie-onderwys en na landbou-opleiding in die besonder. Geïdentifiseerde faktore wat studente se akademiese prestasie moontlik kan beïnvloed, is geïnkorporeer in Astin se inset-omgewing-uitset-model (Engels: 'input-environment-output model') wat as ŉ raamwerk gebruik is om die data wat in hierdie studie gegenereer is, te interpreteer. Sulke kennis kan moontlik waardevolle inligting verskaf aan eerstejaarstudente, dosente en beplanners van grondslagprogramme aan die Elsenburg-Landboukollege en soortgelyke landbou-opleidingsinstellings.

Die doel van hierdie studie was om ondersoek in te stel na die moontlike akademiese faktore wat die sukses van die BAgric-studente wat Chemie (PAS) 111 in hul eerste jaar studeer, beïnvloed. Drie databronne is gebruik: PAS 111 kurrikulum-dokumente, die menings van BAgric-eerstejaarstudente in 2013 en die menings van dosente wat betrokke is by die eerstejaarkursusse en in die besonder by PAS 111. Deur middel van hierdie databronne is daar gepoog om te bepaal tot watter mate – indien enige – akademiese faktore leer in Chemie (PAS) 111 beïnvloed en hoe hierdie faktore deur die hoof- rolspelers ervaar word. Die hoofvraag wat in hierdie studie aangespreek is, was dus: *Waarom presteer studente aan die Elsenburg-Landboukollege nie goed in Chemie (PAS) 111 nie*?

In die studie is van ŉ pragmatiese benadering gebruik gemaak en is ŉ gemengde-metodes-ontwerp gebruik.

Die bevindings van hierdie studie dui aan dat taal, toelatingsvereistes, studentebelangstelling en ondersteuning van studente ŉ groot invloed gehad het op die akademiese prestasie van die PAS 111-groep van studente in 2013. Die implikasies vir die Elsenburg-Landboukollege voortspruitend uit die studie word aangedui en moontlikhede vir toekomstige navorsing word voorgestel.

Sleutelwoorde: studenteleer; chemie-leer; chemie-onderrig; landbou-opleiding; akademiese faktore; akademiese prestasie

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CHAPTER ONE

ORIENTATION TO THE STUDY

1.1 BACKGROUND AND EDUCATIONAL CONTEXT

This study is located in the Department of Agriculture (DoA), Elsenburg Agricultural Training Institution (EATI), where I was a lecturer for six years since 2008. I taught viticulture to first- and second-year higher certificate students and also the diploma module in the Department of Viticulture and Oenology. This study however is situated in the Department of Basic Science on the Principles for Agricultural Science (Chemistry) 111 module also known as PAS 111.

Agriculture is a dynamic, rapidly changing industry that has a challenging and exciting future. However, as first-year students learn to handle the new-found freedom of college life, some of them are experimenting with skipping classes, experiencing social challenges, finding it difficult to handle a new learning environment, struggling to find positions of independence and battling factors that influence their academic performance.

Approximately one quarter of the students who are admitted at most agricultural training institutions are forced to discontinue their studies or do so voluntarily. Most of these cessations of study occur during or near the end of the first year of study. Moreover, the cessation of studies is not the only negative aspect as low pass rates of students at higher education institutions in South Africa are alarming overall (Louw, 2005). More recent statistics indicate that only 35% of the total intake, and 48% of contact students, graduate within five years (CHE, 2013). There is a growing body of research, particularly in the form of local and international retention studies, which indicates that success and failure in higher education is the result of a complex interaction of factors. These factors are both internal, that is, intrinsic to the higher education system, and external, in relation to social, cultural and material circumstances (CHE, 2013).

The Bachelor of Agriculture (BAgric) programme is offered by EATI in collaboration with the Faculty of AgriSciences at Stellenbosch University. The BAgric programme focuses on applied agricultural production and management and although it is practically oriented, it still provides the necessary scientific depth to meet the needs and challenges of modern agriculture. Students may choose two majors from a wide range of study fields with basic and support modules such as soil science, agribusiness management, agricultural engineering, biology, communication, computer literacy, natural resource management, principles of agricultural science, entrepreneurship and crop protection.

Principles for Agricultural Science (Chemistry) 111, also known as PAS 111, is a 10-credit module which is presented in the first semester of the first study year and has been the focus of this study. This module is compulsory for all students registered for the BAgric programme. The total number of students registered for this module depends on the intake of first years but is never more than 120 or lower than 80 students. However, the failure rate for this subject has been significantly high for the past years. For instance, the failure rate in terms of percentages for the period 2010 to 2013 was 34% in 2010, 16% in 2011, 24% in 2012 and 38% in 2013. These statistics are alarming to the Institute and the need arose to investigate the possible academic factors that influence the success of the first-year BAgric students. Such academic factors may include elements such as attitude and personal orientation, transition from school to higher education, students' time management, how workload is handled, student learning style and learning approaches, and students' foundational knowledge, language, home environment and family background, amongst others.

No studies could be found that considered students' own perceptions of the factors influencing their academic success in chemistry. There is, however, literature on a number of studies that statistically investigated the determinants of success in science studies. This literature formed the basis for this study and contributed to my conceptualisation of the justification for the factors related to students' academic performance. A review of some relevant literature is provided in Chapter 3.

1.2 DESCRIPTION OF THE PROBLEM

A literature overview (Chapter 3) revealed that a number of studies have been published that identify learning approaches, prior knowledge and other factors as influencing student success in first-year Chemistry.

For students to pass the module in PAS 111 at EATI they are expected to attend all classes and practicals, and write all tests and examinations. An average of 50% must be attained to pass the module. The class mark accounts for 40% and the examination mark comprises 60% of the performance mark, while a minimum of 40% must be attained in the examination.

The high failure rate for PAS 111 is of much concern, because failure in this module might lead to the cessation of studies. Teaching techniques such as tutorials in smaller groups and summer schools, as well as the appointment of new lecturers have been experimented with, but did not change the trend that students still fail at a high rate as indicated above.

The lecturers teaching in PAS 111 as well as teaching in other subjects have made their own assumptions on the reasons for the relatively high failure rate. These assumptions, mainly based on personal observations, experience and conversations, include the following:

- Chemistry in Grade 12 is not an admission requirement when students apply for the degree in agriculture. Therefore nearly half of the students studying the module have no background in chemistry and students with no background in chemistry seem to struggle with the module, especially in the first semester.
- There is limited provision for either Afrikaans or English tuition in the specific course and so Afrikaans- or English-speaking students may experience language difficulty.
- Class attendance by students is low, averaging between 50% and 60% per week.
- Students appear to be poorly prepared for tests and examinations.
- There is a possibility that examination papers may be unfair.
- It seems that the general presentation of the subject was on a high level or standard.
- It could be that the class notes are outdated and do not correlate with the information presented in class, possibly contributing to further confusion.
- Students' approaches to learning appear to differ and there is no student support system in place to address such a variety of learning needs on campus.
- Tutorials are presented to smaller groups but despite the contact with the lecturer in smaller groups there seems to be no significant improvement in results.

There are two distinctive groups of students taking PAS 111. The first group consists of students who had science at secondary school and who therefore find the module relatively easy in the first semester. Consequently, lecturers assume that these students do not have to study very hard to be successful in the module. Lecturers also accept that class attendance of this group of students is low. These students therefore sometimes have certain misconceptions about chemistry. The second group, which consists of students who did not have Science at secondary school, finds the module very challenging. These assumptions appear to be prevalent, although they have not been empirically investigated in the particular context.

Based on the background sketched above, the following main research question was formulated:
Why do students at Elsenburg Agricultural Training Institute not perform well in PAS (Chemistry) 111?
The sub-questions that informed the main research question are:

- Is the PAS 111 curriculum appropriate for learning PAS 111?
- What are students' perceptions of factors that influence their success or failure in PAS 111?
- What are lecturers' perceptions of factors that influence students' success or failure in PAS 111?
- How do lecturer and student perceptions compare in terms of factors influencing student success or failure in PAS 111?

Flick (2009:98) states that "research questions do not come from nowhere. In many cases their origin lies in the researchers' personal biographies and their social contexts. The decision about a specific question mostly depends on the researchers' practical interests and their involvement in certain social and historical contexts." As a researcher I can identify with such a statement, because as lecturer I worked with first-year students and their success and well-being are my concern. Therefore, I wanted to listen to students and allow them to explain what the challenges to learning were that they were struggling with and how they attempted to deal and overcome them. Equally important to this purpose was the high failure rate in PAS 111 which is an alarming factor to the Institute. With this study I thus wanted to afford the students and lecturers an opportunity to share their learning and teaching experiences with a view to identifying and indicating why students in PAS 111 do not perform well.

1.3 AIM AND OBJECTIVES OF THE STUDY

Given the context which I have described above, the aim of the study was to investigate student and lecturer perceptions about the academic factors that may influence student performance in PAS 111 at Elsenburg Agricultural Training Institute (EATI).

The consequent objectives of the study were to:

- inquire into the PAS 111 curriculum in terms of a set of curriculum criteria;
- determine the perceptions students have about which academic factors may influence their performance in the PAS 111 module; and
- determine the perceptions of lecturers about which academic factors may influence student performance in the PAS 111 module.

1.4 THEORETICAL ORIENTATION

Various studies provide information on students who enter the higher education system (Huysamen, 2003; Masitsa, 2004; Pillay, 2004). Research conducted on the success of first-year students at higher education institutions indicates that one out of every three students will have dropped out of university by the end of their first year (Groenewald, 2005; Scott, Yeld & Hendry, 2007).

A number of studies focused on chemistry students' conceptions of and approaches to learning chemistry (Lastusaari & Murtonen, 2013; Li, Liang & Tsai, 2013; Rollnick, Davidowitz, Keane, Bapoo & Magadla, 2008), while Clifton, Baldwin and Wei (2011) focused on the chemistry course structure, engagement, and achievement of students in first-year Chemistry at the University of Manitoba, Canada. Similarly, Zeegers and Martin (2001) investigated the problem of high student attrition and failure in first-year Chemistry at Flinders University, Australia. They introduced a programme that focused on developing students' understanding of the learning process and of their own learning but also learning chemistry in particular. These studies, however, did not consider the students' own perceptions of their chances to succeed in chemistry at university.

However, in a study at one South African university it was found that students perceived a lack of motivation, lack of self-discipline, concentration and interest in the subject, not asking for help, not perceiving the subject to be important, having a mental block or negative attitude and making unnecessary errors, as factors that influence their academic success (Steenkamp, Baard & Frick, 2009). The findings of this study, which related to accounting students, also pointed to poor class attendance and insufficient studying, a lack of classes offered in English and a lack of time as reasons for failure. These findings were shared with students at the start of the academic year.

In South Africa, many first-year Chemistry students have an inadequate knowledge of the fundamental principles which underpin the study of chemistry (Marais & Mji, 2009). Studies at the Tshwane University of Technology indicated that this may be a problem that emanates from the students' secondary education (Marais & Mji, 2009). Similarly, other South African-based studies illustrated a growing body of interest in research into students' understanding of the methods of procedural knowledge in chemistry amongst students entering into bridging programmes (Rollnick, Dlamini, Lotz & Lubben, 2001). Other research was also based on the relationships between various indicators, notably students' prior school performance, as possible predictors of future academic success (Rollnick et al., 2008).

In the current study, emphasis was placed on learning approaches and the student who brings an accumulation of assumptions, motives, intentions and previous knowledge that envelopes every teaching and learning situation and determines the course and the quality of learning that may take place (Biggs, 1996). The changed and increasingly diversified student population in higher education across the world (Cross, 2004) amplifies the need for chemistry lecturers to take note of their students' assumptions, motives, intentions, and previous knowledge that may influence student success (Byrne & Flood, 2005). Similarly, in his study on first-year dropout rates at four South African higher education institutions, Louw (2005) proposed a conceptual framework which included academic factors that could potentially contribute to early student departure. Student-related academic factors were found to include perceived low level of academic integration; learning backlogs and heavy workload; inadequate study skills; lacking foundational knowledge; lack of commitment; and lack of confidence. Institution-related academic factors included inadequate learning support; inadequate language and communication in classes; large classes; inadequate facilities; inefficient administration; skewed access measures; inadequate teaching; type of assessment; and inadequate/wrong course information.

Both Biggs's (1996) and Louw's (2005) studies focused on possible factors that may influence the teaching and learning environment. These studies provide room for further investigation into chemistry education in higher education and agriculture training in particular. This study was therefore aimed at investigating the perceptions of staff and students about academic factors that may influence students' performance in PAS (Chemistry) 111 at EATI. The information may provide valuable information on why PAS 111 students do not perform well and how to support such students better in future.

Louw's (2005) conceptual framework identified and made explicit factors that could potentially be challenges to the students in the learning process – particularly in agricultural training institutes. Louw's framework supports the thesis that both student and institutional academic factors influence student learning and therefore student performance. These factors tie well into Astin's (1999) model of student involvement which suggests that when students are involved in both the academic and the social aspects of collegiate experience, they will gain more from their studies. In this current study the focus is on academic involvement which underscores Astin's (1999) theory of student learning and performance from an academic perspective.

Astin's Input-Environment-Output (I-E-O) model shows relationships between input, environment and output. Input factors considered in this research were demographic factors and students' prior academic history – for example, whether the student had chemistry in secondary school or not. Environmental factors considered involve academic factors/aspects while the output is considered to be students' academic performance or achievement.

1.5 RESEARCH APPROACH

The research was conducted by taking a pragmatic stance. There are many forms of pragmatism. For many of them, knowledge claims arise out of actions, situations, and consequences rather than antecedent conditions. Pragmatism (Dewey, 1929; Peirce, 1992) is an action-oriented philosophy of science. It studies the link between action and truth, practice and theory. According to Dewey's definition (1938:31), pragmatism is "the doctrine that reality possesses practical character". Pragmatists see the world as a set of practical actions that are born from thinking. There is no dualism between theory and practice; rather, they are two sides of the same coin (Peters, 2007:356).

Pragmatism relies on the consequences of our beliefs (Plowright, 2011). Pragmatism takes both a relativist and fallibilist view of what knowledge is. According to Plowright (2011), this approach is referred to as holistic integrationism which employs a pragmatic, integrated methodology to undertake investigations using empirical data from observation, asking questions and artifact analysis.

The research approach or logic applied in this study was deductive. Deductive reasoning is a logical progression from general observations to a more specific observation or statement and leading to a specific conclusion. Therefore, this study was aimed at discovering what students' and lecturers' perceptions are on academic factors that influence student performance and to imply from their perceptions those that may be associated with unsatisfactory performance in first-year PAS 111. It was decided not to follow the route of data collection via questionnaires and quantitative measures only, but rather to employ a mixed-method design and different forms of data collection in this study.

My intention was to attempt an understanding of the context in which first-year PAS 111 students learn and in particular what the challenges to learning and the enabling factors were for a specific group of students. It thus involved an attempt to understand the who, the where, the what, the why and the how of these students (Gubrium & Holstein, 2000).

1.6 RESEARCH DESIGN AND METHODS

This section is only a brief summary of the key research design and methodology issues of the study. A full description is provided in Chapter 4.

A mixed-method research design was used to investigate the research problem. Both qualitative and quantitative methods were used to generate data. To generate narrative data, interviews were conducted with lecturers, open-ended questions were posed to students and document analysis was done on the PAS 111 module. Numerical data were generated by using a closed-ended student questionnaire with all students who registered for the module in 2013. This included students who had completed the module, those who had failed the module as well as those who were repeating the module. Participation in the student survey was voluntary.

1.6.1 Data collection process

PAS 111– Curriculum analysis

Document analysis was done for the PAS 111 syllabus. To analyse the PAS 111 module documents, a set of curriculum analysis questions as suggested by Posner (1992) was used.

Student perceptions

Students' perceptions of factors influencing their success in PAS 111 were investigated empirically by means of questionnaires which required closed as well as open-ended responses. From the questionnaire results, interpretations were made regarding the possible factors that students perceived to have influenced their success or failure in this module.

The study focused on all students who were registered for the PAS 111 module in 2012 and 2013. This included students who had completed the module, those who had failed the module and those who were repeating the module. The first two sections of the questionnaire contained questions to generate information on students' demographic and educational background. The third section, which also contained closed-ended questions, asked students to respond to statements by means of a five-point Likert scale (1=disagree strongly; 2 = disagree; 3 = uncertain; 4 = agree; 5 = strongly agree). The fourth section contained open-ended questions that focused on factors that might affect success in the module, support structures students can utilise, the perceived importance and difficulty of the module, and the perceived influence of the secondary school preparation (prior learning) on their subsequent success. Students' perceptions of class presentations and learning materials, learning methods and the performance of lecturers were also investigated in this section.

Basic content analysis of the answers to the open-ended questions was done to process and analyse the qualitative elements and to identify main themes in the answers. A questionnaire that was pilot tested and used in a previous published study on first-year student perceptions (Steenkamp et al., 2009) served as a basis for the questionnaire construction. These elements added to the content validity of the questionnaire.

Lecturer perceptions

Data were collected through individual interviews with the lecturer who presented PAS 111 from 2009 to 2013, the current lecturer (2014) and five lecturers presenting other first-year modules (Biology, Mathematics, Chemistry, Introduction to Wine, Natural Resource Management, Agricultural Business Management and Soil Science). The interviews focused particularly on the lecturers' perceptions of factors that may possibly influence the performance of first-year students. The qualitative data generated from interviews were transcribed and coded to provide an integrated overview of the factors that influence the success or failure of first-years PAS 111 students.

1.6.2 Data analysis

The curriculum was analysed by using Posner's (1992) set of criteria for curriculum analysis. Once the questionnaires were collected and interviews conducted, the raw data were organised and divided into conceptual categories in order to identify emerging themes (Neuman, 1997:421). As themes emerged, these themes were coded and plotted using an Excel spreadsheet. In this study, open coding was used. It entails locating themes and assigning initial codes to each theme in an attempt to make the data manageable.

1.7 DEFINITIONS OF KEY CONCEPTS USED

A number of key concepts are used in this thesis. To better inform the reader, these concepts are briefly defined and elaborated on in Chapter 3.

Successful learning: The concept of successful learning is a complex one. However, in the context of this thesis it is used to indicate that a student passed PAS 111 in the first year and was promoted to the second year of study.

Student failure: Failure in the context of this thesis means that a student did not pass PAS 111 in the first year of study. The term 'failure' is also used to indicate students who had to re-register for PAS 111 after failing in the previous year.

Challenges to learning: The concept 'challenges to learning' is used and understood in this thesis to mean any difficulty that students encounter in the learning process; therefore any factors or issues that may be indicated as barriers to learning and that could prevent the student from being successful in the learning process.

Enabling factors: Enabling factors are understood in this study as any issues or factors that fulfil a supporting and an enabling role in the learning process. Therefore, enabling factors are factors such as learning strategies that a student may use to overcome the challenges in order for successful learning to occur.

Curriculum: At the national level, the South African Qualifications Authority (SAQA) defines curriculum as being more than a syllabus. Curriculum refers to all of the teaching and learning opportunities that take place in learning institutions including: purpose and values of learning; learning outcomes; content, activities, methods, media; teaching, learning strategies; forms of assessment and evaluation of delivery, moderation (SAQA, 2000). From this definition one could say that curriculum deals with setting standards, learning programme development and delivery, assessment and the quality assurance of delivery and assessment processes.

Module: The term ‘module’ is used by the EATI Department of Basic Science in referring to subjects or learning areas in the different disciplines in the department. Modules are divided into first-semester modules and second-semester modules and have a credit value of 5, 10 or 15 credits attached to each in the first year of study. First-year students are required to register and pass 10 modules in the first year of study with a total value of 130 credits. All modules are compulsory in the first year. When students do not pass some of the modules in the first semester, they are given another chance to re-register for these modules at the beginning of the next year (in other words, in the first semester). At the end of the first semester of the first year of study, students must pass the modules with a total of at least 30 credits before they are able to register for the second semester. They will receive a written request to discontinue their studies if this requirement is not met (EATI, 2011).

1.8 ETHICS

The ethical considerations with regard to this study are discussed in detail in Chapter 4. Literature on ethics in research was studied and the Stellenbosch University prescribed ethical clearance processes were followed before the study commenced. I presented a research proposal to the Faculty of Education’s ethics committee after which I made adjustments based on their recommendations. The research proposal was then submitted to the Ethics Committee for Human and Social Sciences at Stellenbosch University for approval. The study and data collection could only continue once approval was received. All documentation related to conducting the study in an ethical manner is attached as Addendum G at the end of this thesis.

1.9 CONCLUSION

This chapter outlined the purpose of this study and what was inquired into. To summarise: The research question of this study was: "Why do students at Elsenburg Agricultural Training Institute not perform well in PAS (Chemistry) 111?" In answering this question, perceptions of students and staff about those academic factors that may influence student performance in PAS 111 were generated. IN the next chapter an overview is given of EATI. Chapter 3 reports on relevant literature which was explored to inform this study theoretically. Chapter 4 discusses the research design and methodology and Chapter 5 provides the results and the discussion thereof. Finally, in Chapter 6, some conclusions are drawn from the results and some implications of the study are highlighted.

CHAPTER TWO

CONTEXTUALISING THE STUDY

2.1 INTRODUCTION

EATI, which was the chosen research site for this study, is an accredited agricultural college. SAQA defines accreditation as the certification of an institution for a particular period of time as having the capacity to fulfil a particular function in the quality assurance system (SAQA, 2000). Such accreditation is awarded to education providers who offer outcomes-based learning programmes aligned to the National Qualifications Framework (NQF) registered unit standards and qualifications (Services SETA, 2015).

EATI forms part of the Western Cape Department of Agriculture as full programme and chief directorate. In total there are 11 accredited agricultural colleges in South Africa that offer specific qualifications within the NQF which are coordinated by the Council of Higher Education. The 11 colleges of agriculture are Cedara, EATI, Fort Cox, Glen, Grootfontein, Lowveld, Madzinvhandila, Owen Sitole, Potchefstroom, Tompi Seleka and Tsolo. The legislation pertaining to higher education includes a system of quality assurance, which focuses mainly on the facilities, curricula and academic excellence of institutions and programmes. This chapter provides more background on EATI as a training institution, the BAgric programme offered by the Institution, and the Principles of Agricultural Science (PAS) 111 module which forms part of the BAgric programme and which is the focus of this study.

2.2 CURRICULUM IN AGRICULTURE

The agricultural community is changing rapidly and institutions which serve this sector of the industry must also change to accommodate new and different demands. In general, agricultural businesses are becoming fewer in number, larger and more specialised with less family ownership. Authors agree that if educational institutions are to prepare individuals who are ready to enter the agricultural workforce, the educational system must continually modify their curricula to meet current and future demands (DAFF, 2008; Koga, 2004; Neal, Hammond & Kreps, 2001).

At the national level, SAQA (2000:6) defines a curriculum as being:

> … more than a syllabus…refers to all of the teaching and learning opportunities that take place in learning institutions including: purpose and values of learning; learning outcomes; content, activities, methods, media; teaching, learning strategies; forms of assessment and evaluation of delivery, moderation.

From this definition one could say that curriculum deals with setting standards, learning programme development and delivery, assessment and the quality assurance of delivery and assessment processes.

Prior to 1998 the term 'syllabus' was used more often in South Africa among educators and non-educators, but this changed in 1998 with the implementation of Curriculum 2005 in South African schools (Du Toit, 2011). The implementation of Curriculum 2005 was a move from the National Curriculum Statement (NCS) to the Curriculum and Assessment Policy Statement (CAPS). CAPS is an amendment to the NCS Grades R-12, so that the curriculum is more accessible to teachers. This means that every subject in each grade has a single, comprehensive and concise CAPS that provides details on what content teachers must teach and assess on a grade-by-grade and subject-by-subject basis. With the change to Curriculum 2005, the vision for education was to integrate education and training into a system of lifelong learning (DoE, 1997). Outcomes-based education was adopted as the approach that would enable the articulation between education and training, recognition of prior learning and thus increased mobility for learners (Graven, 2002).

In the past, a number of South African institutions offered post-school education, usually aimed at qualifications for professions. Former agricultural colleges did not include degrees in their programme repertoires although agricultural programmes were included in university curricula and technical programmes in the former technikon curricula for a long time. This situation changed gradually as some agricultural colleges continued to offer non-degree programmes alongside degree programmes offered at universities (Botha, 2009). This is also the current situation at EATI.

One of the main aims of EATI is to train students to become life-long learners who are more responsible for their own learning. In theory and practice this naturally leads towards a curriculum designed with student and market needs as a focus. However, the importance and value of knowledge and social issues that have an impact on the curriculum cannot be ignored and should be strengthened (Du Toit, 2011). In general, the overall number of students in agriculture has increased significantly (see Table 2.1). The number of students who applied has increased, as has the number of students who took longer to complete their studies (see Table 2.1).

Table 2.1: Performance indicators for Agriculture training in the Western Cape Province: 2012/13

Sub-programme 7: Higher Education and Training					
Performance Indicator	**Actual achievements 2011/12**	**Planned target 2012/13**	**Actual achievement 2012/13**	**Deviation from planned target to actual achievement 2012/13**	**Comments on deviations**
National Transversal Indicators:					
Number of students registering for accredited Higher Education and Training (HET) qualifications.	454	350	401	51	The number of students who applied has increased, as has the number of students who took longer to complete their studies.
Number of students completing accredited Higher Education and Training (HET) qualifications.	128	70	140	70	The throughput in the final year is much higher than other years of study.

(Source: DoA, 2014)

At the same time, the ethnic mix of student bodies is changing; consequently, changes have to be made to the curricula. In 2005, white students comprised 89% of enrolments, followed by coloured students (11%) (Cloete, 2012). No African and Indian students were enrolled at EATI. The number of male students in 2005 was higher than females, at 87% compared to 13% respectively (Cloete, 2012). In 2011, white students comprised 69% of enrolments, followed by coloured students (19%) and the African and Indian students constituted 17% of students enrolled at EATI (Cloete, 2012). The number of male students during the 2011 academic year was still higher than that of females, at 72% compared to 27% respectively (Cloete, 2012). From the data provided it is clear that EATI experienced a gradual increase in the enrolment of African, coloured, and Indian students. A more diverse group of students was therefore enrolled between 2005 and 2011. There was also a gradual increase in the enrolment of female students from 2005 to 2011 with a decrease in the percentage of total male enrolments.

With changing student demographics as one challenge, there are more challenges facing the DoA and consequently EATI. For instance, the DoA developed an Agricultural Education and Training (AET) strategy in an attempt to improve agricultural production through the rendering of quality agricultural education and training services. The AET strategy identifies certain challenges in their aim to ensure the provision of quality AET curricula. These issues and challenges experienced with regard to agricultural curricula are:

- A lack of coordination and harmonisation of AET policy and curriculum
- A lack of coordination of AET provision at provincial level
- AET curricula that are not aligned and responsive to the challenges facing agriculture in South Africa
- Disparities in agricultural skills offered to students from different ethnic backgrounds by learning institutions and racial disparities in the access to such learning opportunities
- Poor mobility and transferability of agricultural learning between different AET institutions – for instance, an AET curriculum that is not relevant to the needs of Extension Officers and/or not accessible to them (DAFF, 2008).

It seems important that such challenges are properly addressed by AET institutions and curricula. The curriculum for the PAS 111 module is discussed in depth in 2.2.3.3. Next I briefly look at EATI as the institutional and programmatic context for the study.

2.2.1 The context of Elsenburg Agricultural Training Institute (EATI)

The Elsenburg Agricultural Training Institute (EATI) was established in 1898 as the first agricultural college of its kind in South Africa. The college delivered its first graduates at the end of the academic year in 1899. During the first 14 years of the college’s existence, an average of 44 students was enrolled at the college per year. Thereafter, an association with Stellenbosch University (SU) was established in 1926, where after a diploma course was offered to equip prospective farmers with a qualification. In 1921, this course was replaced by a one-year course, which was replaced by a practical course in 1931. In 1939, a two-year diploma course was reinstated. In 1973, the national Department of Agriculture accepted responsibility for agricultural training at the college. In 1976, the college started their first diploma course in Cellar Technology; where after their relationship with SU was again initiated in 2004. Since then, EATI has been offering a BAgric programme in association with SU (EATI, 2011).

The vision of EATI is stated as follows: "The advancement of Elsenburg Agricultural Training Institute as an agricultural and educational centre of excellence to the benefit of the broader community" (EATI, 2011). The current study was therefore deemed necessary to ensure accountability towards this stated vision as no similar recorded study was previously conducted.

Currently, there are two levels of training offered by EATI which are accredited needs-driven training. These training levels include two sub-programmes which are higher education and training (HET) and further education and training (FET). HET offers the BAgric, Higher Certificate, Diploma and Equine programmes. FET offers the short skill courses and learnership training.

The programme of interest here is the BAgric which forms part of the higher education programme offering at EATI. The purpose of the programme is to deliver graduates that are technically competent in the field of agricultural production techniques and who are able to manage a specific production unit with minimal supervision within the context of sustainable management.

2.2.2 Overview of the BAgric programme

The BAgric programme is offered in collaboration with the Faculty of AgriSciences at SU. This institutional association corresponds with the government's new academic policy to provide higher education students with increased mobility between educational institutions. Students reside on the EATI campus where they receive all their training. At the same time, all agricultural colleges are controlled by the provincial departments of Agriculture in South Africa.

The BAgric programme in applied agricultural production and management is practically oriented and at the same time provides the necessary scientific depth to fulfil in the needs and challenges of modern agriculture (EATI, 2011). The emphasis is on the economic and technical management of commercial farming and agriculture-related production systems. Students may choose two majors from a wide range of study fields consisting of combinations of agritourism, agronomy and pastures, animal production (large stock and small stock), vegetable production, cellar management, cellar technology, entomology, pomology, extension and viticulture and oenology. Basic and support modules such as soil science, agribusiness management, agricultural engineering, biology, communication, computer literacy, natural resource management, principles of agricultural science, entrepreneurship and crop protection form part of the programme. The titles of the qualifications awarded within this programme are: BAgric in Animal Production, BAgric in Plant Production, BAgric in Plant and Animal Production, BAgric in Cellar Management, BAgric in Cellar Technology, BAgric in Agritourism and Plant Production, BAgric in Agritourism and Animal Production, BAgric in Extension and Plant Production and BAgric in Extension and Animal Production. Each programme is offered over a period of three years and is registered at level 7 on the Higher Education Qualifications Framework (HEQF). Students need to obtain a minimum of 360 credits to graduate at the end of the programme. (The outline of the programme is set out in the BAgric Prospectus available at www.elsenburg.com).

After obtaining the BAgric qualification, students could be equipped for managerial positions in a wide range of agribusinesses. Students are also able to enter careers in disciplines such as research, extension, training and education (EATI, 2011). The broad learning outcomes of the programme are stipulated as follows (EATI, 2011:6):

Knowledge

> The graduate should have knowledge of the applicable scientific concepts, the interaction between the biological and abiotic factors in the environment and the basic principles of research methods and methodology. The graduate should have the ability to create new knowledge, generate ideas and act innovatively. They should have the ability to function effectively in an interdisciplinary environment and have and understanding of sustainable development and sustainable resource management. It is important that the graduate will be able to manage information, make informed decisions and apply a systems approach to the analysis of environmental problems.

Attitudes

The graduate should have respect for the environment and its users. They should take acknowledgement of their limitations in terms of knowledge and skills and have a positive approach to continuous professional development. The graduate should be involved in and should be able to provide a service to the wider community. The graduate should be a positive example in terms of social responsibility and obligations and should strive towards the highest academic standards.

Skills

The graduate should have the ability to collect, integrate, interpret and apply knowledge specifically to use this information in problem-solving. The graduate should have effective communication with role-players from various environments and backgrounds. The graduate should have sufficient skills to function as an agricultural scientist, either independently or as a member of a team. He or she should also have the ability to utilise relevant resources in the work environment effectively.

From the above it is clear that specialised knowledge, expertise, production and management skills are required for sustainable agricultural production. Such information on programmatic outcomes is important for lecturers – also for me as a lecturer in Viticulture – a subject which forms part of the BAgric in Viticulture and Oenology and Cellar Technology/Management.

The minimum requirement for admission to the BAgric programme according to the new school curriculum is a National Senior Certificate (NSC) as certified by Umalusi, the school qualifications regulator in South Africa. Students must have a minimum of 50% in each of the four school subjects from the list of recommended university admission subjects. The four admission subjects are (EATI, 2011:8):

- Afrikaans or English (Home Language or First Additional Language) and
- Mathematics or Mathematical Literacy and
- Physical Science or Life Science or Agricultural Science plus
- One of the following subjects as recommended for admission by the University: Business Studies, Dramatic Arts, Economics, Geography, History, Religious Studies, Information Technology, Engineering Graphics and Design, Music, Accountancy, Consumer Studies, Visual Arts, Languages (1 language of learning and teaching at a higher education institution and 2 other recognised language subjects).

It is compulsory for a student to have a minimum of one subject in science, for example Physical Science or Life Science (EATI, 2011). The purpose of the programme and the qualifications it offers is to deliver a graduate who is technically competent in the field of agricultural production techniques and is able to manage a specific production unit with minimal supervision in the context of sustainable resource management. The graduate agriculturist should have the necessary knowledge, skills and attitude to function independently, or in a team, in an agricultural environment. This includes the judicious application of science to the management of the value chain of a variety of food and fibre products in an economical, environmentally friendly and sustainable way for the benefit, betterment and welfare of humanity (EATI, 2011).

The methods used for assessment of the modules are scheduled written tests, practical tests and continuous practical evaluation in the field as well as written examinations and various other methods depending on the module. Examinations are used to provide information about students. This information is used by the students themselves as an incentive to learning, enabling them to appreciate their own progress and highlighting their strengths and weaknesses. The information is also used by lecturers, identifying the needs of pupils for individual guidance, and assessing their merits for the purpose of promotion. Examinations are used collectively to provide information about the relative success or failure of the course.

Table 2.2 below summarises all the first-year subjects offered in the BAgric programme. All modules are compulsory in the first year of studies. Students choose their main subjects (production subjects) in the first semester of their second year. The first-year module that is of importance in this study is the Principles for Agricultural Science module (PAS 111) which is offered in the first semester of the first year. PAS 111 falls under the Department of Basic Science. The department structure will be outlined in the following section.

Table 2.2 First-year subjects that students need to enrol for in the BAgric programme at EATI

	FIRST SEMESTER				SECOND SEMESTER			
MODULE	**CODE**	**CREDIT VALUE**	**NQF LEVEL**	**MODULE DESCRIPTION**	**CODE**	**CREDIT VALUE**	**NQF LEVEL**	**MODULE DESCRIPTION**
Agribusiness Management	112	10	5	Introduction to agro-economic concepts	142	10	5	Planning principles for an agribusiness
Agricultural Engineering					142	10	5	Building science, workshop practice
Biology	113	15	5	Basic and cell biology	143	15	5	Biological process
Communication	111	5	5	Introduction to communication principles				
Computer Literacy	112	10	5	Basic computer literacy				
Crop Protection					141	5	5	Safe handling of toxic substances
Natural Resource Management					142	10	5	Principles of dynamics of ecosystems
Principles of Agricultural Science	111	10	5	Basic principles of chemistry	141	5	5	Laboratory use and techniques
Principles of Agricultural Science	121	5	5	Applied mathematical calculations				
Soil Science	112	10	5	Introduction to soil science	142	10	5	Principles of soil science

(Source: EATI, 2011)

2.2.3 Departments in the BAgric programme

Within the BAgric programme there are six departments, namely the departments of Basic Science, Business Management, Viticulture and Oenology, Agronomy, Pomology, Animal Science and Extension Services. PAS 111 falls under the Department of Basic Science of which the structure will briefly be discussed in the next section.

2.2.3.1 Structure of the Department of Basic Science

The Department of Basic Science consists of six lecturers who report to a senior lecturer also known as the manager of the department and is a lecturer in agricultural resource management and soil science (see Figure 2.1). Lecturing staff in this department are required to have a four-year degree and three years' teaching experience within a specific field.

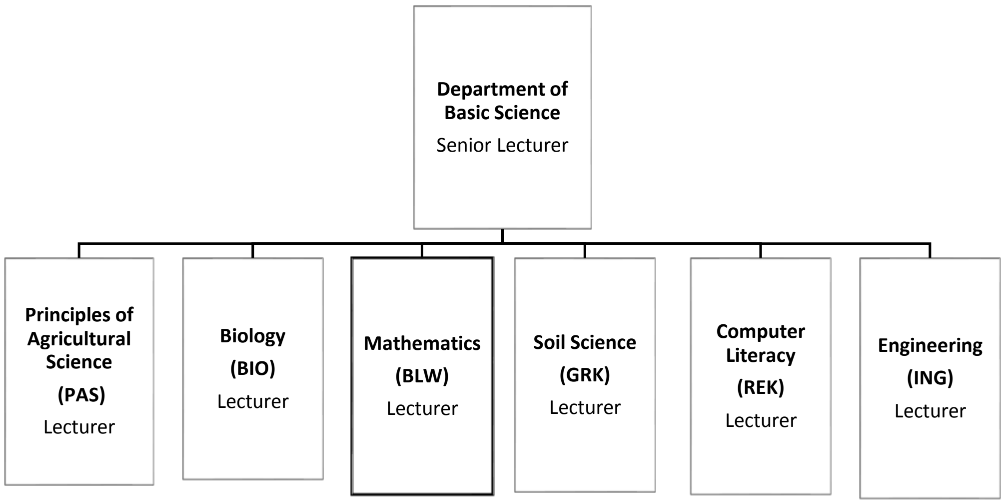

Figure 2.1 Structure of the Department of Basic Science

This department is mainly responsible for all compulsory first-year modules which are Principles of Agricultural Science, Biology, Mathematics, Soil Science, Computer literacy and Agricultural Engineering. The Principles of Agricultural Science module is of importance to this study and it is outlined in the following section.

2.2.3.2 The Principles of Agricultural Science (PAS 111) module

The PAS 111 module falls under the Department of Basic Science and is pitched at HEQF Level 5. The module serves as a prerequisite for Crop Protection 1 and 2 and Animal Production 212. The module has a credit value of 10.

The aim of the module is for the students to know and understand the basic concepts and definitions in chemistry and to gain knowledge on various types of chemical bonds that exist.

On completion of this module, students should be able to demonstrate the ability to solve, calculate, use, interpret, relate, manipulate, apply, classify and put into practice the concepts covered during the course (EATI, 2012).

The module content includes:

- atoms and atom structures
- concepts such as electrons, protons, atom mass, electron structure of atoms and the periodic system of elements
- ions and ion formation and its importance in chemical equations
- concentration expressions, normality, molarity and chemical formulae
- chemical compounds, the characteristics of compounds, solutions and acid base
- physical behaviour of liquids and gases, the characteristics of temperature, phase changes and the transmission of heat
- introductory organic chemistry, alkanes, alkenes, alkynes, alcohols, ethers, esters, aldehydes and ketones, carbocylic acids, amines and amides (EATI, 2011).

The learning outcomes for this module are for students to:

- display a general understanding of basic anatomic and elemental characteristics
- demonstrate an understanding of stoichiometric relationships, balance simple chemical equations
- demonstrate an understanding of redox reaction theory
- describe the historical development of the atomic model
- understand the electronic basis of the periodic table
- understand the basic concepts of modern quantum theory
- describe ionic and covalent bonding
- name simple inorganic compounds
- draw Lewis structures given the chemical formula of a molecule
- comprehend the physical trends (atomic size, electron affinity) in the s- and p-blocks of the periodic table (EATI, 2012).

Graduate attributes for this module are:

- respect for the environment and its users
- acknowledgement of own limitations in terms of knowledge and skills
- a positive approach to continuous professional development
- involvement in and service to the wider community
- a positive example in terms of social responsibility and obligations
- acceptance of and striving towards the highest academic standards (EATI, 2012)

Both formative and summative methods are used to assess student performance. Question papers include selected response and short answers and extended written response questions. In selected response and short answers students select the correct or best response from a list provided. Formats for this type of questions include multi-choice, true or false, matching, short answer and fill-in questions. Extended written response questions require students to construct a written answer to a question or task. Formats for these types of questions include comparing pieces, analysing, interpreting, solving, and describing in detail. Forms of feedback are generic (class marking), student-steered (self-assessment), electronic (email) and in-field (co-grading).

Students who are enrolled for the BAgric programme have access to support services such as the EATI orientation programme at the beginning of the year, as well as the Centre for Student Counselling and Development and the Library and the Language Centre which are based at SU.

The Department of Basic Science provides three additional support services to its students. The first form of academic support provided to first-year students is through a summer school programme (introduction to course) before the start of the academic year. However, the summer school programme is not implemented every year. The second form of academic support is through a tutorial programme which provides opportunities for students to discuss work for clarification on issues that they do not fully understand. The problem, however, is large numbers of students and also that some tutors are not equipped with the necessary skills to conduct the tutorial successfully. The third form of academic support provided by EATI is the library access to resources. This support is available but limited. No other forms of academic support are provided by EATI.

2.2.3.3 Analysis of the PAS 111 curriculum

Posner (1992) states that people have different conceptions of the meaning of curriculum. Some people define a curriculum as the content or objectives for which schools hold students accountable, while others claim that the curriculum is a set of instructional strategies teachers plan to use. Posner (1992) highlights six common concepts of the curriculum and explains how each one of the concepts has different meanings.

- Scope and sequence: the depiction of curriculum as a matrix of objectives assigned to successive grade levels and grouped according to a common theme
- Syllabus: a plan for an entire course, typically including rationale, topics, resources, and evaluation
- Content outline: a list of topics covered organised in outline form
- Textbook: instructional materials used as the guide for classroom instruction
- Course of study: a series of courses that the student must complete
- Planned experiences: all experiences students have that are planned by the school, whether academic, athletic, emotional, or social

There are five types of concurrent curricula which contribute significantly to the education of students, namely the official curriculum, the operational curriculum, the hidden curriculum, the null curriculum and the extra curriculum (Longstreet & Shane, 1993; Olivia, 1997; Posner, 1992). These types of curricula need to be considered when trying to analyse a curriculum.

Porter (2004) defines curriculum analysis as the systematic process of isolating and analysing targeted features of a curriculum. Curriculum analysis most commonly involves describing and isolating a particular set of content in a curriculum and then analysing the performance expectations, or cognitive demand, that describe what students are to know and do with the content. Through systematic analysis of the curriculum, educators can begin to compare and contrast various aspects across multiple curricula. Curriculum analysis can also be described as an attempt to tease a curriculum apart into its component parts, to examine those parts and the way they fit together to make a whole, to identify the beliefs and ideas to which the developers were committed and which either explicitly or implicitly shaped the curriculum, and to examine the implications of these commitments and beliefs for the quality of educational experience (Posner, 1992).

To analyse the curriculum of the PAS 111 module presented at EATI, the following set of curriculum analysis questions by Posner (1992) was used. The reason for the use of this set of criteria was to determine whether the curriculum is appropriate for learning PAS 111 in agriculture.

First Set: Curriculum Documentation and Origins

1. How is the curriculum documented?
    a. On what documents and other resources will the analysis be based?
    b. On what aspects of the analysis do the documents focus?
    c. What limitations do you find in the documentation?
2. What situation resulted in the development of the curriculum?
    a. Who made up the cast of characters in the development of the curriculum? What were their names, with what institution were they affiliated, and what were their respective roles in the project? Within the project team, who represented the learners, the teachers, the subject matter, and the milieu? Was there an obvious blind spot on the team?
    b. To what social, economic, political, or educational problem was the curriculum attempting to respond?
    c. What planning foci dominated the curriculum development process?
3. What perspective, if any, does the curriculum represent?

Second Set: The Curriculum Proper

4. What are the purposes and content of the curriculum?
    a. What aspects of the curriculum are intended for training, and what aspects are intended for education contexts?
    b. At what level, if at all, does the curriculum express its purposes?
    c. What educational goals and educational aims are emphasised, and what are their relative priorities?
    d. What types of learning objectives are included and emphasised in the curriculum?
    e. What are the primary ways in which the curriculum represents the subject matter to students?
    f. What conception of the subject matter is apparent in the curriculum?

5. What assumptions underlie the curriculum's approach to purpose or content?
    a. What conceptions of learning, objectives, curriculum, and instruction underlie the materials you are analysing?
    b. What aspects of a hidden curriculum are likely to accompany the conceptions and perspectives underlying the curriculum?
    c. To what extent is the curriculum likely to play a hegemonic role in terms of purposes or content?
6. How is the curriculum organised?
    a. What provision, if any, is made for the macro-level vertical and/or horizontal organisation?
    b. What basic configurations of content are found more at a micro-level?
    c. How are the various media organised to deliver the curriculum?
    d. What organisational principles are employed?
    e. What is the relative status of the curriculum's subject matter?
7. What assumptions underlie the curriculum's organisation?

Third Set: The Curriculum in Use

8. How should the curriculum be implemented?
    a. What are the temporal, physical, organisational, and political-legal requirements of the curriculum?
    b. What are the probable costs and benefits associated with the curriculum change?
    c. To what extent will the curriculum be consistent with and appropriate for the teachers' attitudes, beliefs, and competencies?
    d. What values are embedded in the curriculum, and how well are these values likely to be suited to the community?
9. What can you learn about the curriculum from an evaluation point of view?
    a. What, if any, data does the curriculum provide? What conclusions about the curriculum seem warranted based on the data provided?
    b. What instruments or suggestions for collecting data does the curriculum provide?
    c. What are your concerns about the curriculum that could be clarified by evaluation data? Consider short-term outcomes, long-term outcomes, antecedents, and transactions.

   d. Does the approach to student evaluation in the curriculum manifest a measurement-based or an integrated approach, or both?
   e. What would a radical evaluation of the curriculum look like?

Fourth Set: Critique

10. What is your judgement about the curriculum?
    a. What are its strengths and weaknesses?
    b. Of what dangers would you want to be careful if you implemented it?
11. How would you adapt it to maximise its benefits and minimise its limitations?

These criteria were used to analyse the PAS 111 module in the BAgric programme presented in Chapter 5. It is important that when designing a curriculum, the backgrounds of students, the nature of the subject, student learning approaches as well as the needs of the industry that have an impact on the curriculum should be accounted for. It is thus important to analyse a curriculum in ways that ensure that these criteria are met. It is also important that quality teaching and learning remain a main focus area of any curriculum to improve academic performance.

2.3 CONTEXTUALISING THE 2013 ACADEMIC YEAR IN PAS 111

At EATI the total number of students registered for PAS 111 depends on the intake of first years but is never more than 120 or lower than 80 students. However, the failure rate for this subject has been significantly high for the past years. For instance, the failure percentage for the past four years was 34% in 2010, 16% in 2011, 24% in 2012, 38% in 2013, 25% in 2014 and 16% in 2015. EATI found these statistics alarming and the need arose to investigate the possible academic factors that influence the success of the first-year BAgric students.

According to the senior lecturer in the department of Basic Science, the academic year of 2013 started off on a chaotic note with confusion regarding the orientation programme of the first-year students. Classes started two weeks earlier than the scheduled academic year with a one-week break and resumed with the senior students after this. During this particular week, lecturers could not start with their normal practical and tutorial programmes as the time table that is normally followed was interrupted and students were more involved with Rag activities.

A complete week of formal tuition, practicals and tutorials was lost and had to be repeated in a short space of time.

The failure rate for 2013 was remarkably high. This study thus focuses on this particular year. Also, students who enrolled for PAS 111 in 2013 were easily accessible as respondents as they were in their second year and still on campus. The high failure rate for PAS 111 is of much concern, because failure in this module might lead to a complete cessation of studies or an extension of years on campus because PAS 111 is a prerequisite for other subjects. Teaching techniques such as tutorials in smaller groups, summer schools and the appointment of new lecturers have been experimented with, but did not change the trend that students still fail at a high rate as indicated above.

According to the head of department at EATI, the students had a difficult time during their first semester. Lecturers, particularly ones that teach first-year groups, experienced radical decision making from a senior manager who had no understanding of the scope of work or the dynamics of the group of students in their first year. Working conditions became unbearable and four lecturers resigned during this time while others attempted to find a new job.

From this particular group of first-year intake, only a few students had physical science at school level. These results are discussed in depth in Chapter 4. This corresponds with results from the National Benchmarking test (HESA, 2006) and the lecturer had to cover knowledge that was assumed should be in place first, before she could start with her syllabus. A local and affordable textbook was prescribed to help students but they failed to obtain the book and expected the lecturer to provide all additional learning materials such as a printout of presentations and tutorial memorandums. This led to learning material that did not match with presentations and students became confused with the structure of the content. Students thus ended up confused with the learning content and did not have sufficient time to discuss their concerns and problems with lecturers.

2.4 CONCLUDING SUMMARY

This chapter provides an overview of EATI, focusing on the BAgric programme and the curriculum of the PAS 111 module offered at the institution. Numerous challenges proved to have affected the PAS 111 module – especially in the Department of Basic Science. The students' failure rate in this module increased from 24% in 2012 to 38% in 2013. One of the challenges associated with this increase in failure were students with no background knowledge of chemistry because taking the subject at school level was not one of the admission requirements. Other challenges were associated with learning material that was not up to standard and tutorials that were missed. Therefore, analysing the PAS 111 module seemed an appropriate project as a start to identify related challenges and to investigate the cause of problems within this department. This is against the background of EATI which strives to produce graduates with appropriate knowledge, attitudes and skills to be successful entrants into the agriculture industry. Chapter 3 focuses on literature related to the key concepts of the study and some background factors that seem to influence student performance in chemistry.

CHAPTER THREE
THEORETICAL PERSPECTIVES

3.1 INTRODUCTION

A number of studies have been conducted on the academic performance of students entering higher education (Huysamen, 2003; Masitsa, 2004; Pillay 2004). Research conducted on the success of first-year students at higher education institutions indicates that one out of every three students will have dropped out of university by the end of their first year (Groenewald, 2005; Scott et al., 2007). Moreover, higher education institutions are plagued by poor throughput rates (Nair & Pillay, 2004) and given the low output of schools in science and technology, every student who fails or drops out is a significant loss to the country (Carnoy & Chisholm, 2008; Van der Berg & Louw, 2006).

From a pragmatist view, effective teaching may play an important role in helping students to succeed whose learning focus are on hands-on problem solving, experimenting, learning projects and working in groups to resolve issues. Rather than passing down organised bodies of knowledge to new learners, pragmatists believe that learners should apply their knowledge to real situations for careers, citizenship and daily living (Plowright, 2011). Effective teaching, however, is not the only factor that may be influencing student success at higher education.

One factor that has been researched and was indicated as influencing students' success is the students' ability to utilise appropriate learning approaches (Hasnor, Ahmad & Nordin, 2013; Malie & Akir, 2012). However, much criticism has been levelled by researchers as to how students should approach their learning to enhance their academic performance (Biggs, 1987; Louw, 2005). Much of the research indicates that students use different learning approaches and strategies which, in turn, influence their academic performance. However, students' learning approaches may be only one of the factors that influence academic performance (Louw, 2005; Malie & Akir, 2012).

From a teaching perspective, it seems necessary for a teacher to have not only a good knowledge of the subject to be taught, in this case, chemistry, but also a well-developed understanding of how students learn. Different researchers have re-examined the perceptions, beliefs and opinions about chemistry (Price & Hill, 2004) and the focus of research has switched from analysing students' learning to their beliefs, knowledge and attitudes (De Jong, 2007). Studies also show that students often perceive chemistry as abstract, difficult and disconnected from relevant problems in everyday life (Black & Atkin, 1996). In South Africa, many first-year students in chemistry present an inadequate knowledge of the fundamental principles which underpin the study of chemistry (Marais, 2011; Rollnick et al., 2008). Ongoing research at the Tshwane University of Technology indicates that this problem emanates from students' secondary education and the problem is compounded by a shortage in skilled teachers in science at schools in the country (Marais & Mji, 2009). Students may bring an accumulation of assumptions, motives, intentions and previous knowledge that envelopes every teaching and learning situation and determines the course and the quality of learning that may take place (Biggs, 1996; Louw, 2005). Various factors thus seem to be influencing students' success and their performance in a subject such as chemistry.

Other influential factors include the changed and increasingly diversified student population in higher education across the world (Cross, 2004). This fact amplifies the need for chemistry lecturers to take note of their students' assumptions, motives, intentions, and previous knowledge that may influence their academic performance (Byrne & Flood, 2005). For instance, Louw (2005) proposes in his study on first-year dropout rates at EATI and three other South African higher education institutions a conceptual framework which includes sets of factors that could potentially contribute to early student departure. These factors are more broadly discussed in section 3.5.1 and include eight indicators in the academic dimension and four in the social dimension.

Biggs (1996), Byrne and Flood (2005), as well as Louw (2005) point toward possible factors that may influence the teaching and learning environment and which provide room for further investigation into chemistry education in higher education and agriculture training in particular. Factors that potentially influence students' academic performance are incorporated in Astin's (1999) input-, environment-, output model as a guide to interpret the data generated in the study and reported in Chapter 5. Such knowledge may provide valuable information to first-year students, lecturers and the planners of foundation programmes at EATI and similar agriculture training institutes. How students learn in general and also how they learn a particular subject or discipline seems to be one of the cornerstones of academic achievement. The following section therefore provides a more in-depth overview of learning and specifically learning in chemistry while other sections in this chapter explore further factors that may influence learning and consequently academic performance.

3.2 CONCEPTUALISING LEARNING

This section focuses on student learning and provides some background information on learning theories, how students learn and, more importantly, approaches students take to learn chemistry.

3.2.1 Learning theories

Learning theories have evolved over many decades through the work of research and education pioneers, and various attempts have been made to categorise them. An example of such categorisation is that of Orstein and Levine (1985), who discussed the work of educational pioneers from which at least 12 learning theories originated. Based on these categories, Schunk (2008), for example, distinguishes between two over-arching groupings, namely behavioural learning theories and cognitive learning theories. Schunk (2008:16) states that "behavioural theories view learning as a change in the rate, frequency of occurrence, or form of behaviour or response, which occurs primarily as a function of environmental factors. Behavioural theories contend that learning involves the formation of associations between stimuli and response." He classifies Pavlov's classical conditioning and Skinner's conditioning theories as behavioural theories. Cognitive theories, however, according to Schunk (2008:16–17), "stress the acquisition of knowledge and skills, the formation of mental structures, and the processing of information and beliefs". These two groupings provide some insight into the early research that was carried out by researchers about how people learn. Much research and many experiments were conducted that gave prominence and validity to these two over-arching groupings of theories on how people learn (Schunk, 2008).

However, these theories were questioned and critics thereof highlighted the fact that they were limited in their application and did not consider other factors that could influence learning (Schunk, 2008). In spite of such limitations there appears to be some merit in both of these categories of theories. However, when new knowledge is constructed, a change in behaviour ought to occur and it would result in personal growth and development (Killen, 2000, 2005; Nieman & Pienaar, 2006). The motivation to learn and to continue learning could be based on environmental factors, as Pavlov and Skinner argued, but it could equally be based on other factors such as intrinsic motivation, role models, and the need for self-actualisation (Biggs, 1993; Maslow, 1970; Schunk, Pintrich & Meece, 2008). According to cognitive theories, the acquisition of new knowledge involves cognition and the extent to which one is able to use and apply one's cognitive skills (Marton & Booth, 1997; Monteith, 1996). Criticism of cognitive theories may thus be justified as there are other factors that also contribute to successful learning as Killen (2000, 2005), Kuh, Kinzie, Schuh, Whitt and Associates (2005), Landsberg (2005) and Strydom and Mentz (2010) advocate. The following section focuses on a more holistic meaning of learning to the student and the student's approach to learning.

3.2.2 Research into student learning

Learning is the 'transformation of internal representations': learning may be said to have occurred if the mental processes by which one represents reality and internal understandings have been changed in enduring ways that are adaptive or advantageous to the individual, and not simply the results of maturation (Holloway, 1978; Shazia & Ganai, 2014). Any learning situation involves an interaction of three factors: a task to be accomplished, a method of learning it, and a learner. Other researchers, such as Bransford, Brown and Cocking (1999), describe concepts of learning under five areas based on research from the past 30 years. According to Bransford *et al.* (1999), the five areas of learning are memory and the structure of knowledge, analysis of problem solving and reasoning, early foundations, metacognitive processes and self-regulatory capabilities, and cultural experiences and community participation. These authors note that there was a move away from teacher-centred learning to how students understand and apply learned knowledge, thus a move to student-centred learning. These areas resonate with mainstream theories that learning is socially situated (Bransford et al., 1999).

More resent research by Illeris (2002) describes learning under three dimensions: cognitive, emotional and social. By integrating the cognitive, behavioural and social dimensions of learning, Illeris (2002) provides a more holistic representation of how learning occurs. Illeris (2002:18) states that, within the cognitive dimension, learning is seen to include both knowledge and motor learning skills that are controlled by the central nervous system and that form part of the cognitive process. The second dimension implies that learning is an emotional process, or what psychologists will refer to as a psychodynamic process involving psychological energy, transmitted by feelings, emotions, attitudes, and motivations, which combine and, at the same time, are conditions that may be influenced and developed through learning. The third and last dimension portrays learning as a social process, taking place in the interaction between the individual and his or her surroundings, and thus in the final analysis a process dependent on historical and societal influences (McGhie, 2012).

Further research indicates that the current focus of student learning research is the relationship between the context of learning (which includes teaching) and the type of learning that students engage in (Biggs, 1993; Biggs, Kember & Leung, 2001). Student approaches to learning is one theme that has been extensively explored (Marton & Säljö, 1976; Ramsden, 2003). Research in this area shows that students tend to approach their learning in more than one way and that such different approaches lead to different levels of quality of learning outcomes and therefore influence academic success. For this reason, learning approaches are discussed in more detail in the following paragraph.

3.2.3 Approaches to learning

Ramsden (2003) describes an approach to learning as a "relation between the student and the learning he or she is doing". The term 'learning approach' refers to the students' intentions when facing a learning situation and the way they engage their learning tasks or assignments (Watkins, 2001). It is evident that approaches to learning are heavily influenced by assessment procedures, dependency on teachers, time available and the quality of teaching (Nagel, 2005).

However, several studies suggest a connection between students' approaches to learning and their learning outcomes (Marton & Säljö, 1976; Ramsden, 2003). Research has also been conducted into the relationship between best practices in teaching by teachers and best practices in learning by students. Results from such research are varied. For instance, some research indicates that students can adopt different approaches to learning, defined classically as deep, surface (Marton & Säljö, 1976) and strategic approaches (Entwistle & Ramsden, 1983). There are other examples where research has shown relations between students' deeper approaches to learning and higher quality learning outcomes (Trigwell, Prosser & Waterhouse, 1999).

In addition, a wide variety of individual learning styles and approaches has been identified and it would not be safe to conclude that any single approach would meet the needs of an entire group of students (Wishart, 2005). Other findings indicate that students have different levels of motivation, different attitudes towards teaching and learning and different responses to specific classroom environments and instructional practice (Felder & Brent, 2005). Interestingly, the broad distinction between an orientation towards comprehending the meaning of learning materials (deep approach) and orientation towards merely reproducing those materials (surface approach) seems to be a universal feature of all systems of higher education (Richardson, 1994). In general, these two approaches to learning are predominant in education literature (Cano, 2005; Chin & Brown, 2000; Marton & Säljö, 1997; Trigwell et al., 1999).

Students who learn by rote or a surface approach are often unable to construct a holistic understanding of what they are learning. Such approaches may allow them to pass examinations, but are mainly about “quantity without quality” (Ramsden, 2003:117). The intention is to cope with the course requirements. This involves, for example, treating the course material as unrelated pieces of knowledge, carrying out procedures routinely, finding it difficult to make sense of new material, seeing little value in courses and tasks, studying without considering the purpose or strategy, feeling undue pressure and worrying about the work and the syllabus requirements (Almeida, Teixeira-Dias, Martinho & Balasooriya, 2011; Lovatt, Finlayson & James, 2007).

In contrast, deep learning approaches integrate facts into a holistic learning of concepts. Students with the ability to use deep approaches may use surface approaches when the task demands it, such as learning a large amount of material quickly for an examination, but without finding such tasks satisfying (Ramsden, 2003). Thus, good performance in examinations may be the result of either a surface approach or a deep learning approach, raising important concerns about the ability of examinations to identify or result in effective learning (Hazel, Prosser & Trigwell, 2002). A deep approach depends on the teacher providing a suitable learning context and the students taking more responsibility for their own learning strategies (Bolhuis, 1996; Entwistle, 1987:101; Taylor, 1995).

Students who adopt a strategic learning approach relate ideas to previous knowledge, look for patterns and underlying principles, and use evidence and relate it to conclusions. They examine logic and arguments cautiously and are critically aware of the understanding developed while becoming actively interested in the studied content (Almeida et al., 2011). The students’ study behaviours are heavily moderated by the requirements of assessment tasks, but are generally highly structured and efficient (Gordon & Debus, 2002). Where feasible, it seems to be more advantageous to allow students to choose styles of learning which suit them and to assist students in recognising their own preferred learning styles (Entwistle, 1987:98).

Personal development also plays a role in the learning process and involves those attitudes, skills, and values that enable one to understand and reflect on one's thoughts and feelings; to recognise and appreciate the differences between one-self and others; to manage one's personal affairs successfully; to care for those less fortunate; to relate meaningfully with others through friendships, marriage, and civic and political entities; to determine personally and socially acceptable responses in various situations; and to be economically self-sufficient. These qualities are usually associated with satisfaction, physical and psychological well-being, and balanced, productive life of work and leisure (Kuh et al., 2005; Kuh, Krehbiel & MacKay, 1981).

Gow and Kember (cited in Fourie, 2003:123) state that the quality of teaching and the attitude of teachers influence students in their approach to learning. Nevertheless, most South African researchers have concentrated on students' approaches to learning in a broad content domain, such as science. Given the nature of different domains in the field of science, such as physics, chemistry and biology (Tsai, 2006) and based on previous research results, this study planned to focus partially on students' approaches to learning in chemistry.

3.2.3.1 Identifying students' learning approaches

Cano (2005) revealed that approaches to learning are a significant factor in predicting students' academic achievement. Tools used to identify students' learning approaches and strategies are thus important in order to determine how to approach teaching chemistry.

One such tool is the 'Learning-to-learn' programme in first-year Chemistry which is a programme used at one Australian university (Zeegers & Martin, 2001). The programme seeks to address the problem of high student attrition and failure in first-year introductory chemistry through the introduction of a student-focused learning-to-learn programme presented in context and which uses authentic course material. The programme focuses on developing students' understanding of the learning process and their own learning, both in general educational terms and in chemistry in particular. The students' approaches to learning in this programme are evaluated and monitored by the use of Biggs's study process questionnaire.

The Study Process Questionnaire (SPQ) (Biggs, 1987) was developed from the earlier 10-scale Study Behaviour Questionnaire (SBQ) (Biggs, 1987), conceived within an information processing framework (Biggs, 1976) in the late 1970s. Students' approaches to learning are conceived as forming part of the total system in which an educational event is located as schematised in the Presage-Process-Product (3P) model (see Figure 3.1) (Biggs, 1993). In the 3P model, student factors, teaching context, on-task approaches to learning, and the learning outcomes, mutually interact, forming a dynamic system.

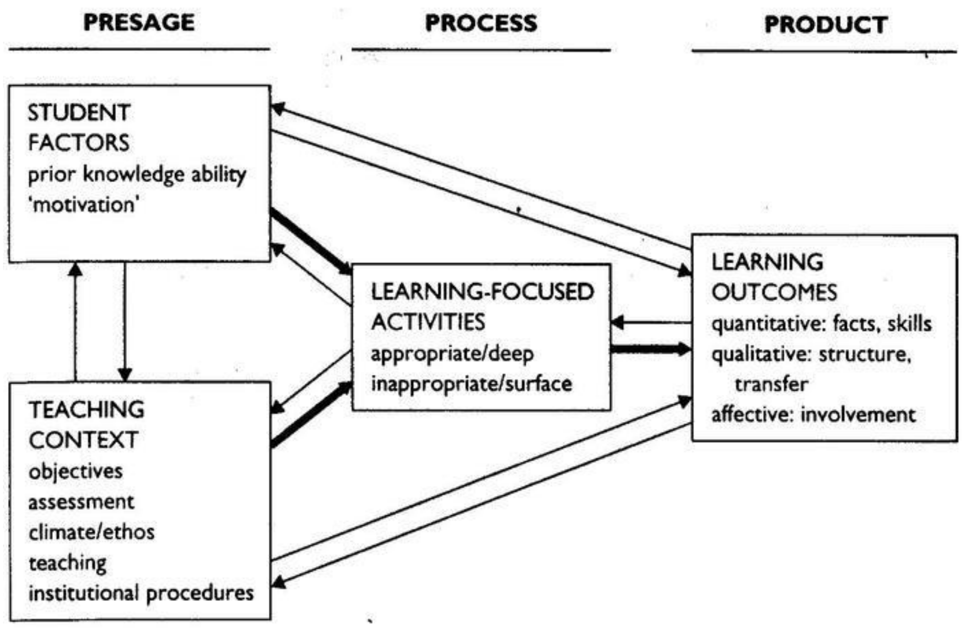

Figure 3.1: The 3P model of teaching and learning (Source: Biggs et al., 2001)

Biggs *et al.* (2001) explain that presage factors refer to what exists prior to engagement that affects learning. On the student side, such factors are prior knowledge, ability, and their preferred approaches to learning; and on the side of the teaching context, the nature of the content being taught, methods of teaching as assessment, the institutional climate and procedures. These factors interact to determine the on-going approach to a practical task, which in turn determines the outcome. However, as the reversible arrows in Figure 3.1 show, each such factor affects every other factor. For instance, the student-preferred approach will adjust to the particular context and course being taught as well as to the success or otherwise of the outcome. The heart of the teaching and learning system is at the process level, where the learning-related activity produces or fails to produce the desired outcomes.

The SPQ constitutes a 42-item questionnaire that provides feedback on the learning approaches in the three domains, namely the surface, deep, and strategic domains, which are further broken down into motives and strategies, which encompass surface motive, surface strategy, deep motive, deep strategy, strategic motive, and strategic strategy (Biggs, 1985). Surface motives are extrinsic, such as fear of failing, and surface strategies include reproductive or rote learning and 'minimalistic' learning – learning that is just enough to meet the demands of the course. Such an approach often leads to poor academic performance. Deep approaches are about seeking to understand and relate understanding to other subjects and develop personal meaning for subject material. However, a deep learner may sometimes wander off track and not follow the course syllabus and outlines. Academic performance, especially in a more structured system, may also be adversely affected. A strategic approach is about maximising performance while optimising efforts to achieve it. These are strategic learners who may use surface or deep approaches – whichever can help them to get high marks (Biggs et al., 2001).

3.2.4 Factors that influence learning

One of the cornerstones of successful student learning is a student's ability to use appropriate learning approaches, but also the ability to integrate her or his learning within the curriculum (Hubbell & Burt, 2004). However, these are not the sole factors that have an impact on academic achievement. Astin (1991) and Louw's (2005) framework, for instance, identified factors that could potentially be challenges to students in their learning process at agricultural training institutions and are therefore discussed in more detail below.

3.2.4.1 Astin's Input-Environment-Output model of student development

What could be termed a 'lens' for this study is primarily derived from Astin's (1999) Input-Environment-Output (I-E-O) model, one of the first influential college impact models to be proposed. The I-E-O model (Figure 3.2) simplifies the complexity of higher education research by examining the interdependence of inputs, environment and outputs. The original purpose of the model was to examine the impact of environmental factors on learning outcomes that account for background characteristics (Astin, 1993).

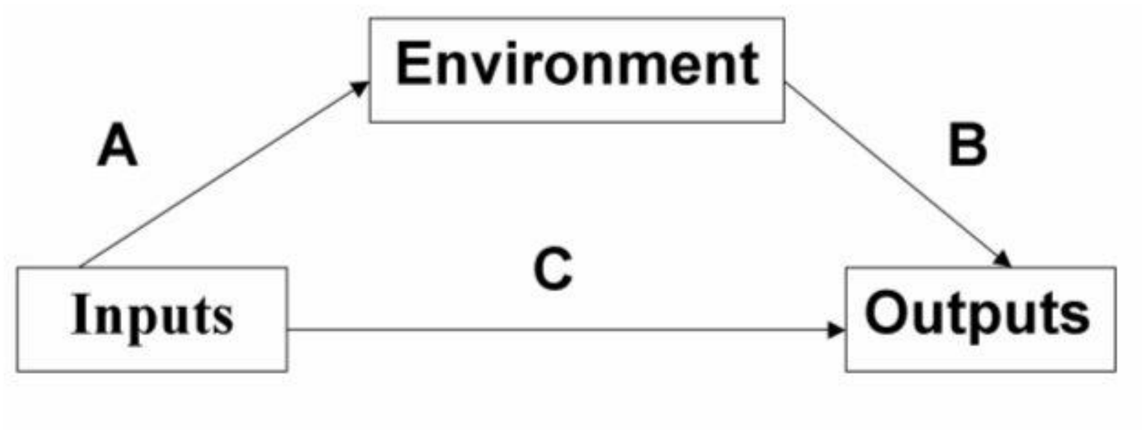

Figure 3.2: Astin's Input-Environment-Output **model (Astin, 1999)**

The I-E-O model allows researchers to examine multiple effects simultaneously, which helps to avoid the problem of a lack of random assignment. As student samples are selected through non-random sampling, the students present with different background characteristics before entering the environment. However, one cannot tell whether background characteristics or environment are responsible for any changes in outcomes (Astin & Sax, 1998). According to Astin (1993:7), "[i]nput refers to characteristics of the student at the time of initial entry to the institution". Input factors can thus be classified into two subgroups: (1) fixed student attributes that include race or ethnicity, gender, and so forth, and (2) cognitive functioning, values and attitudes, and educational background characteristics. Environmental characteristics, in the broadest sense, include anything that happens to a student during college that could affect the learning outcomes in question, where outcomes are the desired aims and objectives of an educational programme (Astin, 1993). The fundamental premise underlying the I-E-O approach (Astin, 1993) is that true educational excellence lies in the institution's ability to affect its students and staff favourably, to enhance their intellectual and scholarly development, and to make a positive difference in their lives.

Central to Astin's theory is the interaction of the student with the environment which translates this interaction into the concept of involvement. Astin found that a student's level of involvement in university activities determines his or her learning and development. He posits that the more students are involved in their studies and in student life, the better the student experience would be (Astin, 1999; also see Jones, 2010). The levels of involvement are not merely a function of the institutional impact on the student, but also an active choice to become involved. The active choice includes devoting time and effort to specific activities which influence the student learning experience. Astin's theory focuses on the motivation and behaviour of the student (Astin, 1999; Pascarella & Terenzini, 1991), but the role of the higher education institution to present opportunities to enhance student involvement is also acknowledged (Pascarella & Terenzini, 2005; Schreiber, 2012).

Astin's (1999) theory postulates five basic ideas:

- Involvement refers to the investment of physical and psychological energy in various objects. The objects may be highly generalised (the student experience) or highly specific (preparing for a chemistry examination).
- Regardless of its object, involvement occurs along a continuum.
- Involvement has both quantitative and qualitative features.
- The amount of student learning and personal development is directly proportional to the quality and quantity of student involvement.
- The effectiveness of any educational policy or practice is directly related to the capacity of that policy or practice to increase student involvement.

Astin's I-E-O model thus provides a conceptual and methodological guide (Pascarella & Terenzini, 1991, 2005) to understand student experience by focusing on what the student brings to his or her learning, how the student interacts and what the student becomes. The purpose of this model is to provide more accurate and comprehensive assessment of environmental impact on student outcomes that controls for input differences (Astin, 1993).

3.2.4.2 Louw's framework

Louw (2005) used Tinto's (1975) student integration model as an interpretive framework in his study on first-year student dropout rates at four South African agricultural training institutions. One of the fundamental principles that Tinto underscored is the existence of a relationship between the student and the institution. Tinto introduced a 'student integration model' after research on student dropout of higher education institutions in the USA. According to Swail, Redd and Perna (2003), Tinto's model is based in part on Durkheim's (1897) theory of explaining suicide and Tinto argues that the social integration of students increases their institutional commitment, which in turn, ultimately reduces student dropout rates.

Tinto's (1975) student integration model consists of six primary characteristics:

- Pre-entry attributes (how the student develops before matriculation to post-secondary education with regard to family background, skills and abilities, and prior-schooling);
- The student's intentions, goals and commitment;
- How the student experiences the institution with regard to the academic social system (academic performance, interaction with staff and faculty) and the social system (extra-curricular activities and peer group interaction);
- How integration is taking place (both academic and social integration);
- The student's intentions, goals, institutional commitment and external commitments; and
- The outcome (decision by the student to remain or to depart).

Tinto proposes that the match between student characteristics and the institution shapes student goals and commitments which in turn, influence persistence (Tinto, 1975). Some have criticised Tinto's model on the grounds that it does not include the interactions of students' off-campus academic and social factors such as finances, family obligations and external peer groups, while others argue that academic integration does not play a very important part in the success rate of students (Baird, 2000; Braxton & Lien, 2000; Swail et al., 2003). However, an important contribution of Tinto's model is its focus on the relationship between the student and the institution. The six characteristics introduced by Tinto also support the argument that the relationship between the student and the institution can influence students' academic performance.

Building on Tinto's model, Louw's study identified eight indicators in the academic dimension and four social dimensions that might potentially influence student departure from agricultural training institutions. As my study focuses only on the academic dimensions as illustrated by Louw (2005), these will be highlighted. According to Louw's findings, academic indicators for early student departure are the following:

- Unclear study goals of students and, related to this, lowered levels of motivation;
- Unrealistic student perceptions of what higher education studies require;
- Substantial gaps in students' foundational and declarative knowledge;
- Inability of students to adjust academically, mainly due to the difference between expectations at the schooling and higher education levels of study;
- Perceived wrong programme choices, mainly related to poor information or weak student counselling;

- Language difficulties, particularly in cases where the language of instruction was different from the student's home or school language;
- The level of difficulty or complexity concerning courses and learning materials; and
- Access granted to students who did not meet the access requirements.

Based on these risk indicators, Louw proposes a conceptual framework (Table 3.1) which points to three sets of factors that could potentially contribute to early student departure.

Table 3.1: Louw's early student departure model

Student background factors	**Student factors**	**Institutional factors**
Self-perceptions of competence Historical experience School support Academic support Self-confidence Learning style Study skills Options and choices	**Academic factors:** Perceived low level of academic integration Learning backlogs Heavy workload Inadequate study skills Lack of foundational knowledge Lack of commitment Lack of confidence	**Academic factors:** Inadequate learning support Inadequate language and communication in classes Large classes Inadequate facilities Inefficient administration Skewed access measures Inadequate teaching Type of assessment Inadequate/wrong course information

(Source: Louw, 2005)

Louw's (2005) study suggests that appropriate attention to risk indicators could limit dropout rates and early departure from higher education institutions (and from agricultural training institutions in particular). Where Tinto's model did not explicitly identify some factors and in some cases the characteristics overlapped, Louw's conceptual framework identified and made explicit factors that could potentially address challenges to the students in the learning process – particularly in agriculture education. Louw's framework underlines the main argument of this thesis, which is that student and institutional academic factors may influence student learning and therefore academic performance. The following section discusses learning in chemistry and methods on how to overcome factors that influence learning in chemistry.

3.3 LEARNING IN CHEMISTRY

It seems important that students be taught how to learn – especially in the field of science education (Nagel, 2005). The way in which students approach their learning is undervalued, as it is assumed that by the time students enter higher education they already know how to study (Fourie, 2003). Therefore, it may be important to teach the skill to learn chemistry through chemistry content.

A number of studies focused on chemistry students' conceptions and approaches to learning chemistry (Lastusaari & Murtonen, 2013; Li et al., 2013; Rollnick et al., 2008), while Clifton *et al.* (2011) focused on chemistry course structures, engagement and achievement of students in first-year Chemistry at the University of Manitoba, Canada. Similarly, Zeegers and Martin (2001) investigated the problem of high student attrition and failure in first-year Chemistry at Flinders University, Australia. The latter institution introduced a programme that focused on developing students' understanding of the learning process and of their own learning but also of how to learn chemistry. These studies, however, did not consider the students' own perceptions of their chances to succeed in university level chemistry.

In South Africa, many first-year Chemistry students have inadequate knowledge of the fundamental principles which underpin the study of chemistry (Marais & Mji, 2009). A study at the Tshwane University of Technology indicated that this may be a problem that emanates from the students' secondary education (Marais & Mji, 2009). Other South African-based studies illustrated a growing body of interest in research into students' understanding of the methods of procedural knowledge in chemistry amongst students entering into bridging programmes (Rollnick et al., 2001). Further research was also based on the relationships between various indicators, notably students' prior school performance, as possible predictors of future academic success (Rollnick et al., 2008). Thus, understanding students' perceptions and the above-mentioned characteristics can potentially play a crucial role in improving students' academic performance.

It is highly commendable that chemistry teachers should try to help students incorporate their learning styles and approaches when they learn chemistry (Rollnick et al., 2008). Chemistry courses do not only incorporate basic general disciplines of mathematics, physics and chemistry but they also involve the following chemistry disciplines: physical chemistry, organic chemistry, inorganic chemistry and analytical chemistry. Many of the traditional methods of teaching chemistry originated from scientific practices of the late nineteenth and early twentieth centuries. During this time, chemistry at the professional level dealt with analysing and classifying substances as well as understanding their properties and structure. In modern times, the work chemists do is more diverse and applied as they apply their knowledge in the field to develop new products and technologies to monitor and understand the world around them (Bulte, Westbroek, De Jong & Pilot, 2006). One of the major goals in teaching chemistry is that students will develop the ability to understand and make decisions about issues they may face in their everyday lives outside of the classroom (King, 2007; King, Bellocchi & Ritchie, 2008). Teachers can thus better prepare students for the modern world by teaching with a novel approach. The following section summarises reported successful strategies used globally to learn chemistry.

3.3.1 Learning strategies in chemistry

Strategies to improve performance in chemistry, as identified from the literature, include the use of context-based learning approaches, interventions such as tutorial schemes, and competence tests (ACS, 1993; Davidowitz & Rollnick, 2005; Pilling, Holman & Waddington, 2001; Pilot & Bulte, 2006). These strategies are subsequently discussed in more detail to identify their potential to improve learning in chemistry.

3.3.1.1 Context-based learning

Context-based learning has been implemented in many school systems in different countries and is a proven concept that incorporates much of recent research in cognitive science (ACS, 1993; Pilling et al., 2001; Pilot & Bulte, 2006). It is also a reaction to the essentially behaviourist theories that have dominated education for many decades.

Considering the low level of interest in chemistry teaching in the USA, approaches have been introduced which try to cope with the highly theoretical nature of the subjects by introducing everyday contexts. Making the content structure more relevant to students by connecting their everyday life to science concepts was seen as a way to raise interest levels and foster learning.

From the 1980s, major international context-based courses such as the Chemistry-in-the-Community (ChemCom) project in the USA (ACS, 1993) and the United Kingdom project of the 'Salters Chemistry' approach were introduced on the basis of this objective. Quite recently, new projects were implemented, such as the 'Chemistry in Context: Applying Chemistry to Society' (CiC) project in the USA, and the German project of 'Chemie im Kontext' (ChiK). Concepts were adopted to encourage a more positive attitude and a better understanding in chemistry. However, it is evident that the implementation of context-based courses is not as simple as it appears, and the effect on students' understanding of chemistry concepts is somewhat disappointing. This approach also does not seem very popular in South Africa as yet.

Context-based approaches to teaching science focus on the transfer of knowledge by linking the macroscopic level described as students' everyday experience and the microscopic level described as the general content and conceptual structure of the discipline. By repeatedly applying the content knowledge to everyday phenomena, an improved ability by students to transfer knowledge is expected. It can be stated that context-based teaching tries to integrate science-specific topics to students' social or personal environments with the aim of increasing students' interest and advancing the quality of science education. However, the development of such approaches has produced unsatisfactory results of science teaching and learning. The following facts seem prevalent:

- Students have shown low and decreasing interest in the so-called hard sciences, such as physics and chemistry.
- Students have not been able to adapt basic concepts on authentic situations outside the classroom contents.
- Studies making use of video recordings have shown that teaching and learning styles were teacher-dominated and did not allow students to develop own ideas as well as a broad range of scientific competencies (Graeber, 1995; OECD, 2007).

Research results and theories about development and support of interest, motivation and learning as well as experiences in practice have strengthened the idea of change towards a more context-based approach. Such an approach has a major impact on teachers as well as students since teachers do not only have to become familiar with the contexts they have often never studied before or experienced, but they are also expected to accept a more student-oriented and student-driven learning approach with less teacher control.

Historically, science content, rather than application, has formed the basis of science curricula (DeBoer, 2000). Within the confines of this conventional, content-based approach, teachers started introducing the core concepts and were then encouraged to reinforce that core material with contexts and applications of their choice, but only to the extent that time is available (Stinner, 1994). Typically, the focus was on the transmission of concepts from teacher to students, and the optional associated experiences or application only applied at the end (see Figure 3.3) (Beasley, n.d.). This model of teaching in science classrooms can be illustrated as follows:

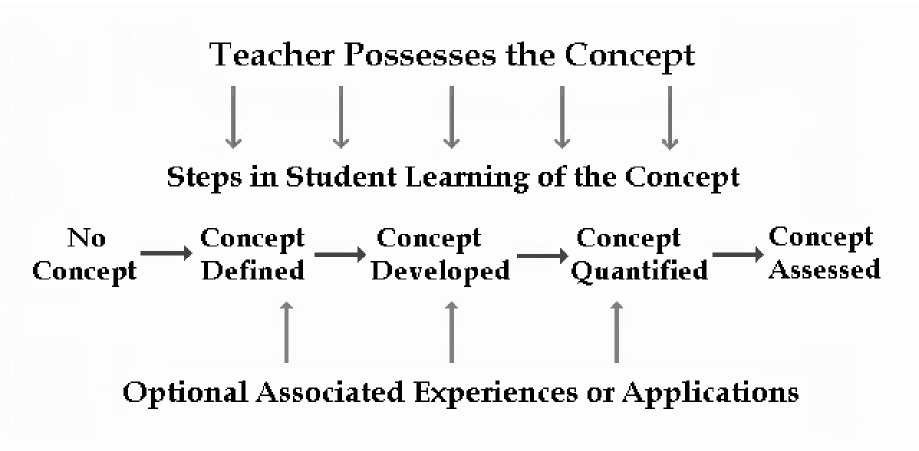

Figure 3.3: A model of teacher transmission of content in a typical science classroom (Adapted from Beasley, n.d.)

In order to create an easier understanding of science, a suggested approach to teaching is to begin with a well-developed context-based application that evokes students' interest and is connected to their lived experiences (Stinner, 1994). In general, this means starting with the application and using it to illustrate science (Rodrigues, 2006). Therefore, from this point forward, context-based approaches may be defined as those where contexts and applications of science are used as the starting point for the development of scientific ideas that emphasise links between science, technology and society (Bennet, Lubben & Hogarth, 2006). Although there are various illustrations of what a context-based approach might look like in a classroom, a general outline is provided by Jones (2012) (see Figure 3.4).

First, the context is introduced and the students can then explore the subject and frame the problems within it. Next, students examine what they already know about the topic and determine what they need to find out. The instructor then guides the students through investigations, research and experiments to gain additional knowledge. This learning eventually helps the students finalise their thoughts and draw conclusions based on the learning context (Beasley, n.d.).

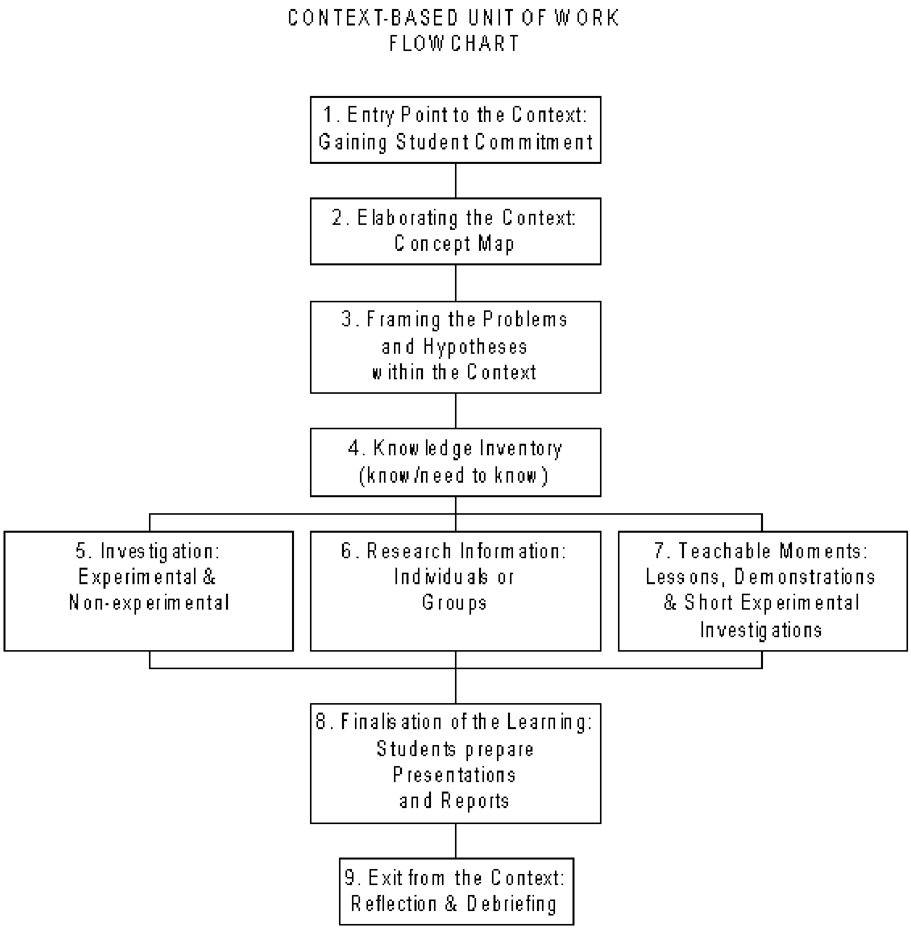

Figure 3.4: Context-based unit of work flowchart (Adapted from Beasley, n.d.)

Teaching within context can thus be quite different from traditional, content-based approaches (see Table 3.2). Content-based teaching tends to focus on specific content within disciplines and typically separates science content into small pieces. However, a context-based approach is characterised mainly by broad integrative elements. Context-based methods also teach content in relation to personal needs of students and make connections to important aspects of contemporary life (Beasley, n.d.; DeBoer, 2000). In general, the context allows science education to be a life-enhancing process that contributes to the quality of students' lives, rather than just delivering facts and information (Beasley, n.d.).

Table 3.2: Comparison of emphasis within content-based and context-based approaches

Content-based approach	Context-based approach
Emphasis on:	Emphasis on:
- knowing scientific facts and information	- understanding scientific concepts and developing abilities of inquiry
- studying subject matter of disciplines	- learning subject matter in the context of inquiry, technology, science in personal and social perspectives, and history and nature of science
- separating science knowledge and science content	- integrating all aspects of science
- covering many science topics	- studying a few fundamental science concepts
- implementing inquiry as a set of processes	- implementing inquiry as instructional strategies, abilities and ideas to be learned

(Source: Adapted from Beasley, n.d.)

In teaching chemistry, Johnstone (1991) has proposed three levels of understanding that are expected from the student: the macroscopic, sub-microscopic or particulate and the symbolic levels (see Table 3.3).

Table 3.3: Levels of understanding chemistry

Level	**Description**
Macroscopic	Students understand the physical and chemical phenomena of chemistry.
Microscopic or particulate	Students understand models of chemical behaviour at the atomic and molecular levels.
Symbolic	Students understand symbols, formulas, and mathematical relationships used in describing chemical relationships.

(Source: Adapted from Johnstone, 1991)

The macroscopic level is real, comprising tangible and visible chemicals, which may or may not be part of students' everyday experiences. The sub-microscopic level is also real and comprises the particulate level, which can be used to describe the movement of electrons, molecules, particles or atoms. The symbolic level comprises a large variety of pictorial representations, algebraic and computational forms of the sub-microscopic representation (Johnstone, 1991). Other studies indicate that many secondary school and college students, and even some teachers, have difficulty transferring knowledge from one level of representation to another (Gabel, 1998).

Context-based approaches have been seen as somewhat controversial because social issues, and not disciplinary content, become the organising themes of science teaching. The challenge is to find a balance between the science content and other important goals of science education. These goals include scientific literacy, understanding the nature of science, humanising concepts, and increasing motivation and understanding (De Boer, 2000). There are numerous ways to incorporate context-based curriculum into science teaching, and researchers have highlighted the benefits associated with these techniques (see Table 3.4).

Table 3.4: Methods and benefits of techniques associated with teaching science in context

Methods of incorporating context-based ideas into the classroom	**Potential benefits**
1. Essays	- Give students the opportunity to connect concepts with their interests. - Can inspire students to read more about science and scientists.
2. Case studies and thematic narratives	- Connect concepts to one, unifying idea.
3. Configurations, dialogues, dramatisations	- Can incorporate historical or debate contexts into science content.
4. Large context problems	- Create a contextual setting that generates questions and problems that are more interesting to students.

(Sources: Adapted from Stinner, 1994; Stinner, McMillan, Metz, Jilek & Klassen, 2003)

Chemistry taught with a content approach typically emphasises the symbolic level as mathematical aspects are heavily emphasised. However, while students are able to accomplish the outcomes within a given process, they may not actually understand its significance. When chemistry is taught in context, students' understanding of all the levels tends to improve as the context more easily integrates the three forms and gives concrete examples of concepts that are traditionally very abstract.

In an action research study by Lin (1998), case studies were used to teach pre-service teachers how to teach chemistry using the history of science. The results showed that after an in-context lesson, the experimental group seemed to better understand creativity, scientific observation and the function of theories (Lin, 1998). The treatment group indicated the challenges they encountered when reading case studies in the history of science, and they were all able to use examples to support their beliefs in the post-treatment interviews.

Another study (Irwin, 2000) utilised historical content to teach a class of 14 year olds about atoms, while another class was taught by traditional methods. The teacher-researcher was disappointed to find there was no difference in the understanding of science content between the two groups but was still able to make a case for using historical examples in order to influence the learning of the nature of science. The fact that content knowledge was not weakened by the unorthodox teaching methods supported his suggestion of using historical contexts to teach science (Irwin, 2000).

In further research (Rodrigues, 2006) a lesson was observed that was taught in context by using a familiar theme to initiate dialogue amongst the students. It was found that simply using a relevant context does not necessarily result in a lesson being taught in context. The students were engaged with the topic, but the assigned tasks were not meaningful. Therefore, the learning did not seem to have been enhanced by the contextual teaching effort (Rodrigues, 2006). This could be one reason why teachers often use a context-based approach at the beginning of a course and then revert to traditional teaching – which does not allow for sustained learning in the contextual framework, and eliminates the benefits that can be associated with teaching in context (Yip, 2006).

Finally, a systemic review by Bennett *et al.* (2006) assembled multiple studies to compare their findings. They concluded that context-based approaches resulted in improved attitudes to science more than conventional approaches. There was also mixed evidence that the contextual approach influenced subject and career choices, while it resulted in more positive attitudes towards science in both females and males. Furthermore, just over half of the studies demonstrated that the understanding of scientific ideas was comparable to that of conventional approaches.

Some of the studies compared by Bennett *et al.* (2006) indicated that there are hardly any advantages of context-based courses in terms of the development of students' understanding. For instance, Ramsden (1997) compared the effects of a context-based course and a more traditional course on British high school students' understanding of key chemistry concepts. His study indicated that there seems to be little difference in levels of understanding concepts as element and compounds, chemical reaction and the Periodic Table.

In conclusion, the reported outcomes of context-based approaches are positive from an effective development perspective, but seem to be somewhat disappointing from a cognitive development point of view. The absence of effects on learning outcomes may be caused by weak relationships between context and relevant concepts in the perception of students and teachers. If nothing else, this situation possibly underlines the need for improving context-based teaching and learning implementation.

3.3.1.2 Course structure, engagement and achievement: an example from the University of Manitoba

Between 1998 and 1999 the Department of Chemistry at the University of Manitoba reorganised its first-year course to include two section types: 'regular sections' for students with high school chemistry grades above 70%, and 'developmental sections' for students with grades between 50% and 70%. Students who had been out of school for a year or more were encouraged to enrol in the developmental sections. The developmental sections were developed to be more learner-centred. The lecturers aligned their expectations more tightly with the actual knowledge and skills possessed by the less-prepared students in the development sections than in the regular sections. The developmental sections met in classrooms of between 60 and 100 students five times a week for 50-minute periods, for 13 weeks. In addition, at the end of each week, the students were given a multiple choice test on the material covered in the previous class periods, and students and lecturers discussed the answers afterwards. In this way, the lecturers helped the students understand their errors and how to correct them. These in-class tests counted for 10% of the students' final grade.

Essentially, the developmental sections were designed according to the principles of mastery learning, a theory which assumes that for less prepared students to succeed, they need to increase the time spent on course material (Guskey, 1985; Lee & Pruitt, 1984). As such, the developmental students spent 250 minutes in the classroom each week, and the lecturers organised their lectures into small discrete units. Following this, the lecturers had the students demonstrate their mastery of the subject matter at the end of each week in questions and answer sessions (Reid, 2008). From the perspective of cognitive psychology, this organisation of the course material helped the students transfer the subject matter from their instructors' lectures and the textbook into their working memory in small volumes which, in turn, helped them transfer the information to their long-term memory, incrementally building their understanding of chemistry (Clifton et al., 2012).

In addition, the weekly tests and question and answer periods helped students assess their understanding of the course content. Learning a complex and hierarchically organised subject such as chemistry requires the integration of new information with information that the students already possess, and then assessing whether or not it has become integrated into the knowledge they have stored in their long-term memory (Ausubel, Novak & Hanesian, 1978; Cowan, 1995; Reid, 2008). Consequently, students in the developmental sections became more actively engaged in the course material (AAC&U, 2007; Eilks & Beyers, 2010).

In contrast, the regular sections with about 200 students in a classroom met either three times a week for 50-minute periods or twice a week for 75-minute periods for 13 weeks, which is the normal arrangement for lecturers at the University of Manitoba. In these sections, lecturers were not as concerned about integrating the chunks of new information with information that the students already possessed nor did they give the students weekly feedback. The students completed four take-home assignments during the semester, representing 10% of their final grades. The students in both developmental and regular sections used the same textbook, completed the same laboratory assignments, and wrote the same mid-term and final examinations which carried the same weight (Clifton et al., 2012).

The results of the study by researchers Clifton *et al.* (2012) demonstrate that the students in the developmental sections did better than students in the regular sections when a number of important factors were controlled. Students' grades in high school chemistry and mathematics were strongly related to their grades in university chemistry; and their attendance in classes and labs, an indicator of their engagement, had a strong effect on the developmental students' chemistry grades. These results demonstrate the importance of increasing the class time with more frequent and better monitored assessment for the less-prepared students. Considerable research has shown that the time spent on learning the course material in chemistry – as well as in other subjects – positively affects their grades (Potgieter, Ackermann & Fletcher, 2010; Wagner, Sasser & DiBiase, 2002).

The results of my study suggest firstly that submission tests could be used to assign students to developmental and regular sections of introductory courses (McFate & Olmsted, 1999). Secondly, the developmental sections should employ specially selected lecturers who closely monitor the progress of the less-prepared students. Thirdly and finally, at the beginning of the courses, the lecturers should emphasise to students that it is of utmost importance to attend classes and actively engage in learning the subject matter.

3.3.1.3 Tutorial schemes for learning chemistry

Little research has been done in South Africa to investigate student performance in second-year chemistry except for work done at the University of the Witwatersrand. Hence, a study by Davidowitz and Rollnick (2005) at the University of Cape Town explored the effect of tutorial interventions in a second-year chemistry course and its impact on organic and inorganic chemistry. The study was done to reduce content for increased mastery and ensure student engagement with chemical concepts where tutorials were introduced in the place of some formal lectures.

Tutorial schemes involve small-group teaching strategies that can be organised in several ways (Carpenter & McMillan, 2003). Such schemes have been described as learning situations where students work together in groups small enough for everyone to participate in a collective task that has been clearly assigned (Cohen, 1994). The role of the tutor varies from situation to situation, but the common factor is the active involvement of students in the learning process. By engaging with the material, they would start to grasp the underlying principles, allowing them to move from the level of comprehension to synthesis and analysis of information (Pungente & Badger, 2003). Traditionally, tutorials in universities have been considered as a form of additional support where students work on problems on their own in a session where they can call for assistance from a senior student or lecturer. In the 1990s there was a move away from this approach and tutorials at the first-year level were more commonly organised in the form of interactive group work (Huddle, Bradley & Gerrans, 1992). The success of tutorials in the form of group work is attributed to their cooperative nature – hence the enhancement of student ability to learn in a social way and subscribing to social-constructivist teaching and learning strategies (Brodie & Pournara, 2005).

The results of the University of Cape Town study show that the introduction of the tutorial scheme had a positive effect on students' experiences of the course as well as on their performance when the number of tutorials was increased from three to four per week. In addition, there was more widespread coverage of content over the four tutorials. Lecturers used problems addressed in tutorials as starting points for examination questions. The increase in the number of tutorials as well as a closer correspondence between tutorial problems and examination questions led to an improvement in the performance of the students and a slight improvement in the overall pass rate of the course (Davidowitz & Rollnick, 2005).

The University of Cape Town study has shown how important tacit knowledge of teaching is to improve teaching – even at the tertiary level (Davidowitz & Rollnick, 2005). Structural changes to a course – such as the introduction of a tutorial scheme – can have a positive effect, but a coordinated approach and its integration into broader teaching strategies is vital to allow such interventions to have maximum impact.

3.3.1.4 The Chemistry Competence Test

In order to assess and monitor preparedness in chemistry at the interface between secondary and tertiary education, a suitable test instrument seems essential. A literature review by Potgieter and Davidowitz (2010) revealed a lack of test instruments with appropriate focus, depth and coverage of application in the South African context. The aim of their study was to evaluate any significant shifts in the level of preparedness for first-year Chemistry between 2005 and 2009 so that teaching at tertiary level can correspond in a meaningful way to curriculum changes. However, results from the South African Grade 12 examinations were not suitable to measure this, because firstly, a single mark was reported for both the physics and the chemistry components of the syllabus, and secondly performance data on individual sections or questions in the physical science paper were not available.

For these reasons Potgieter and Davidowitz (2010) embarked on the development of a test instrument which meets the most stringent requirements of validity and reliability required in educational assessment. This test instrument is known as the Chemistry Competence Test (CCT). Since the curricula for first-year Chemistry at major South African tertiary institutions do not differ much, the CCT instrument was designed to cover fundamental concepts generally accepted as pre-knowledge in all subject topics included in a typical first-year Chemistry curriculum in South Africa. The CCT was also structured to capture conceptual understanding rather than recall or application of practised procedures (Bowen & Bunce, 1997; Mayer, 2002). Conceptual items were chosen to test the students' understanding of chemical ideas associated with each question, rather than algorithmic questions that can be answered by applying a set procedure to generate response. Since proficiency in chemistry also requires the development of a range of skills, several items are included for skills assessment. The skills include the ability to interpret scientific terminology and representational competence – the ability to interpret symbolic, macroscopic and sub-microscopic representations (Ainsworth, 2006; Johnstone, 1991) and basic mathematical skills (McFate & Olmsted, 1999; Wagner et al., 2002).

The CCT instrument was piloted and refined between 2003 and 2005 (Potgieter, Davidowitz & Venter, 2008; Potgieter, Rogan & Howie, 2005), and has been used in an unmodified form since then. The instrument includes test items on 11 different topics: five basic concept topics, four specialist topics and two sets on items for the assessment of mathematical skills and other skills that are required for chemistry. The instrument was used at many South African universities including the University of Pretoria, the University of Cape Town, Stellenbosch University, Rhodes University and Walter Sisulu University.

The CCT instrument was used to monitor levels of preparedness for tertiary chemistry during a period of systemic change and has also been used to evaluate institutional placement policies, to identify specific conceptual problems and procedural deficiencies and to measure conceptual gains over the course of the first year at university. In addition, its application for the prediction of risk of failure in first-year Chemistry based on cognitive and non-cognitive factors was also demonstrated. These findings are valuable as a resource to inform teachers and lecturers who are concerned at high school and at higher education institutions.

3.3.1.5 Academic Development Programme: Skills for Success in Science (S3)

The Skills for Success in Science programme (S3) is an intervention with first-year students enrolled in the General Entry Programme in Science (GEPS), which is part of the Academic Development Programme at the University of Cape Town. GEPS is a foundation programme designed for students identified by the institution as being from educationally disadvantaged backgrounds and provides an alternative one-year access route for students registering for the BSc degree. It offers a curriculum that attempts to take account of poor preparation at school, particularly in mathematics and science, as well as of the fact that the majority of the student target group do not have English as their first language. The aim is to identify, select and prepare students with the potential to succeed in one of the programmes offered by the Faculty of Science. Courses in the GEPS programme have the same contact time as full year mainstream courses. Their aim is twofold, namely to cover about half of the content of the first-year curriculum while at the same time building a deep understanding of such concepts through the inclusion of aspects of the particular discipline which are key to understanding the nature of that discipline and engaging with it at higher levels. Students are supported and encouraged to understand concepts rather than depending on rote learning – a strategy which is prevalent at secondary school level (Davidowitz & Schreiber, 2008).

The social skills and sport programme or the so-called S3 intervention is infused into the GEPS curriculum and based on the notion that group work has the potential to enhance students' learning (Van Rheede, Van Oudtshoorn & Hay, 2004). Weekly small-group sessions with 20 students per group over the first semester are conducted by psychologists who are contracted for the programme while skills in the following areas are developed: adjustment, group work and cooperative learning, coping and stress management, resources on campus, assertiveness and communication, time management, study skills and examination competence. Figure 3.5 below provides an outline of the S3 programme.

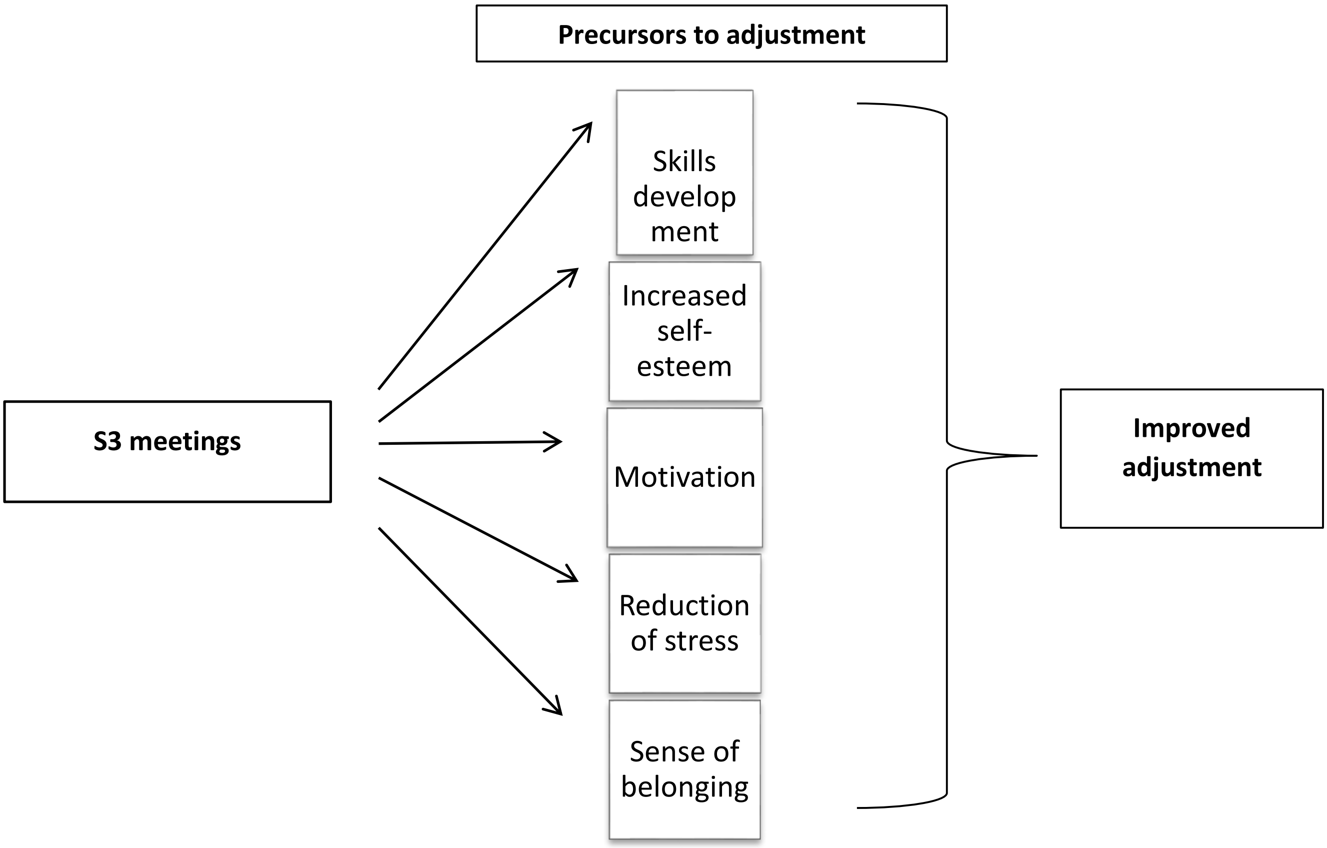

Figure 3.5: Conceptual outline of the S3 programme (Source: Van Rheede et al., 2004)

The interactive, participative learning process of this intervention can be implemented at other universities since it tends to contribute to the improved engagement with fellow students, the academic material and the institutions as a whole (Van Rheede et al., 2004).

3.4 SYNTHESIS

In summary, one may conclude that learning is a multi-layered and complex concept which depends on many different role-players, complex sets of factors and a variety of historical and contextual factors. Similarly, there are many possible factors that may influence the learning of chemistry and this field of inquiry in higher education has not been explored extensively. In this chapter I have provided a broad overview of learning and factors that might influence learning and academic performance, learning in chemistry, and strategies to facilitate learning in chemistry.

From the relevant literature it can be derived that identified strategies to improve performance in chemistry include the use of context-based learning approaches, interventions such as tutorial schemes, and competence tests (ACS, 1993; Davidowitz & Rollnick, 2005; Pilling et al., 2001; Pilot & Bulte, 2006). The use of context-based or context-related approaches seems to improve student attitudes towards chemistry – more so than conventional approaches – and may result in more positive attitudes towards learning chemistry. According to findings presented in the literature, structural changes to a course, such as the introduction of a tutorial scheme, may also have a positive effect on student learning.

This chapter also highlighted Louw's (2005) conceptual framework which expounded factors that could potentially be regarded as challenges to students and inhibiting their learning success – particularly in agricultural training institutes. Louw's framework supports the thesis that both student factors and institutional academic factors influence student learning and thus student performance. As explained, these factors tie in well with Astin's model of student involvement which suggests that when students are involved in both the academic and social aspects of collegiate experience, they will gain more from their studies. In this study, the focus was on academic involvement which underscores Astin's (1999) theory of student learning and performance from an academic perspective. Figure 3.6 below provides a conceptual framework and a summary of my understanding of factors that influence learning in chemistry derived, from the literature consulted in this chapter and my personal experience as a viticulture lecturer. The various elements that make up the framework below were drawn from Astin (1999), Louw (2005) and the relevant authors mentioned in this chapter.

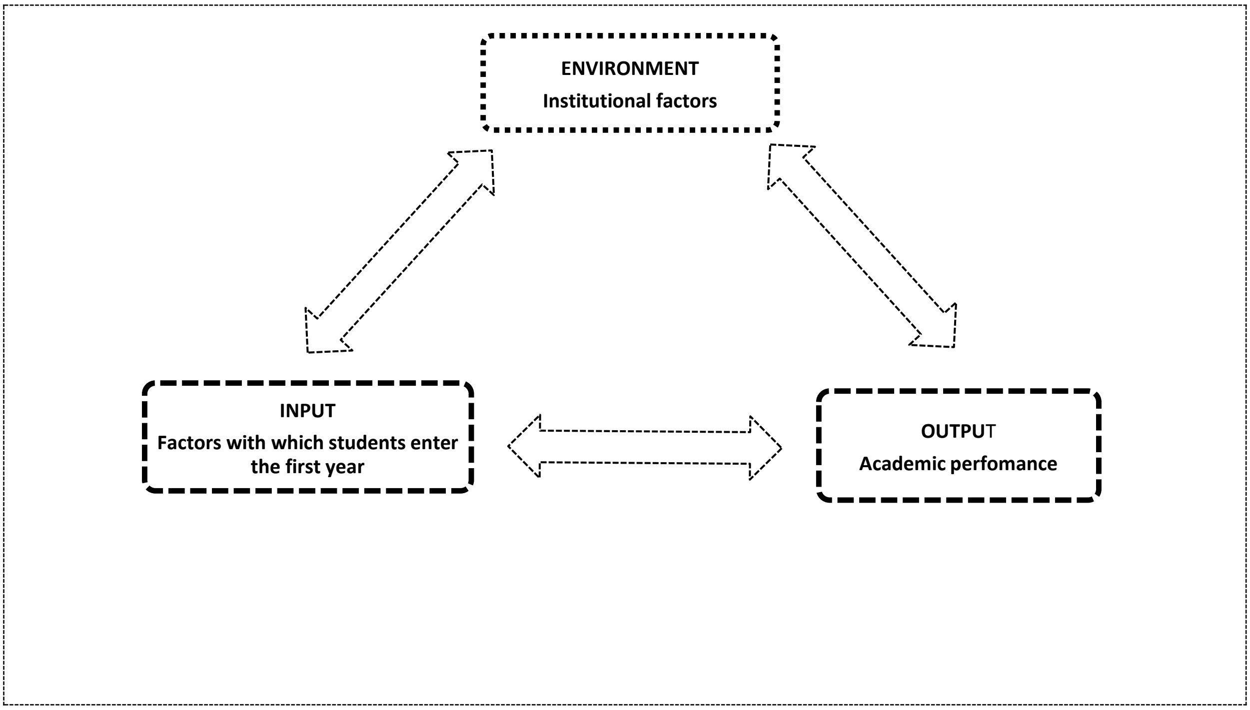

Figure 3.6: Conceptual framework for this study

Figure 3.6 illustrates the potential relationship between input, environment and output. All three of these aspects do not only seem to relate to one another but may also have an influence on one another as indicated by the bi-directional nature of the arrows in the figure. Input represents the student and the factors with which students enter the institution in the first year. These factors might influence how the student approaches the educational environment as well as the output (academic performance). Input factors might include demographic information, educational background, historical learning experience, academic support, learning approach, study skills, admission requirements, language, study goals, students' foundational knowledge of the subject, programme choice, and reason for entering the programme.

Environment represents the institution and the influence it might have on the student in the first academic year (input) as well as the influence it might have on the output (academic performance) of the student throughout the year and at the end of the year. These factors might include level of academic integration, learning blocks, workload, inadequate study skills, foundational knowledge, commitment to the curriculum, facilities, institutional climate, course, teaching style, learning approach, learning support, language and communication in class, size of classes, administration, access measures, lecturing staff, assessment methods, and course information.

Output represents the students' academic performance prior to or after being influenced by input and environmental factors. Academic performance might be influenced before students start the course because of factors such as bad advertising of courses by peer students, fear of difficult subjects, fear of isolation on campus and little or no access to academic support, no support to overcome challenges experienced at the institution and wrong choices in the middle of the course.

Reading through and reflecting on the research conducted on learning chemistry and the theories of integration was thus quite enabling in terms of gaining a deeper understanding of how students taking chemistry as a subject learn and develop. The factors explained above might influence the performance of students taking chemistry, especially as perceived by themselves and their lecturers, which is why one may conclude that there was a need for this study. Also, from the literature there seems to be a lack of research on what students' and lecturers' perspectives are on the factors that influence their academic performance – particularly in agricultural education and training.

The next chapter addresses the research design methodology employed to investigate empirically how academic factors are perceived to potentially influence learning, and eventually student performance at EATI.

CHAPTER FOUR
RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

This chapter describes the research design and methodology used for the empirical part of this study. The previous chapter gave an account of the literature related to the concepts of learning and factors that might have an influence on student performance in Chemistry. This chapter investigates academic factors that may potentially influence learning, and eventually student performance in Chemistry at the EATI, by examining relevant data from curriculum documents, students and lecturers.

From the literature explored in Chapter 3 it is evident that both student and institutional academic factors may influence student learning and therefore student performance. As there seems to be a lack of research on students' and lecturers' perspectives of the factors that influence academic performance, particularly in agricultural education and training, student and staff perceptions were investigated to determine to what degree, if at all, academic factors are seen as influencing learning in PAS 111 and how these factors are perceived. Being an agricultural college and forming part of the Western Cape Department of Agriculture, EATI is accountable to its various stakeholders and therefore the development of well-rounded and professional individuals and graduates is essential. The success and employability of its students is ultimately what enables the institute to be successful and therefore identifying factors potentially contributing to students' academic achievement is crucial information for the institute.

When conducting research, researchers view the research process and the data it generates through a particular 'lens'. This 'lens' is often referred to as a research or knowledge paradigm. In this case a pragmatist 'lens' provided me with particular views of the phenomenon (student failure in Chemistry learning) under scrutiny. In this chapter I explain the chosen paradigm after restating the research questions and aims, followed by an explanation of the design for this study. The later mainly followed the contours of Louw's student departure framework derived from Astin's model of student involvement. The curriculum-analysis criteria by Posner was used to analyse the PAS 111 curriculum.

I classify my research as descriptive and explorative, as it sought to explore, describe and understand a real-life problem: new first-year students and how they experience their first year of studying PAS 111 at a higher education institution in South Africa. The research concerned the challenges they face and how these challenges influence their performance in the learning process and particularly in the PAS 111 module. The motivation for the study and the research questions were provided in Chapter 1, and the literature review in Chapter 3 was guided by these questions. The literature reviewed assisted me in arriving at a design that aimed firstly at guiding the research process and secondly at interpreting the data that were generated. The main research question guided and contextualised the study in that the research site and context was the EATI, an agricultural college that was contextualised in Chapter 2. The main research question further contextualised the study in that it was a specific department with a specific cohort of students that was investigated. Both numerical and narrative data were collected for this study.

4.2 PURPOSE AND AIMS OF THE STUDY

PAS 111 is a module with an annual high failure rate. For instance, the failure rates for the past four years were respectively 34% in 2010, 16% in 2011, 24% in 2012 and 38% in 2013. These statistics are alarming to the institute and the need arose to investigate the possible academic factors that influence the success of first-year BAgric students and might lead to the cessation of studies. EATI has a responsibility towards its students and accountability towards students' sponsors. The onus is on the institute to provide quality education that will result in well-rounded and successful students. This was the backdrop against which the study was undertaken, as Chemistry forms an integral part of the BAgric programme. In particular I wanted to investigate factors that might influence academic performance in the first-year PAS 111 group. The management and faculty of EATI agreed that this could be a valuable study that may inform some institutional changes and improvement. The study was limited to only one agricultural institution (EATI), as this is where the need was identified and I was based until the end of 2014.

4.2.1 Research question

Against the background as sketched in Section 1.2 of Chapter 1 and the problem of high failure rates in PAS 111, the research question posed by this study was as follows:

Why do students at the Elsenburg Agricultural Training Institute not perform well in Chemistry (PAS) 111?

4.2.1.1 Research sub-questions

In order to answer the main question, four subsidiary questions were formulated:

- Is the PAS 111 curriculum appropriate for learning PAS 111?
- What are lecturers' perceptions of factors that influence students' success or their lack of success in PAS 111?
- What are students' perceptions of factors that influence their success in PAS 111?
- How do lecturers' and students' perceptions compare in terms of factors influencing student success or the lack thereof in PAS 111?

4.2.2 Aim and objectives of the study

In view of the posed research questions the main aim of the study was to investigate the academic factors that may influence student performance in PAS 111 at EATI.

The consequent objectives of the study were to:

- inquire into the PAS 111 curriculum in terms of a set of curriculum criteria;
- determine the perceptions students have about which academic factors may influence their performance in the PAS 111 module; and
- determine the perceptions of lecturers about which academic factors may influence student performance in the PAS 111 module.

4.3 RESEARCH DESIGN AND METHODS

4.3.1 A pragmatic paradigm

The study was conducted by taking a pragmatic stance. There are many forms of pragmatism or pragmaticism (as termed by Peirce, 1992), in which knowledge claims arise out of actions, situations and consequences rather than antecedent conditions. Pragmaticism (Dewey, 1929;

Peirce, 1992) is an action-oriented philosophy of science. It studies the link between action and truth, practice and theory. According to Dewey's definition (1931:31), pragmatism is "the doctrine that reality possesses practical character". Pragmatists see the world as a set of practical actions that are born from thinking. There is no dualism between theory and practice; rather, they are two sides of the same coin (Peters, 2007:356).

Furthermore, pragmatism relies on the consequences of our beliefs (Plowright, 2011). Pragmatism takes both a relativist and fallibilist view of what knowledge is. The approach is referred to as holistic integrationism. It employs a pragmatic, integrated methodology to undertake investigations using empirical data from observation, asking questions and analysing artefacts (Plowright, 2011). Pragmatism argues that if statements about knowledge do not lead to consequences, for example decision making or action, those statements will not count as knowledge. A pragmatist will evaluate the quality of a study based on the intended purpose, the resources available, the procedures followed and the results obtained, all the while keeping the context in which the research was conducted in mind (De Vos, 2005). Pragmatism is focused on using research methods that are best suited to the research problem and research question, thereby allowing researchers the freedom to use any form of applicable and valid narrative or numeric data, resulting in a mixed-methods approach. The reasoning behind this is that all methods of data collection have different advantages and disadvantages, therefore using a combination of methods may be more ideal (Plowright, 2011). The decision to use a mixed-methods approach fitted the study well and allowed me to collect data to answer the research questions and inform the findings of this study. I could have also considered using an interpretive lens for this study, but then I would have been constrained in terms of using mixed methods. I therefore opted for a pragmatic knowledge perspective.

4.3.2 A deductive approach

The study mainly followed a deductive logic in the sense that the aim was to determine whether the factors as identified by Louw's study in agricultural institutes have some relevance to student success factors in a Chemistry 1 module at EATI. This is important to know, as the Chemistry module (PAS 111) at EATI shows a consistently high failure rate in the BAgric programme. Deductive reasoning is a logical progression from general observations to a more specific observation or statement, leading to a specific conclusion. The study therefore aimed in particular to determine students' and lecturers' perceptions of academic factors that may potentially influence (hinder or enhance) student performance. From such data one may ultimately draw conclusions as to what may be done to improve the success rate in the first-year PAS 111 module. From a knowledge perspective, the study attempted to gain a better understanding of the context in which first-year PAS 111 students learn, to determine what factors challenge and enable their learning and to come to some understanding as to what needs to be done in order to improve student pass rates, or at least limit students' failure, in the PAS 111 module.

4.3.3 A mixed-methods design

As stated previously, a mixed-methods design was used in this study. A concurrent transformative approach was used to triangulate data. Triangulation is described as the combination of data sources in the study of the same phenomenon (Denzin, 1970:291). By triangulating data, the researcher attempts to provide a confluence of evidence "that breeds credibility" (Eisner, 1991:110). By examining information collected through different methods, the researcher can corroborate findings across data sets and thereby reduce the impact of potential biases that can exist in a single study. Permission was granted by the director of EATI to conduct the research at EATI and the director provide me with all documentation needed. I was also granted and permitted to use the institution as research site and the PAS 111 module as the unit of analysis for this study. A survey questionnaire among students and semi-structured interviews with lecturing staff of EATI were used as methods to generate data. To analyse the curriculum of the PAS 111 module a set of curriculum-analysis questions by Posner (1992) was used. As mentioned in Section 4.3.1, pragmatism allows researchers the freedom to use different forms of narrative or numeric data, resulting in a mixed-methods approach, particularly because different methods of data collection have different advantages and disadvantages (Plowright, 2011). With this in mind, the methods of generating data that were opted for in this study are illustrated in Table 4.1 and thereafter briefly discussed.

Table 4.1: Methods and instruments used

	Methods	Areas of investigation	Sources
1	Document analysis (using Posner's 1992 framework for curriculum analysis)	PAS 111 curriculum 1. The documented curriculum 2. The curriculum proper 3. The curriculum in use 4. Curriculum critique	1. PAS 111 curriculum document(s) 2. BAgric Prospectus 2011
2	Questionnaire survey (using Louw's framework)	Student perspectives 1. Demographic information 2. Educational background 3. Academic performance (closed-ended Likert scale) 4. Academic performance (open-ended narratives)	EATI BAgric students 1. 2013 PAS 111 students
3	Individual interviews (using Louw's framework and a self-generated interview schedule)	Lecturer perspectives 1. Academic performance (closed-ended Likert scale) 2. Academic performance (open-ended interview narratives)	EATI lecturing staff 1. Lecturers teaching first-year subjects 2. Lecturers teaching Chemistry

4.3.3.1 Data-generation methods

In this section all data-generation methods, which included document analysis of the PAS 111 curriculum, a questionnaire survey among PAS 111 students and interviews with EATI lecturers, are discussed. The section includes an outline of how data were generated, how the data were analysed and how quality was enhanced for each of the methods.

4.3.3.1.1 Document analysis

I chose to do an analysis of the PAS 111 curriculum in the BAgric programme as a means to provide more evidence of why students do not perform well in or fail PAS 111. All curriculum documentation, the origin of the curriculum, the curriculum proper, the curriculum in use and critique on the curriculum were accounted for. Table 4.2 provides a summary of the advantages and disadvantages of using document analysis, which were taken into account during the curriculum analysis for this study.

Table 4.2: Advantages and disadvantages of document analysis (adapted from Bowen, 2009)

Advantages	Disadvantages
Efficient method – Document analysis is less time-consuming and therefore more efficient than other research methods. It requires data selection instead of data collection.	Insufficient detail – Documents are produced for some purpose other than research; they are created independent of a research agenda.
Availability – Many documents are in the public domain, especially since the advent of internet, and are obtainable without the authors' permission.	Low retrievability – Documentation is sometimes not retrievable, or retrievability is difficult.
Cost-effectiveness – Document analysis is less costly than other research methods and is often the method of choice when the collection of new data is not feasible.	Biased selectivity – An incomplete collection of documents suggests biased selectivity.
Lack of obtrusiveness and reactivity – Documents are unobtrusive and non-reactive; that is, they are unaffected by the research process.	
Stability – As a corollary to being non-reactive, documents are stable.	
Exactness – The inclusion of exact names, references and details of events makes documents advantageous in the research process.	
Coverage – Documents can provide a broad coverage of the topic under investigation.	

The limitations listed in Table 4.4 are more potential flaws rather than major disadvantages. Given its efficiency and cost-effectiveness, document analysis offers advantages that evidently outweigh the limitations.

a. Data generation

The process of curriculum analysis that was followed is illustrated in Figure 4.1.

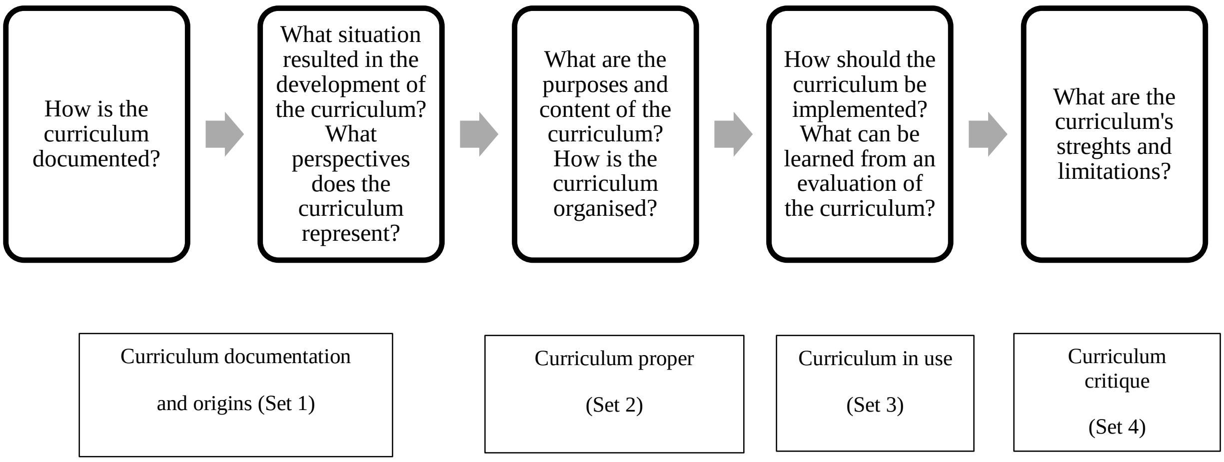

Figure 4.1: The process of curriculum analysis (Posner, 1992)

Figure 4.1 provides the process that was followed when I (as researcher) and the senior lecturer, also manager of the Department of Basic Science, analysed the documents that were used in this study. I explained the purpose of the research, gave an overview of how curriculum analysis is done and explained the terminology used. In addition, the set of criteria was given beforehand to the senior lecturer to gather the appropriate documents to do the analysis. The documents that used were the PAS 111 syllabus guide, the BAgric Prospectus 2011 and PAS 111 learning material, tutorials and assessments. Three days were set out to do curriculum analysis in June 2015 at the EATI offices.

b. Data analysis

Document analysis involves skimming (superficial examination), reading (thorough examination) and interpretation (Glenn, 2009). The documents analysed for this research were all documents that formed part of the PAS 111 curriculum, in other words, curriculum analysis was done. Porter (2004) defines curriculum analysis as the systematic process of isolating and analysing targeted features of a curriculum. Curriculum analysis most commonly involves describing and isolating a particular set of content in a curriculum and then analysing the performance expectations, or cognitive demand, that describe what students are to know and do with the content. Through systematic analysis of the curriculum, educators can begin to compare and contrast various aspects across multiple curricula or documents.

Posner's (1992) set of curriculum-analysis criteria was used to determine whether the curriculum is appropriate for agricultural science, the accuracy of its content and the level of presentation, relevance of subject matter and appropriateness of the way in which the curriculum is taught. These criteria are outlined in Chapter 2 (see Table 2.4) and are applied and discussed in Chapter 5.

The PAS 111 syllabus guide, learning material and assessment tools were evaluated to check whether they correspond with the learning outcomes as set out in the PAS 111 curriculum and the broad learning outcomes of the BAgric programme as set out in Chapter 2.

4.3.3.1.2 Questionnaire survey with students

A questionnaire survey was chosen, as this method can provide a rich source of varied material (Welman, Kruger & Mitchell, 2005:175). As this method of data collection ensures participants' anonymity, the questions are more likely to be answered honestly. Questionnaires remove the issues related to research bias, as there is no personal contact and the participants cannot be manipulated in any way (Neuman, 1997:239).

Questionnaires aimed at the PAS 111 group of students were designed taking Louw's (2005) framework into consideration. Louw (2005) focused on academic factors that might potentially influence student departure from agricultural training institutes. For this study, closed- and open-ended questions were used. A closed-ended question is one where participants in the research are confronted with a question, but instead of being able to give any answer, they are provided with fixed response options from which to choose (Neuman, 1997:240). An open-ended question is one where the researcher asks the participant a question to which any answer can be provided.

Table 4.3 gives a summary of the advantages and disadvantages of using closed-ended questions, which were taken into account during the construction of the questionnaire for this study.

Table 4.3: Advantages and disadvantages of using closed-ended questions (adapted from Neuman, 1997:241)

Advantages	**Disadvantages**
Easier and quicker for participants to answer	Research can suggest ideas participants would not otherwise have
Answers of different participants are easier to compare	Participants with no opinion or knowledge can still answer
Answers are easier to code and statistically analyse	Participants may become frustrated when their desired answer is not a choice
The response choices can clarify question meaning for participants	Confusing if too many response choices are provided
Participants are more likely to answer about sensitive topics	Misinterpretation of a question can go unnoticed
Fewer irrelevant or confused answers	Distinction between participant answers may be blurred
Less articulate or less literate participants are not at a disadvantage	Clerical mistakes or marking the wrong response is possible
Replication is easier	Participants are forced to give simplistic responses to complex issues

Table 4.4 provides a summary of the advantages and disadvantages of using open-ended questions, which were taken into account during the construction of the questionnaire and interview questions for this study.

Table 4.4: Advantages and disadvantages of using open-ended questions (adapted from Neuman, 1997:241)

Advantages	**Disadvantages**
Unlimited number of possible answers	Different participants give different degrees of detail
Participants can answer in detail and clarify responses	Responses may be irrelevant or buried in useless detail
Unanticipated finding can be discovered	Comparisons and statistical analysis become difficult
Adequate answers to complex issues are provided	Coding of responses is difficult
Creativity, self-expression and richness are permitted	Articulate and highly literate participants have an advantage
Participants' logic, thinking process and frame of reference are revealed	Responses are written verbatim, which is difficult for the researcher to interpret
	More time, thought and effort are necessary
	Participants may be intimidated by questions

Table 4.4 illustrates how complex the undertaking of interviews may be when using open-ended questions. Open-ended questions were opted for in this study with careful consideration of the disadvantages and ethical issues (see Section 4.5) to enhance data accuracy and validity.

Tables 4.3 and 4.4 above demonstrate Plowright's (2011) observation that any particular method has various advantages and disadvantages. Neuman (1997:240) explains that it is not a matter of which method is best, but rather which method is best suited for the conditions of the research and addressing the research question. Despite the disadvantages of using questionnaires, the advantages outweighed the disadvantages and a questionnaire was found to be a valid method of data collection for this study. Many researchers suggest that anyone who seeks to use a method should employ a combination of the above techniques in order to strengthen the interpretations and findings with regard to the reliability and validity of the research (Babbie & Mouton, 2001; Creswell, 2007; Flick, 2009; Silverman, 2001). Henning

(2004:147) sums it up aptly: "I would also like to promote good craftsmanship, honest communication and action as reasons for rating research as good scholarship." I have attempted to do this in this study. The instruments used are discussed next.

a. Data generation

The participants in this study were drawn from the 82 registered first-year BAgric students in 2013. A total of 82 students were registered for the PAS 111 module of 2013. The questionnaires were distributed to all students in this group while they were assembled in one venue on the EATI campus during a normal calendar day in August 2014. As explained in the previous section, the questionnaire contained closed- and open-ended questions (cf. Addendum A). Before distributing the questionnaires, I explained the purpose of the research and provided a brief overview of the purpose of the research. This was done to ensure that all students had a uniform understanding of the research topic. The students were also informed that their participation is voluntary and anonymous. There were no clarification questions asked by students and they could complete the questionnaires immediately, which took approximately 30 minutes on average. A total of 52 questionnaires were returned. There were 30 students who chose not to participate. Refer to Addendum D for an example of a completed questionnaire.

b. Data analysis

Once the questionnaires had been collected I organised the raw open-ended narrative data into conceptual categories in order to identify emerging themes, which were used to analyse the data, as recommended by Neuman (1997:421). As themes emerged, they were coded and plotted using an Excel spreadsheet. Open coding was used for this study, which entails locating themes and assigning initial codes to each theme in an attempt to make the data manageable. The identified themes are assigned codes, but the possibility still exists for creating new themes and changing existing codes. The purpose of the coding is to make the amount of data manageable and meaningful (Welman et al., 2005:213).

The areas that were investigated were the students' demographic information, educational background, academic performance (closed-ended questions) and academic performance (open-ended questions). Topics under the closed-ended section of academic performance that were investigated were admission requirements, language, interest, class attendance, study time, contact time with the lecturer, fairness of the examination paper, whether the learning material correlated with the presentations, level of presentation, student support and benefit of tutorials and summer schools. Topics under the open-ended section of academic performance were challenges in Chemistry, factors that helped the student succeed in Chemistry, suggestions on what can be done to succeed in Chemistry, how to overcome challenges in Chemistry, reasons why students fail in Chemistry and approaches to learning Chemistry.

During analysis of the questionnaire data, no attempt was made to generalise the data, as the population and sample were small and this study only focussed on one institution, therefore generalisation to all agricultural higher education institutions based on this study would not be valid.

4.3.3.1.3 Individual interviews with lecturers

Semi-structured interviews were chosen, as such interviews enable participants to clarify issues that need greater clarity and provide follow-up on answers and trends, providing a versatile way of collecting data (Goddard & Melville, 2001:49; Welman *et al*., 2005:166–167).

a. Data generation

The semi-structured interviews with the seven lecturers were conducted during work hours (July 2014) while they did not have any other obligations such as teaching. Five lecturers who present first-year modules were asked 18 open-ended questions (cf. Addendum B), which focussed on the behaviour of first-year students and their perspectives of the PAS 111 module. The other two lecturers who presented PAS 111 in 2013 and 2014 respectively were asked 14 closed- and 13 open-ended questions (cf. Addendum C) focusing on factors that influence academic performance in PAS 111.

Interview questions for the five lecturers teaching first-year subjects focused on admission requirements, language as a barrier, factors that influence academic performance, what could hinder students' interest in first-year subjects, student support, class attendance and challenges in Chemistry. Interview questions for the two lecturers who presented PAS 111 focused on the following topics under the closed-ended section of academic performance: admission requirements, language, interest, class attendance, study time, contact time with the lecturer, fairness of the examination paper, whether the learning material correlated with the presentations, level of presentation, student support and benefit of tutorials and summer schools. Topics under the open-ended section of academic performance were challenges in

Chemistry, factors that helped the student succeed in Chemistry, suggestions on what can be done to succeed in Chemistry, how to overcome challenges in Chemistry, reasons why students fail in Chemistry and approaches to learning Chemistry. The responses are stated and discussed in Chapter 5.

b. Data analysis

As only seven staff members out of 20 took part in the staff interviews, these responses were not coded, but merely stated verbatim. The same areas were covered in the Chemistry lecturer interviews as in the student questionnaire to see whether there were any correlations between the answers.

The staff members were again ensured that their participation is voluntary and anonymous and all seven agreed to participate. The participants' answers were noted verbatim. Refer to Addendum E for an example of a transcribed interview from one staff member.

4.3.4 Sampling

A target population or complete universum was used in the questionnaire survey. The target population for a survey is the entire set of units for which the survey data are to be used to make inferences (Cox, 2008). Therefore, the target population defines those units for which findings of the survey are meant to be generalised. The population or participants included all students who registered for the PAS 111 module in 2013. A total of 82 students were registered for the PAS 111 module in 2013, but only 52 questionnaires were returned. With the use of the total population sampling and a wide coverage of the population of interest there was a reduced risk of missing potential insights from members who did not participate. Many of the students did not attend the Natural Resource Management class on the day the questionnaire survey was handed out, possibly because it was a period set out to discuss a previous written test in which students were not interested.

Purposive sampling was used for the interviews with the lecturers. Purposive or purposeful sampling is sometimes referred to as theoretical sampling (Mason, 2002). Purposive sampling has a strategic focus and the relationship between the sample and the wider universe is not *ad hoc*, accidental, purely opportunistic or indeed representational (Masson, 2002). It is guided by "a combined empirical and theoretical logic" that has an impact on how the group of participants is selected for the study on the basis of the participants' relevance to the research questions, the theoretical position and analytical framework developed by the researcher, and most importantly, the argument or explanation being developed by the researcher (Mason, 2002:124). The process of sampling, data generation and data analysis is viewed dynamically and interactively, allowing the researcher the flexibility to make decisions along the way (Mason, 2002). A purposive sample of five first-year lecturers and two lecturers who presented Chemistry at EATI was chosen. The purpose for using the lecturers who presented first-year subjects was to identify factors outside of the PAS 111 class that might have an influence on the students' academic performance. The purpose for interviewing the lecturers who presented PAS 111 in 2013 and 2014 with the same set of questions used in the student questionnaire was to see whether there were any indications of agreement or disagreement among the lecturers on the factors that contribute to why students do not perform well in their first-year BAgric programme and PAS 111 in particular.

4.3.5 VALIDITY OF THE RESEARCH

The following sections address matters of validity, reliability and trustworthiness as portrayed in the literature and how these issues relate to this study.

4.3.5.1 Validity

An overall definition of validity is an indication of how sound one's research is. According to Welman *et al*., (2005:142) validity is explained to be "the extent to which the research findings accurately represent what is really happening in a situation". Determining validity is crucial to the integrity of a research study, especially if conclusions are to be drawn and recommendations made. More specifically, validity applies to both the design and the methods of one's research. In data collection, validity means that the findings truly represent the phenomenon one is claiming to measure. Validity is explained to be one of the main concerns of research. "Any research can be affected by different kinds of factors which, while extraneous to the concerns of the research, can invalidate the findings" (Seliger & Shohamy 1989: 95). Controlling all possible factors that threaten the validity of the research is a primary responsibility of every good researcher. Factors that threaten the validity of the research include faulty research procedures, poor samples and inaccurate or misleading measurement (Welman *et al.,* 2005:142). It is important to note that these factors are beyond the control of the research, including factors such as history, spontaneous change and other variables. Welman *et al.* (2005:106) explain that there are various requirements to be met for research to be considered valid. One major requirement is that the chosen research design should enable the researcher to answer the research question and therefore serve the purpose for which the research is being conducted.

Throughout this study every effort was made to ensure that the validity of this study was not compromised. Relevant and up-to-date literature was used to support a real issue experienced at EATI. There was minimal interference with the data-collection process. Plowright's (2011) idea on ecological validity was deemed fit for this study, which concerns the degree of naturalness of the research location and situation. The intention of the research is to give accurate portrayals of the realities of social situations in their own terms and in their natural or conventional settings. The level of ecological validity was high because neither were activities disrupted nor was the situation contrived or created just for the purpose of the research.

The research question for this study was relevant to the context and situation, the participants were the real students and staff of the institution and the data would therefore be expected to reflect the perceptions of students and staff of academic factors that influence student performance at a particular point in time at the institution. The study results could not be generalised, as the research was confined to one institution and a particular group of students and staff. A similar study may however be conducted at another institution where different variables may apply.

4.3.5.2 Trustworthiness

Babbie and Mouton (2001) refer to trustworthiness in research as relating to whether the findings of the study are worth taking into account. Shenton (2004:63) quotes Guba when mentioning four criteria researchers must consider for research to be trustworthy, namely credibility, transferability, dependability and confirmability. Each of these criteria is briefly discussed to demonstrate the trustworthiness of this study.

Credibility is an evaluation of whether or not the research findings represent a credible conceptual interpretation of the data drawn from the participants' original data. It refers to the researcher's ability to present a true reflection of the issue being scrutinised (Shenton, 2004). In this study, the questionnaires and interviews were set in such a way that the research question could be answered on several instances for reassurance of the answers. To ensure credibility, the development of an early familiarity with the culture is important. Because I was a lecturer at EATI for six years, I could consult a variety of documentation even before the study commenced; I was actively involved at the institution and was sufficiently engaged with the participants to make assumptions. Therefore, prolonged engagement was established between me and the institution and consequently a relationship of trust was established. Triangulation was another strategy used to make this study credible. It involves the use of different methods, especially observation and interviews. The use of different methods ensured a variety of details of the subjects that were investigated and also substantiated information.

Transferability is the degree to which the findings of the inquiry can be applied or transferred beyond the bounds of the project. It requires the researcher to provide an adequate context of the fieldwork in order for the readers of the research to determine whether the environment pertaining to the study is similar to another situation and whether the findings can justifiably be applied to another setting (Shenton, 2004).

Dependability is an assessment of the quality of the integrated processes of data collection, data analysis and theory generation. It is concerned with the ability of future researchers to repeat the same study in a different setting. At least some effort should be made by the researcher to enable such repetition (Shenton, 2004).

Finally, confirmability is a measure of how well the findings of the inquiry are supported by the data collected (Shenton, 2004).

For this study, in terms of credibility, the empirical data were generated from the real students and staff of EATI and the data would therefore be expected to reflect the true nature of the institution. Concerning transferability, Chapter 2 contains information on the research location that may inform the readers of the research of the research environment, enabling them to determine whether the findings of the study may apply to a similar, but different setting. Regarding dependability, in my opinion, in essence this study could be repeated in future by other researchers, but the methods of data generation may differ pertaining to the size and scope of the institution and population. This would also lead to different means of data analysis. Finally, in terms of confirmability, the findings produced and reported in Chapter 5 of this study were based solely on the data generated and how they compared to the literature perspectives provided in Chapter 3, with similarities noted and conclusions drawn in Chapter 4. This study may therefore be considered trustworthy in terms of the particular context, the group of students and staff as well as the issue under investigation. The next section addresses the ethical considerations that were taken into account during this study.

4.4 ETHICAL CONSIDERATIONS

Ethics pertains to doing good and avoiding harm. Harm can be prevented or reduced through the application of appropriate ethical principles. Therefore, the protection of human subjects or participants in any research study is imperative (Orb, Eisenhauer & Wynaden, 2000). Hammersley and Traianou (2007) in Plowright (2011:153) list five main ethical principles, which were considered during this study. Table 4.5 illustrates these principles and how they were taken into account in the empirical part of this study.

Table 4.5: Five main ethical principles and how they were applied in this study

Ethical principles	Application to this study
Harm Will anyone be harmed by the research?	No person or organisation was harmed or negatively affected through this research.
Autonomy Can the participants choose to take part in the research or not?	The participants in this study were provided with the option to participate in the research or not without obligation or unnecessary influence.
Privacy What information obtained from the participants will be made public?	The participants in this study were informed that their responses would only be made public anonymously and collectively. No participant is identified by name.
Reciprocity Will anything be offered in return for participating in the research?	No compensation of any kind was offered for participation in this study.
Equity All participants must be treated equally without favour or discrimination.	No discrimination whatsoever occurred in this study.

Every effort was made to avoid ethical misconduct throughout this study by referencing all others' ideas as theirs and not my own. Ethical misconduct in research can occur in many regards (Larkham & Manns, 2002), including the theoretical and empirical aspects of conducting research such as plagiarism and misrepresentation of data (Evering & Moorman, 2012). Other aspects of ethical misconduct in research may include issues of research sponsorship/funding, exploitation of other parties and misinterpretation of data or withholding important findings (Anderson, 1990). Effort was made to reduce the negative consequences of ethical misconduct by the use of the following measures set out by Anderson (1990), which were employed in this study to ensure ethical correctness:

- Informed consent – The participants in a research study must be informed of the nature and purpose of the study, including the risk and the benefits involved. The participants must give their voluntary consent to take part in the study. *This was done for this study, as the students and staff of EATI were informed about the study, why it was being conducted and that their participation was in no way compulsory or expected.*
- Using volunteers – Volunteers often feel obligated to participate and/or believe that the research will help them in some way. *Each participant in this research study volunteered to participate.*
- Honesty – Researchers must always be honest and their research must be transparent. *In my opinion the research process was conducted openly, honestly and fairly.*
- The right to discontinue – The participants must be allowed to withdraw their participation at any time during the study. *The participants were given the option to withdraw or not answer certain questions if they did not wish to do so.*
- Debriefing – It is advised that researchers share their findings with participants and clarify any uncertainties participants may have. *The participants were informed that the research findings and implications will be shared with them once the study has been completed and that the thesis will be made public on the library repository of Stellenbosch University.*
- Confidentiality – The researcher and participants must agree on whether the identity of the participants may be known. If not, it is vital that the participants remain anonymous. *The participants remained anonymous throughout this study in terms of their responses. Only the identity of the institution was made known with the permission of the director.*
- Right to privacy – The participants must enjoy their right to privacy, controlling what information they disclose. *The participants did not have to volunteer any information they were not comfortable to provide.*

- Respecting participants' time – Research should avoid wasting participants' time with irrelevant questions or studies that are unlikely to yield significant results. *The questionnaires and interviews only included relevant, important aspects. Therefore, in my opinion it was not a waste of the participants' time.*
- Risks versus benefits – It is important that the potential benefits for the participants outweigh the potential risks. *There was little risk involved in this study.*
- Vulnerable populations – Researchers must be cautious when dealing with participants that are particularly vulnerable in terms of age or any other aspect related to vulnerability. *The population of this study was not considered to be vulnerable.*

The institutional ethical clearance processes of Stellenbosch University were followed before the study commenced. A research proposal was submitted to the Faculty of Education's Ethics Committee, after which adjustments were made based on its recommendations. The research proposal was then submitted to the Research Ethics Committee: Humanities at Stellenbosch University for approval. The study and data collection could only continue once approval was received. All documentation related to conducting the study in an ethical manner is attached as Addendum G.

4.5 CONCLUSION

The chapter provided an outline of the research design and methodology of this study. The study was conducted from a pragmatic stance, allowing me as the researcher to use both narrative and numeric data, resulting in a mixed-methods design. The chapter also outlined the quality measures in generating and analysing the data as well as the ethical concerns related to the study as a whole. In the next chapter (Chapter 5) the empirical findings of this study are reported as related to the relevant literature explored in Chapter 3.

CHAPTER 5
RESULTS AND DISCUSSION

5.1 INTRODUCTION

Chapter 4 provided an outline of how the empirical part of the research was conducted at EATI. The aim of this chapter is to present the results from the data collection at EATI and discuss these accordingly. The results from the PAS 111 curriculum analysis (section 4.3.3.1.1), the questionnaire survey (section 4.3.3.1.2) and individual interviews (section 4.3.3.1.3), each with its discussion, is presented in the following sections.

5.2 RESEARCH RESULTS

5.2.1 Curriculum analysis

Curriculum analysis is defined by Posner (2004:14) as follows:

> [It is] an attempt to tease a curriculum apart into its component parts, to examine those parts and the way they fit together to make a whole, to identify the beliefs and ideas to which the developers were committed and which either explicitly or implicitly shaped the curriculum, and to examine the implications of these commitments and beliefs for the quality of the educational experience.

To analyse the curriculum of the PAS 111 module offered at EATI, a set of curriculum analysis questions as suggested by Posner (1992) were used. The reason for the use of this set of criteria was to determine whether the curriculum is seen as being appropriate for learning PAS 111 in Agriculture. Unpacking the PAS 111 curriculum provided some insights into chemistry learning, the potential deficiencies in the module and how to possibly improve the curriculum.

First Set: Data on curriculum documentation and its origins

1. How is the curriculum documented?
   a. On what documents and other resources will you base your analysis? Which state and national standards are relevant to the curriculum you have chosen?

The Principles for Agricultural Science (PAS 111) module is part of the BAgric programme that is taught at EATI. The PAS 111 module is based on several documents which were *permitted and evaluated by the Academic Programme Committee of Stellenbosch University. The analysis was based on the BAgric Prospectus 2011 (EATI, 2011), the PAS 111 syllabus guide (EATI, 2013c), study material (EATI, 2013b), tutorials (EATI, 2013d), and assessments (EATI, 2013a). Student assessment is traditionally done in the form of scheduled tests and examinations.*

b. What aspects of the analysis do the documents focus on?

The documents focus on:

<u>BAgric Prospectus:</u> Broad learning outcomes, admission requirements, determination of the examination admission marks (predicate marks), examination rules, PAS requirements, admission to supplementary examination, condonations, repetition of modules and continuation of the modules, readmission after unsuccessful study, hostel residence, BAgric programme outline, and content of modules.

<u>Curriculum plan:</u> The module prospectus information, teaching approach, learning outcomes and assessment, methods of assessment, time allocation of teaching and learning methods/activities, academic development and quality assurance methods.

<u>PAS 111 syllabus guide:</u> Requirements for entrance to examinations, PAS requirements, test and examination dates, calculation of marks (scheduled tests, non-scheduled evaluations), literature of learning material, objectives, content, and exit level outcomes.

c. Are there any obvious limitations in the curriculum documents?

The information collected appears to be adequate for the analysis of the PAS 111 module. There were some unanswered questions relating to the development of the BAgric curriculum, but it seems that the group of people who designed the programme either retired or do not serve on the committee any longer. Also, the documents were produced as teaching and learning guidelines rather than for research purposes and were created independent of a research agenda. Currently the PAS 111 course seems outdated, and would benefit from an upgrading exercise.

2. What situation resulted in the development of the curriculum?

   a. Who made up the cast of characters in the development of the curriculum? What were their names, with what institution were they affiliated, and what were their respective roles in the project? Within the project team, who represented the learners, the educators, the subject matter, and the milieu? Were there obvious 'blind spots' noticed?

The lecturers, guided by senior lecturers as well as senior management, in consultation with University of Stellenbosch Faculty of AgriSciences lecturing staff, played a pivotal role in the design of the BAgric curriculum. Industry was consulted, but the question remained as to which part of industry. Was it representative bodies or producers employing the graduates and thus having first-hand experience of the abilities of the students? Student representatives were obviously not consulted or represented. The 'blind spot' was probably the representation or non-representation of clearly defined role-players from the agricultural industry, specifically regarding the need of the programme and the packaging of the various study fields.

b. To what social, economic, political, or educational problem does the curriculum respond?

PAS 111 is a basic, required module, which must be taken by all students who register for the BAgric programme. PAS 111 is required in subsequent modules and the admission requirements of EATI do not have physical science as a requirement. The module is intended to prepare the students with the necessary skills, knowledge and behaviour in an agricultural working environment.

c. What planning elements seem to have dominated the curriculum development process?

Beauchamp (1982) states that a well-designed and balanced curriculum should include four main subdivisions: (1) a statement of intention for use of the document as a guiding force for planning instructional strategies, (2) statements outlining the goals for which the curriculum is designed, (3) a body of content that has the potential for the realisation of the goals, and (4) a statement or an evaluation scheme for determining the worth and effectiveness of the curriculum and the curriculum system.

The intent of the PAS 111 module is to provide students with the required foundation in chemistry, especially for those that did not have chemistry or natural science at school level, to enable them to continue with the modules/study fields where chemistry is a prerequisite. The goals of the module are to ensure that the students achieve the following learning outcomes:
<u>Knowledge</u>: Display a general understanding of basic atomic and elemental characteristics. Demonstrate an understanding of stoichiometric relationships; balance simple chemical

equations. Demonstrate an understanding of redox reactions theory. Describe the historical development of the atomic model. Understand the electronic bases of the periodic table. Understand the basic concepts of modern quantum theory. Describe ionic and covalent bonding. Name simple inorganic compounds. Draw Lewis structures given the chemical formula of a molecule. Comprehend the physical trends in the s- and p-blocks of the periodic table.

<u>Skills</u>: The ability to solve, calculate, use, interpret, relate, manipulate, apply, classify and put into practice the concepts covered.
<u>Attitudes</u>: Respect for the environment and its users. Acknowledgement of own limitations in terms of knowledge and skills. A positive approach to continuous professional development. Involvement in and service to the wider community. A positive example in terms of social responsibility and obligations. Acceptance of and striving towards the highest academic standards.
<u>Behaviour</u>: Disciplined, ethical, self-motivated.

Content that is discussed in the module are: atomic theory, chemical equations, atomic structure and the periodic law, chemical bonding and molecular structure, chemical concentrations, acids and bases, and organic chemistry.

At the end of the semester, students are expected to have obtained the following abilities and skills: demonstrate the ability to solve, calculate, use, interpret, relate, manipulate, apply, classify and put into practice the concepts covered during the course, and be disciplined, ethical and self-motivated after completion of the course. Summative assessments are used to evaluate students' knowledge by means of annual tests and examinations. The introduction to the basic science course was presented to all graduate students who did not necessarily have natural science as a subject in high school causing a disadvantage to students with no prior knowledge of the subject. There was no evidence in the learning material, syllabus guide, and tutorials that provision is made for students with no prior knowledge. There was also no proof of extra classes scheduled for students who were disadvantaged in this regard. The course content largely follows the structure of a first-year tertiary level basic science module.

3. What perspective, if any, does the curriculum represent?

The PAS 111 module is taught through a combination of approaches which embrace the traditional structure of disciplines as well as behavioural and constructivist perspectives. The method of instruction proposed is the 'traditional' method with learning objectives that are transmitted from one person (the 'lecturer') to the other (the 'student').

Second Set: Data on the proper curriculum

4. What are the purposes and content of the curriculum?

   a. What aspects of the curriculum are intended for training, and what aspects are intended for education contexts?

PAS 111 is part of the basic required modules and its function is to provide students with knowledge of basic chemistry. Posner (2004:70) defines training as the context in which we can predict with some confidence the specific situations in which people will use what they learn, and 'education' is defined as referring to "context in which we cannot predict with any specificity or certainly the situation which people will use what they learn".

In the PAS 111 module, the outcomes for training and education are referred to as follows:
Training: *Display a general understanding of basic atomic and elemental characteristics. Demonstrate an understanding of stoichiometric relationships; balance simple chemical equations. Demonstrate an understanding of redox reactions theory. Describe the historical development of the atomic model. Understand the electronic bases of the periodic table. Understand the basic concepts of modern quantum theory. Describe ionic and covalent bonding. Name simple inorganic compounds. Draw Lewis's structures given the chemical formula of a molecule. Comprehend the physical trends in the s- and p-blocks of the periodic table.*
Education: *The ability to solve, calculate, use, interpret, relate, manipulate, apply, classify and put into practice the concepts covered. Respect the environment and its users. Acknowledgement of own limitations in terms of knowledge and skills. A positive approach to continuous professional development. Involvement in and service to the wider community. A positive example in terms of social responsibility and obligations. Acceptance of and striving towards the highest academic standards.*

b. At what level, if at all, does the curriculum express its purposes?

The module is presented at Level 5 of the HEQF. The purpose of the course is reiterated in the BAgric Prospectus and the course calendar that are both given to students at the beginning of the academic year.

The exit level outcomes of the PAS 111 module are stated as follows:

Theme 1 – Atomic theory

- *Familiar with the most important definitions*
- *Describe the composition of atoms and the relationship thereof with atomic mass, mole and molar mass*
- *Calculation of molar mass*

Theme 2 – Chemical equations:

- *Calculations of the molecular ratios in an equation*
- *Calculation of molar masses from an equation*
- *Identify the limiting reactant in an equation*
- *Identify the type of chemical reaction from a chemical equation*

Theme 3 – Atomic structure and the periodic law

- *Understand the various physical properties of matter*
- *Understand the concept of orbitals and electron configuration*
- *Complete the electron configuration of elements with the use of the Aufbau principle or the periodic table*

Theme 4 – Chemical bonding and molecular structure

- *Understand the difference between ionic bonding and covalent bonding*
- *Ability to explain which bond is stronger*
- *Ability to draw Lewis structure*

Theme 5 – Chemical concentrations

- *Identify different chemical concentrations*
- *Describe chemical and physical concentrations*
- *Calculate chemical and physical concentrations from balanced chemical equations or problem statements*
- *Calculate dilution calculations*

Theme 6 – Acids and bases

- *Identify acids and bases as well as conjugate acids and bases from chemical equations*
- *Define acids and bases*
- *Calculate equilibrium constants*
- *Calculate pH and H^+ concentrations*

Theme 7 – Organic chemistry

- *Identify different classifications of organic molecules*
- *Draw organic molecules*
- *Name organic molecules*
- *Identify functional groups.*

c. What educational goals and educational aims are emphasised, and what are their relative priorities?

The educational goals of the BAgric programme are stipulated in the prospectus as:

Knowledge: The graduate should have:

- *knowledge of the applicable scientific concepts, the interaction between the biological and abiotic factors in the environment and the basic principles of research methods and methodology*
- *the ability to create new knowledge, generate ideas and act innovatively*
- *the ability to function effectively in an interdisciplinary environment and have and understanding of sustainable development and sustainable resource management*
- *the ability to manage information, make informed decisions and apply a systems approach to the analysis of environmental problems*

Attitudes: The graduate should:

- *have respect for the environment and its users*
- *take acknowledgement of their limitations in terms of knowledge and skills and have a positive approach to continuous professional development*
- *be involved in and should be able to provide a service to the wider community*
- *be a positive example in terms of social responsibility and obligations and should strive towards the highest academic standards*

Skills: The graduate should have:

- *the ability to collect, integrate, interpret and apply knowledge specifically to use this information in problem-solving*
- *effective communication with role-players from various environments and backgrounds*
- *sufficient skills to function as an agricultural scientist, either independently or as a member of a team*
- *have the ability to utilise relevant resources in the work environment effectively*

d. What types of learning objectives are included and emphasised in the curriculum?
The curriculum emphasises facts and concepts, calculations and equations, and procedures. Objectives are the following:

Theme 1 – Atomic theory: To ensure that he student comprehends the general definitions and concepts of atoms.

Theme 2 – Chemical equations: To familiarise the student with the concept of chemical equations and the application thereof in further chemical calculations

Theme 3 – Atomic structure and the periodic law: To provide the student with an understanding of the properties of matter and thus the properties of atomic structure

Theme 4 – Chemical bonding and molecular structure: To familiarise the student with concepts of chemical bonds and how it determines molecular structure

Theme 5 – Chemical concentrations: To give the student the ability to complete chemical calculations as well as the ability to convert between chemical concentrations

Theme 6 – Acids and bases: To familiarise the student with acids and bases calculation of pH

Theme 7 – Organic chemistry: To introduce the student to organic chemistry and naming of organic molecules

There is also an emphasis on a less strict behaviourist curriculum which includes intellectual and cognitive strategies. Competencies are measuring, observing, categorising, and predicting, with these categories receiving the emphasis, the facts, concepts, and principles of science. Its traditional content primarily assumes an instrumental role as the vehicle of teaching the basic science processes.

e. What are the primary ways in which the curriculum represents the subject matter to students?

The PAS 111 module is divided into seven chapters. The module is primarily presented through theoretical classes and tutorials. Lecturers use computers or laptops and projectors in class to run a PowerPoint presentation or other graphic applications in order to create variation in the instructional process. Most of the documentation or notes are presented in text format with pictures, charts and graphs.

f. What conception of the subject matter is apparent in the curriculum?

All topics on the learning material, objectives, content list, and exit level outcomes are provided. General information is given, such as course name, duration of examination, requirements for entrance to the examination, pass requirements, test and examination dates, lecturer information and consultation time.

Students' use of resources is limited as instruction is only given by means of presentations, learning material, assessments and evaluations. More Web-based resources could be implemented to expose students to various ways of engaging with the content. Lecture rooms are equipped with a computer and a ceiling projector, which can be used for PowerPoint presentations and for playing media documents, helping in the instruction process through the diversification of the methods of information transmission. In the first semester all students do a computer science course which enables all students to have a good knowledge of computers. They are also introduced to the library during the orientation week. The opportunities for access to information on the course are seemingly limited. The module includes the necessary subject matter for a basic science module but there is no evidence of practical exposure to the content of the module.

5. What assumptions underlie the curriculum's approach to purpose or content?

a. What conceptions of learning, objectives, curriculum, and instruction underlie the materials you are analysing?

The theoretical conceptions or principles that characterise the PAS 111 module and indicate a behavioural perspective underlie the materials. Behaviourists affirm that learning is change in behaviour, and the learner is, for all practical purposes, a blank slate on which the environment writes (Posner, 2004). The acquisition of knowledge, on the other hand, implies a different learning perspective, which is known as the constructivist approach, and which *demands meaningful learning and other tasks that require understanding and sense making (Posner, 2004), for example in science problem solving.*

In the PAS 111 module the objectives of the curriculum are stated as that students, after completing the module, should:

- *Display a general understanding of basic atomic and elemental characteristics*
- *Demonstrate an understanding of stoichiometric relationships, and balance simple chemical equations*
- *Demonstrate an understanding of redox reactions theory*
- *Describe the historical development of the atomic model*
- *Understand the electronic bases of the periodic table*
- *Understand the basic concepts of modern quantum theory*
- *Describe ionic and covalent bonding*
- *Name simple inorganic compounds*
- *Draw Lewis structures given the chemical formula of a molecule*
- *Comprehend the physical trends in the s- and p-blocks of the periodic table*

The objectives of this module tend toward behaviourist and constructivist approaches. In this case constructivist thinking can be measured while doing the module whereas behaviours can only be measured after the completion of the module. It is difficult to measure while completing the module. The lecturer has a detrimental effect on the behavioural approach and students are more responsible for constructing their own knowledge, being able to relate to perception, thinking, reasoning, and decision making.

b. What aspects of a hidden curriculum are likely to accompany the conceptions and perspectives underlying the curriculum?

In his comments on the effects of the hidden curriculum on students, Posner (2004:13) states that "the hidden curriculum is not generally acknowledged"; nevertheless, the curriculum could have a deeper and more durable impact on students than either the official or the operational curriculum, since the messages of the hidden curriculum concern issues of gender, class and race, authority and knowledge. The central goals of the PAS 111 curriculum are for students to:

- *Have the ability to solve, calculate, use, interpret, relate, manipulate, apply, classify and put into practice the concepts covered*
- *Respect the environment and its users*

- *Acknowledge their own limitations in terms of knowledge and skills*
- *Have a positive approach to continuous professional development*
- *Be involved in and offer service to the wider community*
- *Be a positive example in terms of social responsibility and obligations*
- *Accept and strive towards the highest academic standards*
- *Be disciplined, ethical, self-motivated*

Hidden goals that are not mentioned in any documentation but are sensed are for students to apply the knowledge they have learnt in this module to real and everyday life, making a positive contribution to the environment and the world. A further goal is to prepare students unknowingly for other subjects and how these subjects fit in with the content.

c. To what extent is the curriculum likely to play a hegemonic role in terms of purposes or content?

The PAS 111 curriculum prepares the student to take the prerequisite subjects. These subjects are:

- *Animal Production 212 (Animal Nutrition)*
- *Crop Protection 141*
- *Oenology 212*

The PAS 111 module plays a hegemonic role in to the content of the above-mentioned modules as it explains the basic fundamentals of chemistry and introduces the learner to elements, the periodic table, chemical equations and chemical concentrations. This is vital content in order to complete a degree in animal production, crop protection and oenology.

6. How is the curriculum organised?

a. What provision, if any, is made for the macro-level vertical and/or horizontal organisation?

On a macro-level EATI offers the courses below and is designed to prepare students to do the following modules:

- *Principles for Agricultural Science 141*
- *Animal Production 212 (Animal Nutrition)*
- *Crop Protection 141*
- *Oenology 212, 242, 313, 321, 342, 361*

The courses represent the vertical dimensions (Posner, 2004) of the above-mentioned modules in the BAgric degree. The curriculum does not mention any content taught in other subjects, *but on the first day of class the lecturer presents this information to students. The curriculum does not mention what the students are expected to know when they arrive on the first day.*

The module is organised in such a way that it is vertically aligned with modules that are on a higher course level. Modules are numerically sequenced and indicate that the lower course levels are prerequisites for the higher course levels.

The chapters of this module are divided into groups and build on each other on the vertical axis (Posner, 2004). The groups discuss the following themes: (1) atomic theory, (2) chemical equations, (3) atomic structure and periodic law, (4) chemical bonding and molecular structure, (5) chemical concentrations, (6) acids and bases, and (7) organic chemistry.

Horizontally, the content of these themes is reinforced in tutorial sessions through reviewing and practising of calculations and equations.

b. What basic configurations of content are found more at a micro-level?

The seven chapters contained in the PAS 111 module are divided, at a more micro-level, into more sections, this time discussing discrete pieces of information, which embrace multiple, unrelated, concepts or skills in a pyramidal or hierarchical structure (Posner, 2004).

c. How are the various media organised to deliver the curriculum?

Posner (2004) defines 'media' as linked to the ways in which instructional activities, methods and materials – media in the broadest sense – relate to particular objectives. Posner (2004) also describes three basic approaches to the use of media: parallel, convergent, and divergent. All approaches have their strengths and weaknesses. The answer is between these extremes, where one can see a mixed curriculum that capitalises on strengths of each activity and method to teach certain content but regularly focuses on all the activities of a common objective. The use of such a mixed curriculum allows the teaching of the PAS 111 module through a multitude of approaches and devices. The notes include the module content, and the course calendar organises the content into the planned sequence. All the seven sections of the notes contain developments of various topics and these topics are also illustrated in tutorials.

Parallel structure – chemistry text and laboratory guide might represent essentially separate courses with no attempt to make connections for the student.

d. What organisational principles are employed? Does or can technology play a role in curriculum organisation?

Posner (2004) advises as organisational principles for the curriculum Schwab's structure scheme, or commonplaces: (1) the subject matter, (2) the learner and the learning process, (3) the teacher and teaching process, and (4) the milieu in which education takes place. The organisational principles are used in the course in a weight order similar to the one mentioned in Schwab's commonplaces scheme. The subject matter is emphasised in the course at the macro-level of organisation through the course description and the content structure of the module in the notes.

Also, a more constructivist approach is being employed that consists of cooperative and self-directed learning to establish or encourage a continuous learning environment.

e. What is the relative status of the curriculum's subject matter, if any?

The PAS 111 module is structured as an uneven arrangement of organisational approaches, among which the bottom-up structure takes a central position, while the project and top-bottom structures follow in the listed order of importance. Some of the content of the module is acquired through the learning of prerequisite skills, which is done working backward from the intellectual skills desired at the completion of the curriculum.

The bottom-up epistemological assumptions that reside in the PAS 111 module claim that all complex or general knowledge and skills can be analysed into more specific or simple elements. Those of the top-down view are that each discipline is distinct and has its own structure, based on fundamental themes, concepts, or principles, while the notions of the project method announce recurrent cycles of thought-action-reflection (Posner, 2004). Most of the content of the PAS 111module is taught through the bottom-up model; for instance, doing tutorials on calculations. Rhetorical modes (e.g. description, argument) are first defined, then discussed, and afterwards exemplified, through the top-down approach.

7. What assumptions underlie the organisation of the curriculum?

The PAS 111 module is structured as an uneven arrangement of organisational approaches, among which the bottom-up structure takes central position. Much of the content of the course is acquired through the learning of prerequisite skills, which is done working backward from the intellectual skills desired on the completion of the BAgric curriculum. The bottom-up *approach that is followed claims that education should focus on teaching intellectual skills rather than facts, and secure learning success for all students (Posner, 2004).*

Other approaches, for example the top-down viewpoint, claims that education should entail understanding the structure of each major discipline of knowledge, while according to the project method, the goal of education is to help students reconstruct or reorganise their experience. The PAS 111 module follows the bottom-up approach and is designed to teach intellectual skills, through various facts which reinforce knowledge.

Third Set: Data on the curriculum in use

8. How should the curriculum be implemented?

   a. What are the temporal, physical, organisational, and political-legal requirements of the curriculum? (Does the curriculum have any special scheduling requirements? / Will the time allocated for students to learn be adequate? / Is the time teachers will need to prepare for their teaching of the curriculum realistic?)

Temporal requirements: The PAS 111 module is scheduled to be taught 10.5 hours per semester, hence students have contact time with the lecturer in the 8 hours scheduled for tutorials. The total number of hours for instructional learning is 18.5 hours. The rest of the hours are divided into self-directed learning of which 10.5 hours are allocated for online-learning and 21 hours for revision. The full duration of the module adds up to 50 hours of instruction. The allocated time for the course appears to be realistic, and good planning allows lecturers to keep pace with the course calendar. Calculated hours are based on a 56-day academic semester.

Physical requirements: All classrooms are equipped with a blackboard, computer or laptop, projection screen and projectors. Students have access to computers in labs where each student can do work on a computer. In this way online-learning can take place. The sufficient number of seats in the classroom provides a cinema-style teaching frame.

Organisational: The design of the curriculum and modules, and schedule of classes are determined by the Curriculum Committee and Stellenbosch University.

Political-legal: The PAS 111 module which forms part of the BAgric programme has been approved by Stellenbosch University as a degree programme.

b. What are the probable costs and benefits associated with curriculum change?

Facilities needed to present the PAS 111 module that are in place at EATI are lecture rooms and a laboratory for computer use. Every year the budget allows for upgrading and purchasing of equipment. The budget includes the post or expenses of a lecturer presenting PAS 111. Both the Department of Agriculture, which funds the programme, and students in the BAgric programme, are likely to benefit from implementing the new curriculum.

c. To what extent is the curriculum consistent with and appropriate for the lecturers' attitudes, beliefs, and competencies?

There are continuous training opportunities in place for staff members or lecturers, for instance through the Staff Development Plan. However, this does not reflect in the curriculum. Teachers mainly follow a traditional method of teaching.

Limitation: The job requirements for lecturers to teach at EATI are: a four-year degree in a specific field / specialisation in a specific field. There is no requirement for an educational degree.

d. What values are embedded in the curriculum, and how well are these values likely to be suited to the community?

The values embedded in the PAS 111 module are to respect the environment and its community and to apply the knowledge and skills in a way that is not harmful to anyone or anything.

There is a need for better understanding of students and their backgrounds, learning styles and approaches, and for better rapport between lecturers and students. There is also a need to revise the teaching skills of lecturing staff in order for staff to be on the same competency level of lecturing..

9. What can you learn about the curriculum from an evaluation point of view?

a. What, if any, data does the curriculum provide? What conclusions about the curriculum seem warranted based on the data provided?

Posner (2004) mentions two purposes for curriculum evaluation: to provide information for making decisions about individuals and to provide information for making decisions about the curriculum. Concerning decisions about individuals, Posner mentions six fundamental purposes, namely diagnosis, instructional feedback, placement, promotion, credentialing, and selection. The most essential of these is the diagnosis concerning strengths and weaknesses and determining areas that need special instructional attention. Posner (2004) also mentions the following diagnosis methods: observations of student performance; attitude, interest and behaviour scales; and standardised achievement and aptitude tests with sub scores.

Concerning curriculum decisions, Posner (2004) affirms that their purpose is a judgement regarding the value or worth of such a document. Is the document complete, internally consistent, and well written? Does the document represent a curriculum that has sufficient depth and breadth and is well organised, rigorous and up to date? How can it be improved? These questions are relevant and important, and could prove of great value to the lecturers who use the curriculum.

The PAS 111 module contains no evaluation data regarding the value or worth of the module, because no evaluation has been performed on the course in the Basic Science Department. There are informal comments about the curriculum from the lecturers who have been implementing it in their classes, but the usefulness of such comments is limited because the information is not objective and reliable. Due to a lack of data, no conclusions can be drawn regarding the value or worth of the module documents (Posner, 2004).

b. What instruments or suggestions for collecting data does the curriculum provide?

The instruments used for collecting data on the PAS 111 module in terms of student performance are assessment methods which include tests, tutorials and examinations.

c. What are your concerns about the curriculum that could be clarified by evaluation data? Consider short-term outcomes, long-term outcomes, antecedents, and transactions.

Concerning the process of planning a curriculum evaluation, Posner (2004) poses the following questions which would guide the evaluation: What are the kinds of things would you want to evaluate regarding the curriculum? How would you know if the curriculum is a success? What is supposed to occur in the classroom, labs, or the field when the curriculum is fully implemented and taught properly? What are your concerns about the curriculum that an evaluation could help you clarify? Answers to these questions can help determine what aspects of the curriculum one would want an evaluation to focus on.

The problem at EATI or with the BAgric degree is that the PAS 111 module does not make provision in evaluation between students who did have Natural Science in school and students who did not have Natural Science in school. However, as Posner (2004:249–250) states, "most evaluations focus on only those outcomes that reflect the curriculum's goals and objectives, what we shall term the narrow sense of outcome-based evaluation".

Whether predicted or unexpected, curricula have both long-term and short-term outcomes, therefore the evaluation needs to deal with both these aspects. The most essential information for students and instructors seems to come from the short-term outcomes, and includes what students remember and can do during and immediately after taking a course, then teacher satisfaction with curriculum, and last, community support for a curriculum.

Since the PAS 111 curriculum does not present a controversial subject, there are no negative issues related to the attitude of the community towards the course. The important concerns lecturers have on the short-term outcomes are what students remember and can do during and immediately after taking the PAS 111 course, and what the level is of teacher satisfaction with the curriculum.

Lecturers seek to assess and evaluate student performance and progress on a permanent basis during a course. An estimation of the result of the multiple factors which have a role in students' success or failure could provide the educators with a provisional conclusion which might answer the following questions: Do students learn? Do they retain what they are thought? Is their progress acceptable? However, there is no chance, at this time, for the lecturers who teach the PAS 111 module to find answers to the above questions or to one other question that troubles them: Do students still remember the information immediately after taking the module? The reason is that no follow-up is performed at EATI on the students who did the course.

The answers to the above questions would provide lecturers with the needed feedback on the effects of instruction in PAS 111 and would give them an idea of the quality of the module, and the effectiveness of the instruction.

Lecturer satisfaction with the curriculum or module is another matter of importance because it could provide an answer to the question: How adequate is the PAS 111 module design for the teaching of the course? A questionnaire containing pertinent prompts related to the issue would be useful for curriculum evaluation, but no such questionnaires have been dispensed to the lecturing staff of the Basic Science Department at EATI.

One of the long-term curriculum outcomes mentioned by Posner is the following: What students remember and can do with their knowledge well after the details of the course are forgotten, students' attitudes toward the subject matter, and the general support generated by the curriculum (Posner, 2004). Answers to such questions would also be useful in attempting to understand the long-term effects of the PAS 111 module on the students, the general perception students have about the module, and the long-term impact produced by the curriculum of the PAS 111 module on the students' attitude towards EATI. In this case, data collection would require longitudinal follow-up research on the students that could last decades, and there seems to be no interest at EATI at this time for this kind of exploration.

Transaction might be another issue of concern regarding the PAS 111 module. Transaction occurs whenever a student interacts with a lecturer, guidance counsellor, coach, librarian, other students, or instructional material (Posner, 2004). Such transactions, remarks Posner, comprise the process of education and therefore data on transaction are particularly important in curriculum evaluation to explain why certain outcomes did or did not occur; for example, a student's participation in classroom activities.

Posner proposes a cluster of transactional issues and questions that might help lecturers who teach PAS 111 to understand better how the module functions and to utilise it in the best manner. Data on the transactions also give the evaluator information on the way the module has functioned, the variety of ways it has been implemented, and the possible pitfalls a lecturer might face in using it. Posner (2004) highlights the following relevant questions: What are the potential problems or rough spots in its operation? What aspects have been crucial for success? How has the curriculum been implemented? What kinds of adaptations have been counterproductive? These questions are of major concern to both the lecturer and students, and adequate responses to them would produce a significant change in instruction; that is, in the approach lecturers would take for implementation of the PAS 111 curriculum.

d. Does the approach to student evaluation in the curriculum manifest a measurement-based or an integrated approach, or both?

Posner (2004:257) distinguishes these two assessment methods as (1) measurement-based evaluation, and (2) integrated evaluation. Concerning the first approach, he states: "The dominant perspective on evaluation is a close relative of the technical production model of curriculum development." To review, this model is based on two assumptions: (1) that educational practices are justified by the learning outcomes educators seek to achieve, and (2) that the outcomes can be measures.

There is strong criticism against the measurement-based method. Posner (2004:261) reviews the most common argument in the following words: "The problem with measurement-based evaluation, according to its critics, is its focus on trivial and contrived tasks, as the tasks may not test the students' ability to use their knowledge and skills in the real worlds."

The integrated approach to evaluations seems to be better and more adequate in education, because of its comprehensive perspective. In contrast to measurement-based evaluation, an integrated evaluation tends to be more consistent with an experiential perspective, though its proponents would likely object to any labels. Like experiential education, integrated evaluation tends to be growth-oriented, student-controlled, collaborative, dynamic, contextualised, informal, flexible, and action-oriented. While few, if any, evaluations have all of these characteristics, many curricula provide for at least some of them (Posner, 2004).

In the PAS 111 module, evaluation combines the measurement-based method with the integrated approach because some curriculum objectives are specific and can be converted into test items. Other objectives, however, contain a series of factors that need to be considered in the process, and therefore evaluations must be performed in the light of the degrees of curriculum implementation and the quality of instruction that took place (Beauchamp, 1978).

Though the lecturers who presented the PAS 111 module made a constant effort to provide instruction which included the positive characteristics of both evaluation approaches, there needs to be greater emphasis on the use of evaluations which contain the most relevant features of the integrated method: (1) growth-oriented, (2) action-oriented, (3) contextualised, (4) flexible, and (5) dynamic. Allowing students to control the evaluation is still controversial, but comments and observations on the usefulness of the evaluation tools and some problems related to assessments are expected and sought from the students.

e. What would a non-conservative (radical) evaluation of the curriculum look like?

For a definition of a conservative evaluation, Posner (2004:271) quotes Gouldner (1970:332) in the following paragraph which contains the main features of conservation:

> What makes a theory conservative (radical) is its posture toward the institutions of its surrounding society. A theory is conservative to the extent that it: treats these institutions as given and unchangeable in essentials; proposes remedies for them so that they work better, rather than devising alternatives to them; foresees no future that can be essentially or implicitly, counsels acceptance or resignation to what exists, rather than struggling against it (Gouldner, 1970, cited in Posner, 2004:271).

In contradiction to the fundamental characteristics of conservation described above, a non-conservative or radical evaluation of the curriculum would be based on a critical look at the college as an educational institution, and would question the central claims which maintain its existence, among which are the educational tradition, the contented state of affairs that characterises the bureaucratic apparatus of the institution, and the assumed sufficiency of the theoretical and practical approaches to instruction and learning. Instead of looking at educators and students as the reason for education failure, radical or non-conservative investigations would search for the hidden reasons that lie at the core of the problem.

According to Barr and Tagg (1995), the paradigm that has governed our colleges is that a college is an institution that exists to provide instruction. This perspective on education, the traditional, dominant paradigm, is the instruction paradigm which mistakes a means for an end because it takes the means or method called instruction or teaching, and makes it the end or purpose of the college. Concerning the structure that supports the paradigm, the writers affirm: Under it, colleges have created complex structures to provide for the activity of teaching conceived primarily as delivering 50-minute lectures – the mission of a college is to deliver instruction. Even worse, the instruction paradigm rests on conceptions of teaching that are increasingly recognised as ineffective. Given this fact, the elemental flaw inherent in the instruction paradigm, the obligation of educators is to get to the source of the problem, and change the paradigm. The solution, state Barr and Tagg (1995:13), is a perspective change, a shifting into a new paradigm: "A college is an institution that exists to produce learning. From this new angle of vision, instructors are helped to be aware that our mission is not instruction but rather that of producing learning with every student by whatever means work best."

A non-conservative (or radical) evaluation of the PAS 111 module would take into account all the issues above, and examine them in an open manner, in an attempt to align the configuration of this course with the theoretical perspective that would offer the best learning context for the students. Risks might have to be taken, and deep changes might have to be made about content structure, methods of instruction, and assessment and evaluation, but in the end such changes will make available to educators and students a learning atmosphere that would bring about the creation of remarkable outcomes.

Some of the perspectives that would have to be re-evaluated under the learning paradigm, and worked into a new educational dimension, are the role of the students in relation to the curriculum implementation and the role of the students in the learning process. Under the instruction paradigm, students are handed the curriculum, and their role is that of passive acceptors, with no active and considered participation in the process. In the learning paradigm, students will have to assume an active role in the shaping of all aspects of instruction. Under the instruction paradigm, students are handed all information, and their obligation is to acquire it. Under the learning paradigm, matters of learning are a cooperative effort between the students and their instructors, as teachers elicit student discovery and construction of knowledge (Barr & Tagg, 1995:16). The involvement and cooperation of both students and instructors in the learning process would turn the classroom from a conference hall into a learning centre where all participants share in the learning and construct knowledge, in constant spiral progression towards an increase in the understanding and integration of the studied subject.

Most of the questions in this section could not be answered because doing a curriculum evaluation has never been one of the focus areas at EATI. For the time being, lecturers only seem to focus on the short-term objective of the module, which is to reach the successful outcomes-based evaluations. Since it was found that data to answer all questions were lacking, there is clearly a need to gather data for longitudinal follow-up research.

Fourth Set: Critique of the curriculum

10. What is your judgement of the curriculum?
    a. What are its strengths and weaknesses?

The 2013 academic year at EATI started off on a chaotic note with confusion regarding the orientation programme of the first-year students. Classes started two weeks earlier than the scheduled academic year with a one-week break and resumed with the senior students after this break. During this particular week, lecturers could not start with their normal tutorial programmes as the time-table that is normally followed was interrupted and students were more involved with Rag activities. A complete week of formal tuition, practicals and tutorials was lost and all these activities had to be crammed into a short space of time.

The failure rate for 2013 was remarkably high. The high failure rate for PAS 111 is of much concern, because failure in this module might lead to a complete cessation of studies or an extension of years on campus. The failure rate increased year by year by 28% on average over four years.

Barriers or weaknesses of the PAS 111 module are the following: language of instruction; inadequate prior knowledge of students; not realising that students may hold different world-views; admission requirements to the programme which should include natural science as a requisite; no opportunities created in the module for revision; limited provision for formative assessment; limited options for student support; a lack of practical exercises; and inconsistency of learning material.

A strengths of the PAS 111 module is the growing reputation of EATI as a leading agricultural institute producing, amongst others, highly skilled winemakers.

b. Of what dangers would you want to be careful if you implemented the curriculum?

The dangers that would threaten a lecturer who would want to implement the PAS 111 curriculum or module are: (1) misconceptions regarding Chemistry –the curriculum is not designed to develop conceptual understanding but rather recall of information; (2) the Chemistry content that is a language on its own which needs to be interpreted to students; and (3) the insufficient time allocated to students who did not have Chemistry at school.

However, with regard to curriculum, the needs and issues of society as well as industry are complex. Language is indicated as one of the barriers. Another barrier is the different world views of the students, as is evident from the recent happenings at EATI where a group of students' disrupted classes, insisting that they be taught in English because they could not *follow lectures presented in Afrikaans. The problem is that the 50/50 English and Afrikaans language policy as stipulated in Addendum K has never been properly implemented at EATI. Addendum L provides evidence that there were issues with language and transformation at the institution. The debacle has forced the institution to re-examine its language policy, to institute a process of diversity training for lecturers and to provide conflict resolution interventions for students.*

11. How would you adapt the PAS 111 module to maximise its benefits and minimise its limitations?

Some preliminary suggestions on how the PAS 111 module could be adapted in order to accomplish its intended purposes are the following.

- *Align the PAS 111 curriculum with the Physical Science Grade 10–12 (2003) outcomes-based curriculum.*
- *Eliminate, as far as possible, artificial barriers to social transformation and the attainment of the qualification.*
- *Promote integrated learning within and across subjects and fields of learning.*
- *Ensure articulation (BAgric) – there is currently limited access from one degree to another in Agriculture.*
- *Focus on Agricultural Chemistry.*
- *Conduct proper assessment on practical skills.*
- *Coordinate and harmonise AET policy and curriculum.*

Synthesis of section 5.2.1

The Chemistry (PAS 111) module aims at equipping students with the knowledge and skills to apply basic chemistry concepts. The module also aims at enabling students to relate basic chemistry to other sciences including biology, mathematics and soil science. Time allocations seem to be important in order to allow students to understand and not simply memorise chemistry concepts, and reduction would allow such time (Mgajiorgu & Reid, 2006). Other findings from the analysis include an observation that ample reason and space exist for improving the PAS 111 curriculum in principle; the need to re-examine whether the assumptions underlying the curriculum are still valid and defensible; a need to identify current blind spots, biases and accepted perspectives; and lastly the need to demonstrate the worth of the curriculum to different stakeholders and especially its students. However useful criterion-based evaluation of the PAS 111 curriculum by any one person may be, a proper longitudinal evaluation by a curriculum team will probably result in a more accurate judgement of its effectiveness and efficiency.

5.2.2 Results from questionnaire

As mentioned in Chapter 4, questionnaires constructed from Louw's framework were distributed to first-year BAgric students at EATI. To estimate factors influencing the PAS 111 or Chemistry 111 module, students were asked to complete the questionnaire. The questionnaire contained open- and closed-ended questions. Of the 82 questionnaires distributed to the group of students, 52 were returned. The questionnaires distributed among students consisted of four sections, each section with a different focus. The four sections were (1) demographic information, (2) educational background, (3) academic performance (closed-ended), and (4) academic performance (open-ended). The results from each of these sections are presented and discussed separately in the sections that follow.

5.2.2.1 Demographic information

The first section of the student questionnaire covered demographics of the PAS 111 student population at EATI. Demographic information included gender distribution, age distribution, year of study, and students' first language. An explanation will be provided for why each demographic factor was included.

5.2.2.1.1 Gender

Table 5.1 indicates the gender distribution of the participants. Gender was included as a demographic factor to determine whether students from a minority group may display different perceptions of factors that may possibly influence their academic performance.

Table 5.1: Gender distribution of student participants

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Male	42	80.77	52	100
Female	10	19.23	10	19.23
Total	52	100		

Table 5.1 illustrates that the majority of students who completed the questionnaires were male students (80.77%) with less than a quarter being female students (19.23%). The higher male percentage is an indication that agriculture is still a male-dominated industry (see statistics presented in Chapter 2).

5.2.2.1.2 Age

Table 5.2 indicates the age distribution of the student participants. The majority (67.35%) of the students at EATI taking PAS 111 were between the ages of 21 and 25 years; 30.61% of the students were 20 years and younger and 2.04% were between the ages of 26 and 30 years. The data were captured in 2014 when all participating students were in their second year and had completed PAS 111 in 2013. Normally, students in their second year are around 20 years old. However, Table 5.3 confirms that the majority (63.46%) of the students who participated were in their second year. This might be because many of the students in the 21 to 25 year group were repeating the subject.

Table 5.2: Age distribution of student participation

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
<20 years	15	30.61	15	30.61
21–25	33	67.35	48	97.96
26–30	1	2.04	49	100
Total	49	100		

*Frequency missing =3

Table 5.2 indicates that the majority of the students taking PAS 111 most probably commenced their tertiary education after a gap year because of the higher percentage (67.35%) in the 21 to 25 year age group. Normally students commence their tertiary education directly after high school which puts them in the <20 years bracket. In view of Koljatic and Kuh (2001), Kuh (2002), Kuh, Kinzie, Schuh, and Whitt (2011) and Strom and Strom's (2013) view that first-year students are generally unprepared or under-prepared for higher education studies, student age is an important factor for educators of EATI to take into account. Should it be determined that many students struggle to adapt to the higher education environment or cannot manage the level of learning expected of them, student support initiatives may be relevant. Cruce, Gonyea, Kinzie, Kuh and Shoup (2008) mention examples of such initiatives intended to reduce first year students' risk of failing: well-designed orientation programmes, first-year seminars, constructing learning communities, intrusive advising, early warning systems, peer tutoring and mentoring and effective teaching practices.

5.2.2.1.3 Year of study

Table 5.3 indicates the year of study of the participant students. The year of study was included as a demographic factor to determine whether all participant students were taught by the same lecturer in PAS 111.

Table 5.3: Year of study of student participants

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Year 1	2	3.85	2	3.85
Year 2	33	63.46	35	67.31
Year 3	14	26.92	49	94.23
Year 4	3	5.77	52	100
Total	52	100		

*Frequency missing = 0

Even though the students were repeating the module or completed the module for the first time in 2013, all students were taught by the same lecturer. The new lecturer only started to present the module in 2014. Therefore, students in years 1, 2, 3 and 4 were taught by the same lecturer the first time they did the module. All comments in the questionnaire were therefore based on a period when only one lecturer taught the subject.

5.2.2.1.4 First language

Table 5.4 indicates the first language of students. The first language of students was included as a demographic factor to determine whether students who are in a language minority position would rate factors affecting performance in PAS 111 differently from those in a major language position.

Table 5.4: First language distribution of participants

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Afrikaans	42	80.77	42	80.77
English	7	13.46	49	94.23
Xhosa	2	3.85	51	98.08
Zulu	1	1.92	52	100
Total	52	100		

Table 5.4 indicates that the most common first language of students was Afrikaans (80.77%), with English (13.46%) and Xhosa (3.85%) second and third. One student's first language was Zulu. While a variety of factors may influence students' attitudes towards and relationships with their peers, language was considered an important factor as one might naturally assume that students prefer communication in their first language (Ngcobo, 2009). Therefore if they find themselves in an environment where few or no others speak and understand their first language and they are expected to communicate in a second or even third language, this may influence their willingness to engage in their learning. This aspect was also pointed out by the first-year lecturers in the scheduled interviews.

The language of chemistry is another important aspect. Chemistry language has high information density (Mgajiorgu & Reid, 2006) and contains discursive characteristics. Whereas social discourses are characterised by being personal, theory-constructive, anthropomorphic, speculative and animistic, the language of chemistry is often impersonal, descriptive, transmissive, objective and labelling. In other words, the technical language of chemistry is actually composed of words that have common-sense conceptions. This interaction leads to confusion and influences students' performance. It is thus important to build chemical language in line with social discourse (Mgajiorgu & Reid, 2006).

5.2.2.2 Educational background

5.2.2.2.1 Chemistry/Science in high school

Table 5.5 indicates the position of whether students had Chemistry or Natural Science in high school or not. The distribution of students who had Chemistry or Natural Science in high school was included as educational background factor to determine if students who did not have Chemistry or Natural Science were disadvantaged or accommodated for and whether Chemistry should become an admission requirement for the BAgric programme. Also, students who had Chemistry in high school might have other conceptions or perhaps misconceptions about the subject.

Table 5.5: Distribution of student participants who had Chemistry in high school

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
No chemistry in high school	28	54.9	51	100
Chemistry in high school	23	45.1	23	45.1
Total	51	100		

*Frequency missing = 1

Table 5.5 indicates that participant students who did not have Chemistry as a subject in high school were in the majority (54.9%) and students who had Chemistry were in the minority (45.1%). According to Mgajiorgu and Reid (2006), alternative conceptions or misconceptions of chemistry are resistant to change but can be changed over a long period of time. The best way to handle alternative conceptions or misconceptions may be to create cognitive conflict or through the use of anomalous data. Lecturers are supposed to check what conceptions students bring to their chemistry learning and set up opportunities for these to be discussed and challenged as necessary. This process will depend on questioning, discussion, group work, and time allowed for learners to play with ideas (Mgajiorgu & Reid, 2006).

5.2.2.2.2 Reason for studying at EATI

Table 5.6 indicates the reasons why participant students studied at EATI. This open-ended question was included as an educational background factor to determine the main reasons why students study at EATI. Open coding was used to identify common themes from the given answers.

Table 5.6: Reasons why student participants study at EATI

Response	Frequency	Percentage	Cumulative Frequency	Cumulative percentage
Quality of institute	19	38	50	100
Farming	17	34	17	34
Practical experience	6	12	31	62
To learn	5	10	22	44
Qualification	3	6	25	50
Total	50	100		

*Frequency missing = 2

Table 5.6 indicates that the most common reason students study at EATI is the quality of the institute (38%), with farming (34%) and practical experience (12%) as second and third reasons. To learn and have an education in Agriculture (10%) and obtaining a qualification in Agriculture (6%) were the less popular reasons.

5.2.2.2.3 Main subject choice

Table 5.7 indicates the main subject choice of the participant students. This question was included to get an idea of what the students' interests are. Main study fields are Agri-tourism, Agronomy and Pastures, Animal Production (small stock), Animal Production (large stock), Vegetable Production, Cellar Management, Pomology, Extension, Viticulture and Oenology. The main study fields that are not included are listed as Other.

Table 5.7: Student participants' main subject choice

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Plant and Animal Production	24	48	24	48
Other	15	30	50	100
Cellar Technology/Oenology	4	8	28	56
Extension and Plant Production	2	4	33	66
Extension and Animal Production	2	4	35	70
Agritourism and Plant Production	1	2	30	60
Agritourism and Animal Production	1	2	31	62
Total	50	100		
Frequency missing = 2				

Table 5.7 indicates that 48% of the participant students were studying towards a degree in Plant and Animal Production, and 30% towards a degree in Agronomy and Pastures/Vegetable Production/Pomology (listed as Other). The rest of the mainstream choices are in the minority.

Students often ask questions about the importance of chemistry in agriculture. Chemistry in agriculture involves many aspects and includes agricultural production, the processing of raw products into food and wine as well as environmental monitoring. A study in chemistry also emphasises the relationships among plants, animals and bacteria and their environment, the science of chemical compositions, and changes involved in the production, protection, and use of crops and livestock. As a basic science, it involves all the life processes through which humans obtain food and fibre for themselves and feed for their animals. Chemistry as an applied science is directed toward the control of processes to increase yields, improve quality, and reduce costs. Students often do not understand the common thread that chemistry ties together, for example genetics, physiology, microbiology, entomology, soil science and numerous other sciences that have an effect on agriculture. This proves that chemistry is important in agriculture and validates that it is incorporated in all mainstream subjects offered in the BAgric programme.

5.2.2.2.4 Did you pass the PAS 111 module in 2013?

Table 5.8 indicates the percentage of students who passed and failed the PAS 111 module in 2013. The table does not include students who were repeating the subject.

Table 5.8: Module pass and failure distribution of student participants

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Yes	43	82.69	43	82.69
No	9	17.30	52	17.31
Total	52	100		

Table 5.8 indicates that in 2013, 82.69% of the participant students passed the PAS 111 module and 17.30% of the students failed the module. However, the failure rate does not correspond with the failure rate indicated by the student information system in 2013. This figure was given as 38%. As participation in this study was voluntary, the missing 20.7% could be due to the fact that for unknown reasons, 20 of the registered 82 students for the module in 2013 did not participate in the study.

5.2.2.3 Academic performance (closed-ended)

The third section of the questionnaire consisted of a series of statements in the form of a five-point Likert scale (1=disagree strongly; 2 = disagree; 3 = uncertain; 4 = agree; 5 = strongly agree) to measure students' perspectives on factors that might have an influence on academic performance. The results of these statements are displayed in Table 5.9 and a discussion follows.

Table 5.9: Student perspectives of factors that might have had an influence on their academic performance

STATEMENT	Strongly disagree %	Disagree %	Uncertain %	Agree %	Strongly agree %	*Frequency missing
Chemistry should be an admission requirement for the BAgric programme	19.23	25	15.38	34.62	5.77	0
There was limited provision for Afrikaans tuition	9.8	27.45	13.73	29.41	19.61	1
There was limited provision for English tuition	10.2	51.02	20.41	10.2	8.16	3
Students were interested in the module	11.76	37.25	37.25	11.76	1.96	1
Class attendance was good	2	12	26	52	8	2
I had enough time to prepare for tests and exams	5.77	11.54	17.31	57.69	7.69	0
I had enough contact time with the lecturer	9.62	28.58	21.15	34.62	5.77	0
The examination paper was fair	15.69	25.49	19.61	35.29	3.92	1
The module was presented at a high level	5.77	13.46	30.77	44.23	5.77	0
The notes correlated with the presentations	5.88	13.73	17.65	54.9	7.84	1
The standard of the notes was fair	3.92	19.61	15.69	56.86	3.92	1
You received student support	13.46	23.08	23.08	36.54	3.85	0
Tutorials helped improve your understanding of the subject	1.92	9.62	5.77	73.08	9.62	0
Summer school can help you pass the module	0	0	21.57	37.25	41.18	1

As indicated in Table 5.9, 44.23% of the students indicated that they strongly disagreed or disagreed that Chemistry should be an admission requirement to the BAgric programme, while

12.38% were uncertain and 40.39% strongly agreed or agreed. With more or less the same percentage of students who agreed and disagreed overall to the statement and whether Chemistry should become an admission requirement or not, Chemistry lecturers should take note of their students' assumptions, motives, intentions, and more importantly, their background, that may influence the students' academic performance (Byrne & Flood, 2005).

Altogether 37.25% of students indicated that they strongly disagreed or disagreed that there was limited provision for Afrikaans tuition; less than a quarter (13.73%) were uncertain and the majority of the group (49.02%) strongly agreed or agreed that there was limited provision for Afrikaans tuition. Table 5.4 indicates that 80.77% of the students' first language was Afrikaans – this is the majority of the group who did not receive tuition in their first language. More than half of the students (61.22%) indicated that they strongly disagreed or disagreed that there was limited provision for English tuition, 20.41% were uncertain, and 18.36% strongly agreed or agreed that there was limited provision for English tuition.

Regarding interest in the module, 49.01% of the students indicated that they strongly disagreed or disagreed that they were interested in the module, 37.25% were uncertain, and 13.72% strongly agreed or agreed that they were interested in the module. This is similar to the findings of Graeber (1995) who found that students have low and decreasing interest in sciences such as physics and chemistry.

Only 14% of the students strongly disagreed or disagree that class attendance was good, 26% were uncertain, and more than half (60%) strongly agreed or agreed that class attendance was good.

Less than a quarter of the students (17.31%) reported that they strongly disagreed or disagreed that they had enough time to prepare for tests and examinations, an equal percentage of students was uncertain, and 65.38% of the students strongly agreed or agreed that they had enough time.

Regarding contact time with the lecturer, 38.2% strongly disagreed or disagreed that they had enough contact time with the lecturer, 21.15% were uncertain, and 40.39% of the students strongly agreed or agreed that they had enough contact time.

Altogether 41.18% of the students strongly disagreed or disagreed that the examination paper was fair, 19.61% were uncertain, and 39.21% of the students strongly agreed or agreed.

Less than a quarter (19.23%) of the participants strongly disagreed or disagreed that the course was presented on a high level, 30.77% were uncertain, and 50% of the students strongly agreed or agreed that the course was presented on a high level.

Similarly, less than a quarter (19.61%) strongly disagreed or disagreed that the course notes correlated with the presentations, 17.65% were uncertain, but more than half (62.74%) of the group strongly agreed or agreed that the course notes correlated with the presentations.

A total of 23.53% of the students reported that the standard of the notes was fair, 15.69% were uncertain, and more than half (60.78%) strongly agreed or agreed that the standard of the notes was fair.

On the question of student support, 36.54% of the students strongly disagreed or disagreed that they received student support, the same percentage was uncertain and 40.39% strongly agreed or agreed. In their study, Davidowitz and Rollnick (2005) found that an increase in the number of tutorials as well as a closer correspondence between tutorial problems and examination questions led to an improvement in the performance of the students, and a slight improvement in the overall pass rate of the course. This corresponds to the students' feedback in the current study that only 11.54% of students strongly disagreed or disagreed that tutorials helped improve their understanding of the subject; a mere 5% were uncertain and 82.7% strongly agreed or agreed. No one strongly disagreed or disagreed that summer school could help them pass the module, 21.57% were uncertain, and 78.43% strongly agreed or agreed that it could help them.

From the findings in Table 5.9 it is clear that the students strongly disagreed with the admission requirements to the BAgric programme and that they were not interested in the PAS 111 module.

5.2.2.4 Academic performance (open-ended)

The fourth section of the student questionnaire focused on factors that might influence the students' academic performance. In this section, open coding was used to identify common themes from the given answers to understand students' perspectives of the different aspects involved in their academic performance.

5.2.2.4.1 Why did you decide to study towards a degree in Agriculture?

Table 5.10 indicates the reasons why participant students had decided to study towards a degree in Agriculture. This open-ended question was included to get perspectives on academic performance and to determine the main reasons why students study towards a degree in Agriculture.

Table 5.10: Reasons why student participants were studying towards a degree in Agriculture

Response	Frequency	Percent	Cumulative frequency	Cumulative percent
Learning	15	29.41	33	64.71
Qualification	15	29.41	51	100
Farming	9	17.65	12	23.53
Job opportunity	5	9.8	18	35.29
Family history	3	5.88	3	5.88
Passion	3	5.88	36	70.59
Interest	1	1.96	13	25.49
Total	51	100		

*Frequency missing = 1

Table 5.10 indicates that 29.41% of the participant students were studying towards a degree in Agriculture because they wanted to obtain a qualification and they wanted to learn in Agriculture; 17.65% wanted to farm; 9.8% wanted to obtain a degree for a better job opportunity; 5.88% did it because of their family history and passion for agriculture; and only 1.96% were studying because they are interested in agriculture. None of the students mentioned anything about science or chemistry which is basically what agriculture is about. The importance of agriculture in the modern world is critical. In South Africa we still rely what we produce from the land (for example food) and as development throughout the world continues, so will demand. The introduction of technology has reshaped much of the industry which is constantly advancing the way we farm and studying at an institution such as EATI should be one of the reasons why students are there to learn.

5.2.2.4.2 Do you have family and friends that support you? If no, please explain why not.

Table 5.11 indicates whether students received support from family and friends. This question was included as an open-ended question to see whether students receive support other than institutional support.

Table 5.11: Distribution of family support to student participants

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Yes	42	100	42	100
Total	42	100		

*Frequency missing = 10

Table 5.11 indicates that all students received support from family members and friends. In a study on family support, Hodge (2011) found that families primarily indirectly or invisibly motivate their children to attend and perform well in institutions of higher education. These students are motivated to attend college for many reasons, including to achieve more than their parents had achieved or to support their family members financially in the future.

5.2.2.4.3 What is good or positive about your studies?

Table 5.12 indicates positive factors of their studies identified by student participants at EATI. This open-ended question was included as an academic performance factor to determine what factors influence their studies positively.

Table 5.12: Positive factors of studies indicated by student participants

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Learning/Expand knowledge	20	41.67	33	68.75
Interesting	11	22.92	13	27.08
Academic performance	6	12.5	39	81.25
Obtaining a qualification	5	10.42	47	97.92
Practical experience	3	6.25	42	87.5
Accessibility	1	2.08	1	2.08
Create opportunities	1	2.08	2	4.17
Willingness	1	2.08	48	100
Total	48	100		

*Frequency missing = 4

The positive factors that influence students' studies indicated in Table 5.12 are the opportunity to expand knowledge (20%), it is an interesting programme (11%), academic performance (6%), and to know they will obtain a qualification (5%). Each of the positive factors accessibility to campus, create opportunities and their willingness to study at EATI was indicated by only 1%.

It is questionable whether this caused 11% of students to indicate that the course was interesting, but the literature indicates that making the content structure more relevant to students by connecting their everyday life to science concepts was seen as a way to raise interest levels and foster learning.

5.2.2.4.4 What do you think about the subject Chemistry (PAS) 111 that was presented in 2013?

Table 5.13 indicates student perspectives on the PAS 111 module that was presented in 2013. This question was included in the questionnaire to determine possible reasons why students succeeded or failed the subject.

Table 5.13: Student perspectives on the PAS 111 module presented in 2013

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Difficult	10	20.41	21	42.86
Poorly presented	7	14.29	5	10.2
Not interesting	5	10.2	46	93.88
Well presented	4	8.16	30	61.22
Interesting	3	6.12	35	71.43
Fair	3	6.12	26	53.06
Challenging	2	4.08	11	22.45
Easy – had chemistry in school	2	4.08	23	46.94
Important	2	4.08	32	65.31
Feel neutral	2	4.08	38	77.55
Not applicable	2	4.08	40	81.63
Bad subject	1	2.04	1	2.04
Bad notes	1	2.04	6	12.24
Learn	1	2.04	36	73.47
Mistakes in notes and tutorials	1	2.04	41	83.67
Not relevant	1	2.04	47	95.92
Not satisfying	1	2.04	48	97.96
Relevant	1	2.04	49	100
Total	49	100		

Frequency missing = 3

As indicated in Table 5.13, most of the students (20.41%) were of the opinion that PAS 111 was a difficult module, 14.28% thought that the module was poorly presented, 10.2% saw the module as not interesting, 8.16% thought it was well presented, 6.12% thought it was presented fairly and interestingly, 4.08% considered the module either as challenging or as easy because they had taken Chemistry in high school. Only 2.04% of the students indicated that Chemistry is a bad subject, they had bad notes, they had to learn, had noticed mistakes in notes and tutorials, the subject is not relevant, and not satisfying. In this question one could also distinguish the attitudes of students towards the subject, the teaching of the subject and the lecturer.

It is clear from the literature that, from a teaching perspective, it is necessary for a teacher not only to have a good knowledge of the subject that is taught, in this case PAS 111, but also to have a well-developed understanding of how people learn. The focus of research has switched from analysing students' learning to students' beliefs, knowledge and attitudes (De Jong, 2007). However, as Table 5.21 illustrates, students' approaches to learning in the PAS 111 module is also important as this issue appears frequently in the literature on student success or failure.

5.2.2.4.5 What were your challenges in Chemistry (PAS) 111?

Table 5.14 indicates student perspectives on the challenges they experienced in the PAS 111 module that was presented in 2013.

Table 5.14: Student perspectives on challenges in PAS 111

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Calculations	10	22.73	10	22.73
Difficult	7	15.91	20	45.45
Lecturer	5	11.36	26	59.09
No background	5	11.36	38	86.36
Lecturing style	4	9.09	31	70.45
None	3	6.82	41	93.18
Little practical	2	4.55	33	75
Calculations and language	1	2.27	11	25
Calculations and no background	1	2.27	12	27.27
Calculations and theory	1	2.27	13	29.55
Difficult and lecturer	1	2.27	21	47.73
Lecturer and language	1	2.27	27	61.36
Practical	1	2.27	42	95.45
Preparation	1	2.27	43	97.73
Time	1	2.27	44	100
Total	44	100		

Frequency missing = 8

Various studies have shown that Chemistry is perceived as abstract, difficult and disconnected from relevant problems in everyday life (Black & Atkin, 1996). In South Africa, many first-year students in Chemistry present with an inadequate knowledge of the fundamental principles which underpin the study of chemistry (Marais, 2011; Rollnick et al., 2008; Steenkamp et al., 2009).

Table 5.14 indicates that the challenge most experienced (22.73%) was the calculations in the module. Altogether 15.91% of the students found the module difficult, 11.36% found the lecturer challenging and 11.36% indicated that their lack of a background in Chemistry was problematic. Of the students, 9.09% indicated a problem with the lecturing style, 6.82% experienced no challenges and 4.55% thought they had too little time for practical work. Only 2.27% felt factors such as language, calculations with no background, calculations and theory, lecturer and language, practical, preparation and time were challenges. One of the indicators of Louw's findings of academic indicators for early student departure is language difficulties, particularly in cases where the language of instruction is different from the students' home or school language (Louw, 2005). Some other factors are those associated with changing and increasingly diversified student populations in higher education across the world (Cross, 2004). This amplifies the need for chemistry lecturers to take note of their students' assumptions, motives, intentions, and previous knowledge that may influence the students' academic performance (Byrne & Flood, 2005).

5.2.2.4.6 What helped you succeed in Chemistry (PAS) 111?

Table 5.15 indicates factors that assisted the participant students in succeeding in PAS 111. This question was included because not many studies could be found that considered the students' own perceptions of their chances to succeed at tertiary level chemistry.

Table 5.15: Student perspectives on factors that helped them succeed in PAS 111

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Learning	11	23.91	15	32.61
Private tutors	9	19.57	31	67.39
Secondary school	5	10.87	36	78.26
Group studies	4	8.7	4	8.7
Peers	4	8.7	22	47.83
Tutorials	3	6.52	42	91.3
Other lecturers	2	4.35	18	39.13
Summer school	2	4.35	39	84.78
Tutorials and Learning	2	4.35	44	95.65
Old exam papers	1	2.17	16	34.78
Self-study	1	2.17	37	80.43
Tutorials and summer school	1	2.17	45	97.83
Web (internet)	1	2.17	46	100
Total	46	100		

*Frequency missing = 6

Table 5.15 indicates that the main factor that helped student respondents succeed in PAS 111 was to learn (23.91%). Learning a complex and hierarchically organised subject such as Chemistry requires the integration of new information with information that the students already possess, and then assessing whether or not it has become integrated into the knowledge they have stored in their long-term memory (Ausubel et al., 1978; Cowan, 1995; Reid, 2008). Consequently, students in the developmental sections became more actively engaged in the course material (AAC&U, 2007; Eilks & Beyers, 2010). The use of private tutors (19.57%) was the second factor indicated; then Chemistry at secondary school (10.87%) third, and group studies and peers (8.7%) fourth. Other factors indicated were tutorials (6.52%), the help of other lecturers together with summer school, and tutorials together with learning (4.35%).

Only 2.17% of students identified factors such as the use of old examination papers, self-study, tutorials included in summer school activities and the use of internet resources.

5.2.2.4.7 Any suggestions on what EATI can do to help you overcome the challenges in PAS 111?

Table 5.16 indicates what, according to the student participants, the institute can do to overcome challenges students experience in PAS 111.

Table 5.16: Student perspectives on what EATI can do to overcome challenges in PAS 111

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Better lecturer	22	51.16	22	51.16
Tutorials	7	16.28	42	97.67
Better notes	5	11.63	27	62.79
Remove chemistry	2	4.65	34	79.07
Extra classes	2	4.65	30	69.77
None	1	2.33	31	72.09
Presentations	1	2.33	32	74.42
More time	1	2.33	35	81.4
Bridging course	1	2.33	28	65.12
Tutorials and summer school	1	2.33	43	100
Total	43	100		

Frequency missing = 9

Table 5.16 indicates that more than half (51.16%) of the student participants were of the opinion that EATI should appoint better lecturers, while 16.28% indicated that more tutorials and a summer school should be worked into the programme and 11.63% felt that better notes should be provided. Other students (4.65%) suggested that extra classes be worked in for PAS 111 factors and a similar percentage of the group was of the opinion that PAS 111 should be removed from the programme. Altogether 2.33% of the group suggested that a bridging course should be implemented, nothing should be done, more time should be allocated to the module and summer school should be held every year.

Other strategies from the literature that were suggested to improve performance in Chemistry include the use of context-based learning approaches, interventions such as more structured tutorial schemes and competence tests (ACS, 1993; Davidowitz & Rollnick, 2005; Pilling et al., 2001; Pilot & Bulte, 2006).

5.2.2.4.8 Any suggestions on what you can do to overcome the challenges in PAS 111?

Table 5.17 indicates perspectives from students on what they can do to overcome challenges in PAS 111.

Table 5.17: Student perspectives on what they can do to overcome their own challenges in PAS 111

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Learning	5	14.71	16	47.06
Extra classes	5	14.71	9	26.47
Tutorials	4	11.76	34	100
Self-study	3	8.82	28	82.35
Ask lecturer	3	8.82	19	55.88
No comment	2	5.88	22	64.71
Nothing	2	5.88	24	70.59
More time	2	5.88	30	88.24
Class attendance	1	2.94	2	5.88
Concentrate	1	2.94	3	8.82
Easier	1	2.94	4	11.76
Study groups	1	2.94	10	29.41
Work with peers	1	2.94	11	32.35
More exams	1	2.94	20	58.82
Remove	1	2.94	25	73.53
Total	34	100		

*Frequency missing = 18

Table 5.17 shows that most of the students (14.71%) were of the opinion that extra classes and learning can help them overcome their challenges in PAS 111. Altogether 11.76% of the students indicated that tutorials can help them, 8.82% would ask a lecturer or would revert to self-study, while 5.88% said they can do nothing or have nothing to contribute and need more time. The rest of the students (2.94%) indicated time management, class attendance, increased concentration levels, making learning easier, working with peers, more examinations and removing the module from the BAgric programme.

I agree with what is stated in the literature, namely that students need help from their lecturers to succeed. From the literature it seems highly commendable that chemistry teachers should try to help students incorporate their learning styles and approaches when they learn chemistry (Rollnick et al., 2008).

5.2.2.4.9 Any suggestions on what the Department can do to overcome the challenges in PAS 111?

The suggestions mentioned by participating students are summarised in Table 5.18 below.

Table 5.18 Student perspectives on what the Department of Basic Science can do to overcome challenges in PAS 111

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Better lecturer	11	40.74	17	62.96
Tutorials	4	14.81	26	96.3
Give examples	2	7.41	2	7.41
Explain less complicated	1	3.7	3	11.11
Extra classes	1	3.7	4	14.81
Extra course	1	3.7	5	18.52
Involve students	1	3.7	6	22.22
Improve notes	1	3.7	18	66.67
Notes	1	3.7	19	70.37
Presentations	1	3.7	20	74.07
Questionnaires	1	3.7	21	77.78
Support	1	3.7	22	81.48
Language	1	3.7	27	100
Total	27	100		

*Frequency missing = 25

Table 5.18 shows that almost half of the students (40.74%) indicated that the Department of Basic Science can appoint more suitable lecturers to present PAS 111; 14.81% agreed on more tutorials and 7.41% agreed on giving more examples in class. Of the participants, 3.7% agreed that the department could ask the lecturer to explain the module in a less complicated way, arrange extra classes, arrange an extra course, involve students in knowledge transfer, improve the quality of the notes, hand out more notes, give presentations, give more questionnaires, put support structures in place and address language differences.

5.2.2.4.10 Do you have any advice for students taking PAS 111?

Table 5.19 indicates the advice participating students gave to students taking PAS 111 in the future.

Table 5.19: Advice from participating students to students taking PAS 111

Response	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Learn	13	28.89	27	60
Attend class	8	17.78	8	17.78
Self-study	7	15.56	40	88.89
Practise	3	6.67	32	71.11
Contact your lecturer	2	4.44	10	22.22
Take notes	2	4.44	42	93.33
Tutorials	2	4.44	44	97.78
Do your best	1	2.22	11	24.44
Extra classes	1	2.22	12	26.67
Good luck	1	2.22	13	28.89
Homework	1	2.22	14	31.11
Old exam papers	1	2.22	28	62.22
No comment	1	2.22	29	64.44
Secondary school chemistry	1	2.22	33	73.33
Language help	1	2.22	45	100
Total	45	100		

*Frequency missing = 7

The advice participating students gave to students taking PAS 111 in the future (see Table 5.19) was to learn (28.89%), attend class (17.78%), do self-study (15.56%) and practise calculations (6.67%). Other advice was to have contact with the lecturer, take notes, attend tutorials, do their best, organise or attend extra classes, good luck, do their homework, and work out old examination papers.

5.2.2.4.11 In your opinion, what are the main reasons why other students are not doing well in PAS 111?

Table 5.20 indicates what participating students saw as reasons why other students were not doing well in PAS 111.

Table 5.20: Student perspectives on why other students are not doing well in PAS 111

Response	Frequency	Percentage	Cumulative Frequency	Cumulative percentage
Bad lecturer	9	18.75	26	54.17
Difficult subject	7	14.58	12	25
No background in chemistry	6	12.5	32	66.67
No interest in subject	6	12.5	38	79.17
Don’t attend class	5	10.42	5	10.42
Don’t learn	5	10.42	17	35.42
Student life	2	4.17	43	89.58
Time management	2	4.17	45	93.75
Lecturing	2	4.17	48	100
No comment	1	2.08	39	81.25
Poor notes	1	2.08	40	83.33
No self-study	1	2.08	41	85.42
Workload	1	2.08	46	95.83
Total	48	100		

*Frequency missing = 4

As shown in Table 5.20, students' responses on why other students were not doing well in PAS 111 are that they had a bad lecturer (18.75%); it is a difficult subject (14.58%); students had no background in chemistry and students had no interest in the subject (12.5%); students do not attend class and do not learn (10.42%). Other reasons were student life (social and out of class activities), time management, lecturing (4.17%) and too heavy workload (2.08%). The issue of student interest was highlighted in a study by the American Chemical Society (ACS, 1993) that found that students with science as major direction show low and decreasing interest in the so-called hard sciences, such as physics and chemistry. The answers to this question correspond well to the answers give in Tables 5.13, 5.14 and 5.18.

5.2.2.4.12 What approach did you use to learn in PAS 111?

Table 5.21 indicates students' learning approaches in terms of surface, deep and strategic strategies in PAS 111.

Table 5.21: Learning approach of student participants

	Frequency	Percentage	Cumulative frequency	Cumulative percentage
Deep approach	24	53.33	35	77.78
Surface approach	11	24.44	11	24.44
Strategic approach	10	22.22	45	100
Total	45	100		

*Frequency missing = 7

Students' ability to utilise appropriate learning approaches is a crucial aspect of successful student learning (Hasnor et al., 2013; Malie & Akir, 2012). Table 5.21 indicates that students use different learning approaches. The majority of the students in this study (53.33%) used a deep learning approach to study PAS 111, 24.44% used a surface approach and 22.22% used a strategic approach.

Deep learning approaches integrate facts into a holistic learning of concepts. Students with the ability to use deep approaches may use surface approaches when the task demands it, such as learning large amount of material quickly for an examination, but do not find such tasks satisfying (Ramsden, 2003). Students who learn by a surface approach are often unable to construct a holistic understanding of what they are learning. These approaches may allow them to pass examinations, but are mainly about “quantity without quality” (Ramsden, 2003:117). The intention is to cope with the course requirements. Then, the students who adopt a strategic learning approach relate ideas to previous knowledge, look for patterns and underlying principles, and use evidence and relate it to conclusions. They examine logic and arguments cautiously and are critically aware of the understanding developed while becoming actively interested in the studied content (Almeida et al., 2011).

Synthesis

The previous section contains the findings of the student questionnaires. From the demographic information, it became known that the majority of the participant group was male, which is a sign that the agricultural training sector may still be male dominated. The section ‘Year of study’ was mainly meant to demonstrate that all the students who participated in the study were lectured by the same lecturer. In terms of the findings in respect to language, 80% of the students indicated that their first language was Afrikaans. The lectures in the PAS 111 module were, however, mainly in English. The language barrier became evident in the curriculum analysis as well. Besides this language barrier, chemistry has a language or jargon of its own which also seems difficult for students to adapt to.

From the educational background information it became known that the majority of the students who participated in the study did not have Chemistry or An Introduction to Chemistry in high school. This could be one of the major reasons why students have struggled in the PAS 111 module. The quality of EATI seems to be the most popular reason why students study at EATI and almost equally so is farming as a career. What was concerning however, was the fact that students could not see how Chemistry fits into the learning of agriculture.

The next section focuses on what students’ perspectives were in terms of the factors that influence their success or failure in the PAS 111 module. From the section on academic performance (closed-ended questions) it became clear that students could see the importance of Chemistry as an admission requirement to the BAgric programme because the majority of the group who participated did not have Chemistry at school. Language as a barrier was once again highlighted in this section because it was found that limited provision was made for

Afrikaans tuition. It also stood out that almost 50% of students were not interested in the module; this general state of affairs is noted frequently in the literature overview in Chapter 3. Another matter of concern indicated by the students was the agreement on the fact that the course was presented 'at a high level'. However, students also indicated that they had little student support and that tutorials and summer schools could possibly help them succeed in the PAS 111 module.

The questionnaire data on academic performance (open-ended questions) revealed that students had the support of family and friends, but not necessarily of EATI. Students were found to be more interested in the BAgric programme than the PAS 111 module that forms part of the programme. This outcome could be ascribed to many factors; one being that the way in which the subject was presented did not show its relevance to the greater programme. Students' perspectives on the PAS 111 module were diverse but they seemed to agree that the module was difficult, that it was poorly presented and that it was extremely challenging. The students indicated that they experienced the following challenges with regard to the module: doing calculations, 'difficult' subject content, difficulty in following the lecturer and having no background knowledge of the module. When they were asked about what helped them succeed in the module, they indicated factors such as learning the subject content, the use of private tutors, the fact they had Chemistry in high school and the use of study groups and tutorials.

Students were also asked what EATI could do to overcome challenges students experience in PAS 111. Most frequently indicated were the appointment of more competent lecturers, the scheduling of more tutorials and offering summer schools.

When asked about what could be done to overcome challenges experienced in the module, students indicated the need to attend extra classes, to utilise learning support, to make use of tutorials and self-studying. In terms of what the Department of Basic Science can do to overcome challenges experienced in the module, once again students highlighted the appointment of a more competent lecturer, agreement on the implementation of more tutorials and the incorporation of more examples. Advice participant students gave to their peers in PAS 111 included the following: to learn, to attend class, to do self-study, to practise calculations and to have contact with the lecturer. Students use different approaches to learning but most prominently were the use of a deep learning approach which is a more holistic way of learning difficult concepts.

The next section contains the results and discussion of the staff interviews.

5.2.3 Interviews with lecturing staff

As explained in Chapter 4, semi-structured interviews were also conducted with lecturers as part of the accumulation of data for this research. As indicated in Chapter 1, the lecturers teaching in PAS 111 as well as those teaching in other subjects made their own assumptions on the reasons for the relatively high failure rate in PAS 111. Since these assumptions were mainly based on personal observations, experience and conversations, there was a need to conduct interviews to check whether such views and assumptions could be confirmed. Two groups of staff members were interviewed. The first set of interviews was with five lecturers who presented first-year modules in the BAgric programme. They were asked 18 open-ended questions which focused on the behaviour of first-year students and their perspectives on the PAS 111 module. The other two lecturers who taught in PAS 111 in 2013 and 2014 were asked 14 closed- and 13 open-ended questions focusing on factors that potentially influence students' academic performance in PAS 111.

5.2.3.1 Interviews with lecturers presenting first-year BAgric subjects

Each of the five lecturers at EATI was asked 19 questions. Seeing that there were only five participants, their responses were recorded and are presented verbatim here. These questions were intended to investigate what lecturers' perceptions are of factors that influence students' success or their lack of success in PAS 111.

5.2.3.1.1. What module do you present at EATI?

Respondent 1 (R1): Soil Science 112; Natural Resource Management 142

Respondent 2 (R2): Biology 112

Respondent 3 (R3): Principles of Agricultural Science 111 (first two cycles of 2014)

Respondent 4 (R4): Soil Science 142

Respondent 5 (R5): Principles of Agricultural Science 121 (Maths); Agricultural Engineering 142

These questions were included as proof that the participant lecturers had personal experience of teaching first-year students. All the participant lecturers were involved in first-year subjects within the BAgric programme. The question relates to the changed and increasingly diversified student population in higher education (Cross, 2004) and amplifies the need for lecturers to take note of students' assumptions, motives, intentions, and previous knowledge that may influence student success (Byrne & Flood, 2005).

5.2.3.1.2 Do you think Chemistry should be an admission requirement for the BAgric programme? If yes, explain why.

One of the challenges associated with an increase in students' failure in PAS 111 is that students have no background knowledge of chemistry because the subject was not one of the admission requirements. Two of the lecturer respondents did not agree with this statement and one (R1) responded to the question as follows: "No, it should only be a requirement for specific study directions, for example Wine Technology. Admission criteria should be streamlined for specific main directions." Respondents 2, 3 and 4 took an alternative perspective by responding: "Yes, considering how they struggle, Chemistry is important, especially if their main direction of study is wine technology. They need a basic understanding of chemistry for Soil Science, Biology, Wine Chemistry and Chemistry 3 (R2)"; "Yes. It is too much work that first-year students need to deal with. Especially those who did not have Chemistry in high school" (R3); "Yes, definitely on BAgric level for more background. Rounds student off to work in the industry one day. Especially if the students would want to work in fertilisation" (R4). Respondent 5 agreed with Respondent 1 and said: "No, the total applications for the course will then be less." Biggs *et al.* (2001) explain that presage factors refer to what exists prior to engagement that affects learning. For students to have prior knowledge on the subject could mean to have the ability to use preferred approaches to learning and understanding chemistry.

5.2.3.1.3 Do you think language can be seen as a barrier – especially to first-year students coming from an Afrikaans/English/Xhosa first-language background? How, in your opinion, does this affect student performance?

Respondent 3, who responded differently from the rest of the group, did not agree that language is a barrier and said: "No. Provision are made for English and Afrikaans tutoring. It can be problematic to Xhosa-speaking students. Both English and Afrikaans are complete science languages, unfortunately not Xhosa." The rest of the participant lecturers agreed that language can be seen as a barrier to first-year students, a view that resonates with Louw's (2005) findings that language difficulties, particularly in cases where the language of instruction was different from the home or school language of students, can be seen as a barrier to student performance. Respondent 1 emphasised difficulties in adapting to the situation and tuition: "Yes. Students first need to adapt to the institution, then adapt to the language of tutor. Students learn better if they are taught in their mother tongue." Respondent 2 said: "Yes, it might affect students' level of understanding the subject." Respondent 4 highlighted the Xhosa students: "Yes, especially Xhosa-speaking students. Subject terminology is a problem." Respondent 5 said: "Yes, maybe to a small group" and also referred to the Xhosa group. There is an option for students who are enrolled for the BAgric programme have access to a language centre or facility, currently only based at Stellenbosch University.

5.2.3.1.4 Would you say students in their first year are focused on their studies? If yes, what factors could influence their academic performance?

Most of the respondents answered 'no' to this question and were of the opinion that students are not sufficiently focused on their studies. However, Respondent 2 said: "Yes, the majority. There is a learning culture on campus, self-motivation and the positive campus environment especially those students living on campus." The literature also suggests other factors that influence academic performance, such as the students' ability to utilise appropriate learning approaches, which seems to be one of the crucial aspects of successful student learning (Hasnor et al., 2013; Malie & Akir, 2012), changed and an increasingly diversified student population (Cross, 2004), environmental factors and other factors such as intrinsic motivation, role models and the need for self-actualisation (Maslow, 1970; Biggs, 1999; Schunk et al., 2008). The responses of the rest of the respondents were as follows: "No, not always. The freedom affects their performance. They realise only at a later stage the importance of their studies. There are too much sport and other activities" (R1). Respondent 3 said: "No, not everyone. They come from a disciplined school background to an environment where they have to act more independently. Not all students can handle it." Respondent 4 commented: "No. the sudden freedom they have when they arrive on campus. Students are not ready to study independently and have a lack of learning culture; they can't handle or control the sudden freedom and emotional intelligence." Respondent 5's view was: "No. Most students are not completely focused – especially the freshmen – and still have the talk-chalk mentality."

5.2.3.1.5 What, in your opinion, could hinder students' interest in first-year subjects?

Respondent 1 said: "Students' inability to grasp the understanding where modules influence their study option." Both Respondent 2 and Respondent 3 mentioned the environment in which the students function, which corresponds with Astin's theory of the environment that plays a role in the students' success: Respondent 2 said: "Firstly, former students that negatively market a subject especially Basic Science and Soil Science; secondly, heavy workload and lastly, language". Language once again came up as a barrier to students' interest and was indicated in the questionnaire responses from students as well. The Respondent 3 noted: "The fact that they are in an environment which expect of them to behave independently and to maintain disciplined while they are not ready. Older students are more focused." Respondent 4 said: "Students have unrealistic expectations of the subject and romanticise about the subject especially if they want to go into winemaking. Because of the syllabus and curriculum of the subject, students build a mental block about it." The last response (R5) echoes the findings of Graeber (1995) that students have low and decreasing interest in sciences, such as physics and chemistry: "It is about the students' interest in the subject. They are especially not interested if they did not have the subject in school."

5.2.3.1.6 Do students at EATI receive student support? If so, what kind of support?

The majority of the respondents (R1, R2, R3 and R5) responded 'no' to this question and said that the students do not receive student support and mentioned contact with the lecturer and support from the library resources as the only support available at EATI. One of the respondents (R4) was more positive: "Yes. They can get academic support from lecturers by making appointments. EATI has an agreement with the University of Stellenbosch to make use of their facilities. They can also use the computer room 24 hours and seven days a week on the EATI campus."

5.2.3.1.7 Do you think student support is important in the first year? How can student support help students achieve academic goals?

All respondents answered 'yes' to this question. Respondent 1 highlighted effort from the student in his/her response and said: "Yes, students should also identify to the lecturer when a problem occurs or when help is needed" whereas respondent 2 focused on how support from EATI could help students: "Yes, it can help them with study techniques, self-discipline and motivation. It can also enhance their focus which will lead to more meaningful learning (deeper learning)". Other respondents said: "Yes, especially in the first year" (R3); "Yes, by means of question and answer sessions, technical support and double-coaching" (R4); and "Yes, concepts can be better explained by the lecturer" (R5).

5.2.3.1.8 Do you think class attendance has an influence on the students' performance? If so, why?

Leon (2007), who gives reasons why class attendance is important, says that class attendance has the most academic value when both students and teachers are actively engaged. Students will accomplish little academically if they only come to class to socialise, complete work for other classes or activities, or sleep. Students must choose to participate in their own education and take responsibility for their learning. Class attendance does not guarantee success, but can enhance the probability of academic success. All respondents agreed with this view: "Yes, students' embedded knowledge is not in place. The only platform to address that is in the classroom" (R1); "Yes, it leads to integration, retention of information and a firmer grasp of the knowledge" (R2); "Yes, it allows them more contact time with the lecturer and have more access to the learning material. It creates more opportunities for questions and uncertainties" (R3); "Yes, it should be compulsory" (R4); and "Yes, new concepts are explained so more contact time with lecturers could help them" (R5).

5.2.3.1.9 Do you think the time-table has an effect on the students' performance? If so, in what way?

Respondents 1 and 2 agreed with this statement and said lecturers are not evenly distributed amongst different modules (R1) and when subjects are presented one after another, it makes it difficult for students to focus and assimilate knowledge (R2). The other three respondents did not react to this question.

5.2.3.1.10 Do you think the examination roster has an effect on the students' performance? If so, in what way?

Respondent 3 said 'no' to this question, but gave a valuable reason and said: "Exam rosters are distributed well in advance for students to plan accordingly and it should not have an effect on the students' performance." The respondents who answered 'yes' said: "The sequence of exams did not take into consideration the credit load of the subjects" (R1); and "Students need adequate time between exams to prepare to lessen anxiety and stress. It is difficult to retain information when stressed or anxious" (R2).

5.2.3.1.11 Do you think student performance is affected if students have problems with transport? If so, in what way?

Three of the respondents indicated 'yes' to this question and answered as follows: "Especially public transport – and they miss classes which creates a backlog and [they] never catch up on the work" (R1); "The student might miss out on valuable contact time" (R2); and "Yes, but this can be overcome with proper planning" (R3).

5.2.3.1.12 Do you think student performance is affected if students have problems with accommodation? If so, in what way?

One respondent responded 'no' to this question and the rest replied 'yes'. Respondent 1 said: "They miss classes and it creates a backlog and never catch up on the work"; Respondent 2 commented: "The environment needs to be conducive for learning"; Respondent 3 replied: "For a better learning environment you need a good home and need to be in a secured area"; and Respondent 5 commented: "If students stay in res it is easier to attend classes. Students that do not stay in res would not drive in for class if they only have one period for the day."

5.2.3.1.13 Do you think financial issues can influence the students' performance? If so, in what way?

Respondents 2 and 3 answered 'yes' to this question. Respondent 2 said: "Students need their basic needs to function optimally for example transport, food, clothes, and textbooks" and Respondent 3 said: "It would have a negative influence."

5.2.3.1.14 Do you think the support of family and/or friends could help students succeed? If so, in what way?

All respondents answered 'yes' to this question. Support identified from comments was the following: moral support, support from peers, learning support and language support. Responses were: "Morally, especially when students tend to lose focus" (R1); "If surrounded by the right peers and influence it would create a positive attitude towards students" (R2); "By giving support by means of encouragement, help, advice" (R3); "They will be in a better environment, but Xhosa students might have a problem" (R4); and "Study groups have a positive influence. Parent interest also plays a role" (R5).

5.2.3.1.15 What would you ascribe the high failure rate in Chemistry presented in 2013 to?

Requirements for admission to the BAgric programme that were mentioned by three of the respondents (R1, 4 and 5) seemed to be a concern to students too. Respondent 1 said: "Admission criteria, skew reflection of performance of national senior certificate results, experience of lecturer (subjective and didactic experience)". Respondent 2 was of the opinion that students found that staff were not approachable: "Approachability of staff". Respondent 3, who was the only lecturer in this sample who taught the PAS 111 module for a few months, had a more insightful comment: "Difficult concepts, outdated notes (learning material), level of assessment is too high according to question papers, classes are too big, no interest and willingness, negative influence of senior students, presentations did not correspond with notes." This comment could be very helpful when rewriting the curriculum in future.

5.2.3.1.16 What do you think are the students' challenges in Chemistry? Any suggestions on how students can overcome these challenges?

In the first part of his/her comment, one lecturer (R1) agreed with what Rollnick *et al.* (2008) imply, namely that many first-year students in Chemistry have inadequate knowledge of the fundamental principles which underpin the study of chemistry and said: "The embedded knowledge not in place. Their inability to integrate the subject with maths, science, physics. The lack of detail information transfer because of inexperience of lecturer and assessment methods." Other challenges mentioned more than once by lecturer and student participants were entrance criteria, language, lack of prior knowledge, competency of the lecturer, and the integration of the subject into other subjects. The responses were: "Psychological, they've been told its difficult, entrance criteria (students can do the subject without having it in school), language, approachability of lecturers and staff" (R2); "To consider Chemistry as a challenge" (R3); "Total lack of understanding of the subject. A lack of Chemistry background" (R4); and "The module should be presented by a competent lecturer. The inability to integrate the subject with soil science" (R5).

5.2.3.1.17 Any suggestions on what EATI can do to overcome the challenges students have in Chemistry or any other first-year subject?

As illustrated in Table 5.16, more than half of the participant students were of the opinion that EATI should appoint better lecturers. Similar responses were received by two of the respondent lecturers who said: "Appoint experienced and qualified lecturers. Change the admission criteria. Provide proper practical facilities" (R1); "Appoint skilled lecturers. Start an annual support programme and identifying programme to identify students that struggle" (R5). Again, one can agree with Cruce *et al.* (2008) that support initiatives such as the following could be implemented to reduce first-year students' risk of failing: well-designed orientation programmes, first-year seminars, learning communities, intrusive advising, early warning systems, peer tutoring and mentoring and effective teaching practices. Admission criteria, implementing a bridging course, early assessments, adequate and effective assessments, Chemistry as a prerequisite to the BAgric programme, smaller classes and lifting the standard of the course were other factors mentioned by the respondents. The respondents said: "Implement bridging courses, early assessments, adequate and effective assessments (R2); "Make Chemistry a prerequisite for the BAgric programme. Establish a better learning culture by establishing proper student support. Smaller classes or appoint more staff" (R3); and "Compulsory bridging course in chemistry and maths. Lift standards" (R4).

5.2.3.1.18 Any suggestions on what the faculty could ask the lecturers to do to overcome the challenges students have?

The suggestions from the students in the student questionnaire illustrated in Table 5.18 are similar to what the lecturers suggested in terms of arranging more tutorials and extra classes, putting support structures in place and addressing language differences. Respondent 1 and Respondent 2 had a similar take on the question and answered: "Additional classes, tutorials, one-on-one sessions" (R1); "More tutorials, more formative assessments to prepare for big assessments" (R2). Respondent 3 and Respondent 5 highlighted the responsibility of the lecturer: "The lecturer should behave more pro-actively and should be more focused on the students' problems. Ask the lecturer to rewrite the syllabus and to consider what the needs are for second- and third-year Chemistry" (R3); "Each lecturer should be responsible for his own subject. Establish a supporting programme" (R5). Respondent 4 touched on language adaptation and responded: "Make presentations English and Afrikaans. Lecturer should adapt to language needs. Practicals should be compulsory" (R4).

5.2.3.1.19 Do you have any general advice to students taking Chemistry?

Some general advice from the first-year lecturers to students taking the PAS 111 module were as follows: "Work hard from day one and practise" (R1); "Get additional help, form study groups, self-motivation" (R2); "They should try to tackle and confront concept as soon as possible" (R3); "Study your chemistry. Put a sweetener to it" (R4); and "Time and task" (R5). This is some useful advice for students taking the module in future.

5.2.3.1.20 Other comments

Only Respondent 4 made one last comment and said: "Students should be called to order! Compulsory class attendance. Lecturers should not put presentations on the electronic student network."

Synthesis of section 5.3.1

This section provided interview data from the lecturers who (at the time of the investigation) taught first-year subjects. Similar questions were asked in the interviews as in the questionnaires to students. This was done to measure or justify student responses against lecturer responses for reassurance and accuracy purposes. Factors that followed the same trend as factors mentioned in the student questionnaires were in no particular order: the EATI admission requirements and Chemistry as a requisite to the BAgric programme. This finding corresponds with Byrne and Flood's (2005) argument that lecturers should take note of their students' assumptions, motives, intentions, and more importantly their previous knowledge that may influence the students' academic performance, as indicated in Chapter 3.

Among other factors that can influence student's' attitudes towards and relationships with their peers (see literature review in Chapter 3), language was considered an important factor. It can naturally be assumed that students prefer communication in their first language (Ngcobo, 2009). This literature corresponds with the findings from the first-year lecturer interviews which pointed out that language used in tuition is very important. The literature further affirms that if students find themselves in an environment where few or no others speak and understand their first language and they are expected to communicate in a second or even third language, their willingness to engage in learning may be influenced. Other factors such as academic support, finances, family support, experience of the lecturer, skew reflection of performance of National Senior Certificate results, approachability of staff and difficulty of the subject were also highlighted. Issues such as the quality of learning material, the level of assessment, the size of classes, a lack of student interest, the need for integration with other modules, and student class attendance were also relevant factors.

5.2.3.2 Interviews with lecturers presenting Chemistry (PAS 111)

The two lecturers of EATI who presented PAS 111 in 2013 and 2014 were each asked 14 questions. Seeing that there were only two participants, their responses were recorded and are presented verbatim.. The respondents have been labelled Lecturer 1 and Lecturer 2 for reporting purposes. With these interviews I wanted to investigate what lecturers' perceptions are of factors that influence students' success or their lack of success in PAS 111. The 14 questions and the lecturers' responses are provided below.

5.2.3.2.1 In what year did you present Chemistry (PAS 111)?

The answers to this question serve as proof that the respondents did lecture the subject over the period of the study. Lecturer 1 presented the PAS 111 module in the year 2014 while Lecturer 2 presented the module from 2010 to 2013.

5.2.3.2.2 What do you think about the students' interest in Chemistry (PAS 111)?

In the students' questionnaire students were asked what they thought about the PAS 111 module that was presented in 2013. Only 3.12% (see Table 5.13) indicated an interest in the module which resonates well with what Lecturer 2 said: "Non-existent. Less than 5% have interest or has done Chemistry in matric." Lecturer 1, who presented the module in 2014, responded more positively to the question and answered: "Students started to develop interest when they realised where the subject fits into the industry but interest was not very high at the beginning."

5.2.3.2.3 Do you think students have enough time to prepare for tests and examinations? If no, explain why not.

Both of the lecturers responded “yes” to this question and were of the opinion that students generally have sufficient time to prepare for tests and examinations.

5.2.3.2.4 Do you think students have enough contact time with the lecturer? If no, explain why not.

Lecturer 1 said: “Yes”; however, Lecturer 2’s response pointed towards the unfairness of the admission requirements of EATI: “No – especially those who did not have Chemistry before. There is a big variation in chemistry knowledge – students’ contact time was dependent on this.”

5.2.3.2.5 In your own opinion, what do you think can be done to improve the students’ performance in chemistry (PAS 111)?

Lecturer 1’s response suggested that the curriculum be adapted: “The module should be adjusted to more applicable chemistry which will allow students to see where it fits in industry”, whereas Lecturer 2 highlighted – for the second time – admission requirements and said: “Make Chemistry a minimum requirement as entry to the BAgric programme.”

5.2.3.2.6 Below are a number of statements regarding the Chemistry (PAS) 111 module. Please respond to each one and indicate to what extent you agree or disagree with each statement.

Table 5.22 indicates lecturers’ responses on statements regarding the Chemistry (PAS) 111 module.

Table 5.22: Lecturers' responses to statements regarding the Chemistry (PAS) 111 module

#	STATEMENT	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
A	Chemistry should be an admission requirement for the BAgric programme.		L1			L2
B	There was limited provision for Afrikaans tuition.		L1 L2			
C	There was limited provision for English tuition.		L1 L2			
D	Students were interested in the module.	L2		L1		
E	Class attendance was good.				L1 L2	
F	The students had enough time to prepare for tests and examinations.				L1 L2	
f.7	The students had enough contact time with the lecturer.		L2		L1	
G	The examination paper was fair.				L1 L2	
H	The module was presented at a high level.				L1 L2	
I	The notes correlated with the class presentations.				L1 L2	
J	The standard of the notes was fair.				L1 L2	
K	The students received student support.				L1 L2	

L	Tutorials helped improve the students' understanding of the subject.				L2	L1
M	Summer school can help the students to pass the module.		L2		L1	

The lecturers did not agree on only four of the 14 statements. The first statement (A) that the two lecturers did not agree on was: 'Chemistry should be an admission requirement for the BAgric programme.' Lecturer 2 strongly agreed with the statement and Lecturer 1 disagreed. Lecturer 1 was uncertain about statement (D): 'Students were interested in the module' whereas Lecturer 2 strongly disagreed with the statement. They also did not agree on statement (G): 'The students had enough contact time with the lecturer.' Lecturer 1 agreed that students get enough contact time and Lecturer 2 did not agree. Lecturer 1 agreed and Lecturer 2 disagreed with the last statement, (M): 'Summer school can help the student to pass the module.'

5.2.3.2.7 What do you think were the students' challenges in Chemistry (PAS 111)? Any suggestions on how to overcome these challenges?

When the lecturers were asked what they thought the students' challenges were in PAS 111, their answers were: "Lack of previous experience. Mathematics is a big problem" (Lecturer 1), and: "No background in chemistry. Fear of the subject. Make chemistry a pre-requisite of the BAgric programme" (Lecturer 2). The only suggestion that came out was to make Chemistry a prerequisite for the BAgric programme; in other words, to make Chemistry part of the admission requirements for the BAgric programme.

5.2.3.2.8 What can help students to succeed in Chemistry (PAS 111)?

Lecturer 1 responded to this question by suggesting that the module be changed to a more applicable Chemistry module involving more practical classes: "The material can be adjusted – less chemistry learning material but more applicable chemistry can be included". Lecturer 2 felt strongly about mathematics as a basis to be understood before understanding chemistry and answered: "Mathematics".

5.2.3.2.9 Any suggestions on what EATI can do to overcome the challenges students have in Chemistry (PAS 111)?

Lecturer 2 became annoyed at this point because all his/her answers were directed to the adjustment of the admission requirements and said: L2: "Make it a requirement!" However, Lecturer 1 answered more calmly: "Increase application requirements and look at students' matric Mathematics marks".

5.2.3.2.10 Any suggestions on what the faculty could ask the lecturers to do to overcome the challenges?

Suggestions from students in the student questionnaire were to appoint better lecturers to teach the PAS 111 module. Suggestions from the first-year lecturers when asked this question were to appoint experienced, skilled and qualified lecturers, initiate an annual support programme for students, have seminars, adjust admission requirements, start a bridging course, do adequate assessments and have better student support in place. Lecturers who presented the module answered very briefly and suggested: "Schedule extra classes" (Lecturer 1) and "Introduce more tutors for tutorials" (Lecturer 2). Suggestions made by the lecturers who presented the module were not the same as those of the students and first-year lecturers and can probably be added to the list of suggestions.

5.2.3.2.11 Do you have any advice to students taking Chemistry (PAS 111)?

Advice the lecturers gave to students taking the PAS 111 module were to study more, work consistently and to prepare for lectures. Lecturer 1 said: "More study time" and Lecturer 2 said: "Work consistently and prepare for lectures."

5.2.3.2.12 In your opinion, what are the main reasons students are not doing well in Chemistry (PAS 111)?

A remark made by Lecturer 1 was that students do not know how to study and claims it as one of the reasons why students are not doing well in PAS 111: "Students does not know what it is to learn." Lecturer 2 once again blamed admission requirements and said: "No background in chemistry."

5.2.3.2.13 What approach do you think most students used in PAS 111 to learn chemistry? (See description of approaches below.)

Table 5.23: Approaches to learning

Surface approach	Deep approach	Strategic approach
Students mainly: - study without deep understanding - study to pass - study to satisfy parents - study to obtain a qualification - don’t see how chemistry can help them in the future	Students mainly: - study with the intention of understanding - relate previous knowledge in chemistry to new knowledge - integrate knowledge from different subject areas - relate what they have learnt in chemistry to everyday experiences - distinguish between chemical concepts and examples - define own goals and pursue them in an own way	Students mainly: - are interested in getting high marks - are deliberate and careful in planning their studies - plan scheduled study times - have organised note-taking methods - practise examination questions to maximise scores - stick closely to the syllabus

Both lecturers indicated that students mainly use a surface approach whereas students indicated that they use deep, surface and strategic approaches (see Table 5.21).

5.2.3.2.14 Did you teach chemistry mainly to promote a surface, deep or strategic approach to learning? Please motivate why this was/is the case.

None of the lecturers indicated that they promote a surface approach. They indicated, however, that most students approach their learning at a surface level. Lecturer 1 said: "Strategic approach. This helps students to study/learn all their subjects." Lecturer 2 commented: "Deep approach. It puts the work that you do into perspective."

5.2.3.2.15 Any other comments

Lecturer 1 made one last comment and suggested that the learning material be revised.

Synthesis of section 5.3.2

This sub-section reports on interview data generated from the two PAS 111 lecturers. These findings relate to what Byrne and Flood (2005) found, namely that students' prior knowledge influences their academic performance which possibly directs attention to the concern about admission requirements for PAS 111 at EATI. Language and student responsibilities for their learning were also mentioned by lecturers and academic support as important factors.

Other findings include a skewed reflection of students' performance in results of the National Senior Certificate, difficulty of the subject, inaccessible learning material, lack of student interest, a poor understanding of the subject, a lack of integration of the module content with other modules, the need for tutorials, summer schools, and increased contact time with the lecturer.

Findings reported in the literature also seem to be similar to what was experienced at EATI and shown by the data generated in this study. Many students appear to be unable to manage the level of learning expected of them and student support initiatives are seen as relevant. Such initiatives are mentioned by Cruce *et al.* (2008) in particular who suggest a number of possible measures to prevent first-year failure. Such measures include well-designed orientation programmes, first-year seminars, constructive learning communities, strong student advisory services, early warning systems, peer tutoring and mentoring and effective teaching practices.

5.3 DISCUSSION AND SUMMATIVE PERSPECTIVES

This chapter contains the findings from the empirical part of this study. Data generated from the document analysis, questionnaires and interviews were portrayed and links to relevant literature as explored in Chapter 3 were made. My summative perspectives on the findings as they emerged from the document analysis, questionnaires and interviews are discussed next.

It is clear that many factors influenced the learning environment of the students and consequently their academic performance. This was captured in the conceptual framework presented in Chapter 3 which provided a summary of my understanding of the factors that potentially influences the study success of first-year students in particular. This framework was derived from the relevant literature consulted and personal experience of factors that influence learning in Chemistry – especially in the first year of studies.

As illustrated in Figure 5.1, a qualitative relationship is suggested between factors related to the input, environment and output of student learning. All three of these aspects are related to and have a direct influence on one another as indicated by the direction of the arrows. Therefore the findings of this study are discussed and presented through this model (Louw, 2005).

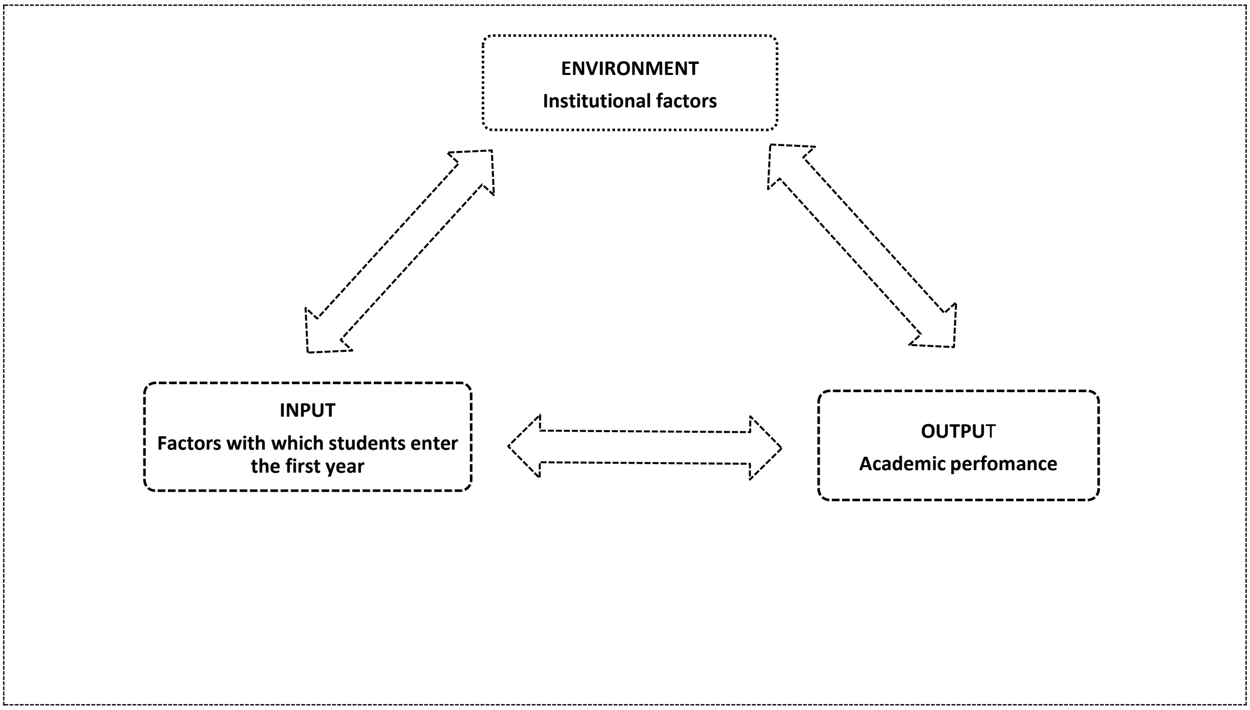

Figure 5.1: Conceptual framework for this study (also see Figure 3.6)

Findings on input: Input represents the students and the factors with which students enter the institution in the first year. These factors might influence how students approach the educational environment as well as the output (academic performance). Input factors might include demographic information, educational background, historical learning experience, academic support, learning approach, study skills, admission requirements, language, study goals, students' foundational knowledge of the subject, programme choice, and reason for entering the programme.

Findings on this section could be retrieved from the findings on the student questionnaires and lecturer interviews. Factors that were found in this study to have an influence on academic performance of PAS 111 students are discussed next.

Demographic information included gender distribution, age distribution, year of study and students' first language. The findings illustrated that the majority (80.77%) of the students were male with less than a quarter being female (19.23%) (see 5.2.2.2). This may be an indication that agriculture is still a male-dominated industry; it also points back to the general statistics on Agriculture students reported in Chapter 2 (see section 2.2).

It was found that the majority of students commenced their tertiary education after a gap year because 67.35% of the students were in the age group of 21 to 25 years (see 5.2.2.3). Age was an important factor to investigate because according to the literature (Strom & Strom, 2013), many students struggle to adapt to the higher education environment or cannot easily manage the level of learning expected of them.

The year of study was included as a demographic factor to determine whether all students were taught by the same lecturer in PAS 111 in 2013 and it was found that all students were taught by the same lecturer. The most common first language was found to be Afrikaans (80.77%) (see 5.2.2.5). Language is considered an important input factor as one might assume that students prefer to be taught and to learn in their first language. In this case, the lecturers' first language was English and almost half (49.02%) of the students agreed that limited provision was made for Afrikaans tuition.

In terms of the students' educational background, it was found that 54.9% of the students did not have a background in Chemistry knowledge (see Table 5.5). This means that they did not have Chemistry as a subject in high school. No proper provision for these students was thus made as Chemistry is not an admission requirement for the BAgric course. Also, no special arrangements were made for students with no prior knowledge of chemistry. At least one lecturer was heavily opposed to this practice and ascribed the poor pass rate in PAS 111 directly to the wrong admission requirement (see 5.3.2.9).

Findings from the lecturer interviews on academic support were mixed. Some lecturers indicated that students do not receive sufficient academic support from EATI (see 5.3.1.f). Others were of the opinion that students can gain support by approaching lecturing staff and use the library facilities or facilities at Stellenbosch University.

Students were found to use different approaches in their learning but most prominent was the use of a deep learning approach which is a more holistic way of learning concepts. However, both lecturers who presented PAS 111 were of the opinion that a surface approach was the one most used by students (see 5.3.2.14). Students themselves indicated (see Table 5.21) that they use deep, surface and strategic approaches.

Factors that were highlighted numerous times in the curriculum analysis, student questionnaires and lecturer interviews were (in no particular order) the EATI admission requirements and Chemistry as a prerequisite to the BAgric programme, which apparently has a considerable influence on the students' academic performance in PAS 111 in particular.

The empirical findings also showed that the most common reason students choose to study at EATI is the quality of the institute (38%), with farming (34%) and practical experience (12%) as second and third reasons. To learn and have an education in agriculture (10%) and obtaining a qualification in agriculture (6%) were the less popular reasons. Still, many students grapple with the question of what the importance of chemistry is in agriculture. This question may relate to why almost half of the students (49.01%) are not much interested in the PAS 111 module (see .Table 5.9). This corresponds to earlier findings by Graeber (1995), namely that students have low and decreasing interest in the sciences and in subjects such as Physics and Chemistry. More recent literature on this aspect could however not be found.

Findings on environment: 'Environment' mainly represents the institutional context and the effect it might have on entering students (input) as well as its influence on the academic performance and academic success of students (output). These factors might include, but are not limited to, the students' level of academic integration, time-tables, expected student workload, inadequate study support, foundational knowledge required, institutional commitment to the curriculum, institutional facilities, institutional climate, course structure, lecturers' teaching qualifications and styles, learning support to students, language of teaching and learning, communication to students, size of classes, administrative procedures, access measures, the quality of lecturing staff, learning assessment methods, course information and more (see Chapter 3, sections 3.2.3.1 and 3.4).

Findings on environmental factors could be retrieved from the curriculum document analysis, findings from the student questionnaires and lecturer interviews. Factors that were found in the research to have an influence on academic performance are discussed next.

Many factors underlying the curriculum analysis emerged as having the potential to influence students' academic performance in PAS 111. It was found, for instance, that the PAS 111 curriculum was not aligned with the Physical Science Grade 10-12 (2003) outcomes-based curriculum, which was the relevant school curriculum at the time of study (see 5.2.1.11). Little effort was made to eliminate artificial barriers to social transformation and the attainment of the qualification to educational needs. The curriculum proved not to be focused on agricultural chemistry and therefore students appeared to have little interest in the module. In addition, little provision is made for the assessment of practical skills in the curriculum (see 5.2.1).

Environmental factors (not only confined to institutional factors) highlighted by first-year lecturers included the availability of financial support, family support, the experience of lecturers, a skewed reflection of student performance in the National Senior Certificate, the (un)approachability of staff, the difficulty of the subject, ineffective learning material, the level of assessment, the size of classes, psychological influences, efficiency of presentations, securing an understanding of the subject, integration with other modules, the offering of tutorials and summer schools, and class attendance requirements (see 5.3.1).

Environmental factors highlighted by the lecturers who presented the PAS 111 module corresponded to a large measure to those pointed out by other first-year lecturers. These factors are the difficulty of the subject, the effectiveness of learning materials, securing an understanding of the subject, integration of the module content with other modules, the offering of tutorials and summer schools and available contact time with lecturers (see 5.3.2).

Other findings on environmental factors that have an influence on students' academic performance as judged by themselves were that PAS 111 was a difficult module (20.41%), the module being poorly presented (14.28%), and the module not being interesting (10.2%). A small minority of students found the module easy because they had Chemistry in high school and an equally small number found that the subject was not relevant or satisfying. These findings point mainly to environmental factors that do not add much to success in PAS 111 or an appreciation for the measures EATI has in place to support student success.

Findings on output: Output represents the students' academic performance as a function of input and environmental factors (see Figure 3.6). The failure rate for the PAS 111 module has been significantly high for the past years. For instance, the failure percentage for the past four years was 34% in 2010, 16% in 2011, 24% in 2012, and 38% in 2013. Academic performance might be influenced even before students start a course because of factors such as bad advertising of courses (often by peers), fear of difficult subjects, fear of isolation on campus and limited or no access to academic support, no support to overcome personal and social challenges, the wrong programme choice or changes in the middle of a course. Factors that were found in the empirical part of this study to have an influence on academic performance are discussed next.

From the first-year lecturers' interviews fear of chemistry and mathematics emerged as potentially important factors influencing students' academic performance and output. Bad marketing of or misinformation on the course by peer students is bound to happen, but was not mentioned by students. Yet, the 'bad lecturer' was mentioned several times. Another factor that was mentioned often was the lack of support to overcome academic performance challenges.

A factor that influences students' academic performance output is the way in which they approach their learning in general but also in a particular subject. Learning approaches seem to be one of the crucial aspects of successful student learning (Hasnor et al., 2013; Malie & Akir, 2012). The majority of the students (53.33%) used a deep learning approach to study PAS 111; 24.44% used a surface approach, and 22.22% used a strategic approach. Much of the research indicates that students use different learning approaches and strategies which, in turn, influence their academic performance. However, it was found that lecturers assume that most of the students use a surface approach to learning PAS 111, which is cause for concern (see 5.3.2.14).

It was found that many of the factors experienced by students and what the researcher assumed to have an influence on academic performance were accurate and corresponded with the literature reviewed in Chapter 3. In the next chapter, some conclusions are drawn based on the findings of the study and related to the literature review presented in Chapter 3.

CHAPTER 6

CONCLUSIONS AND IMPLICATIONS

6.1 INTRODUCTION

Chapter 5 presented the results and discussion of the empirical data generated by this study. In this chapter some conclusions are drawn based on the findings of the study and related to the literature overview presented in Chapter 3. The purpose of this study was to address and answer the research question: Why do students at Elsenburg Agricultural Training Institute not perform well in PAS (Chemistry) 111? The conclusions that follow illustrate that the research question has been adequately addressed.

6.2 CONCLUSIONS

Based on the findings reported in the consulted literature and the empirical findings reported in Chapter 5 of this study, a number of conclusions can be drawn regarding the PAS 111 module and perceptions of factors that influence students' success or failure in PAS 111. This study afforded students and lecturers an opportunity to share their experiences regarding the PAS 111 module. Most of the findings agree with the literature reviewed, with what lecturers perceived as learning barriers, and what I as the researcher and former lecturer at EATI found to be challenging factors in the module. The conclusions drawn therefore result from the findings from the curriculum document analysis, student responses and lecturer responses.

6.2.1 Conclusions regarding the PAS 111 module

The first subsidiary question of this study inquired into whether the PAS 111 curriculum is appropriate in terms of student learning. The exact question was: Is the PAS 111 curriculum appropriate for learning PAS 111? Factors underlying the curriculum analysis were found to have an indirect influence on academic performance. It was found that the PAS 111 curriculum is not completely aligned with the Physical Science Grade 10-12 (2003) outcomes-based curriculum (see Chapter 5, section 5.2.1). This corresponds with the literature that in South

Africa, many first-year students in Chemistry present an inadequate knowledge of the fundamental principles which underpin the study of Chemistry (Marais, 2011; Rollnick et al., 2008; Steenkamp et al., 2009).

In view of the evidence gained from the analysis of the PAS 111 curriculum, it seems safe to conclude that no effort was made to eliminate the observed barriers to the curriculum, the transformation of the curriculum and the attainment of the qualification. The PAS 111 curriculum does not seem to be focused on Chemistry within the context of Agriculture (see 5.3.2.5) studies and thus students appear to have little interest in the module (see Table 5.9). Moreover, little provision is made for the assessment of practical skills in the curriculum and overall the current PAS 111 module seems outdated and may thus benefit from an intensive curriculum inquiry exercise (see Chapter 5, section 5.2.1).

6.2.2 Conclusions on academic factors that influenced success or failure in PAS 111

This section addresses three of the research sub-questions, namely:

- Is the PAS 111 curriculum appropriate for learning PAS 111?
- What are students' perceptions of factors that influence their success or failure in PAS 111?
- What are lecturers' perceptions of factors that influence students' success or failure in PAS 111?
- How do lecturer and student perceptions compare in terms of factors influencing student success or failure in PAS 111?

6.2.2.1 Conclusions based on student perspectives

Firstly, while language is currently (2015) a hot discussion topic at EEATI, when this research was being conducted, the language of instruction was also found to be a contentious topic. Eighty per cent of the students at the time indicated that their first or home language was Afrikaans (see Tables 5.4, 5.14, 5.18, 5.19). However, the lectures in the PAS 111 module were mainly conducted in English. The language barrier also became evident in the curriculum analysis (5.2.1.10.a) and besides this language barrier, chemistry has a conceptual and technical language of its own which also seems difficult for students to adapt to. One may thus conclude that not only the language of teaching and learning, but also the language of chemistry will need intensive attention in any curriculation effort.

Secondly, the findings indicated clearly that the majority of the students did not have Chemistry or an Introduction to Chemistry in high school (see Tables 5.5, 5.13, 5.15, 5.19, 5.20). This is judged to be one of the major reasons why students are struggling in the PAS 111 module. Also, students who had Chemistry in high school might have other conceptions, or perhaps misconceptions, about the subject. PAS 111 is required in subsequent modules and the admission requirements of EATI do not have Physical Science as a requirement. The module is also intended to prepare the students with the necessary skills, knowledge and behaviour in an agricultural working environment, but this is very difficult to accomplish seeing that some of the students have no background or prior knowledge of the subject. It is therefore concluded that the entry requirements for the BAgric programme and PAS 111 module in particular may need serious reconsideration and attention.

Lastly, it also stood out that almost half of the students were not interested in the module (see Tables 5.9, 5.12, 5.13, 5.20) amidst the fact that student interest proves to be an important performance factor as also highlighted in the literature overview in Chapter 3. From the results on the PAS 111 module analysis it does not seem that the PAS 111 module is sufficiently focused on chemistry *within the context of agriculture*. Seeing that most students who enrolled for the programme are interested in farming, one might expect the module to be more favourably aligned within agricultural contexts. One may therefore conclude that the PAS 111 module should be revised or that an intensive curriculum exercise is needed to address this potential deficiency.

6.2.2.2 Conclusions based on lecturer perspectives

Firstly, and in accordance with the perceptions of PAS 111 students, the EATI admission requirements and Chemistry as a prerequisite to the BAgric programme were found to be a concern (see sections 5.2.3.1.2 and 5.2.3.1.15, 5.2.3.2.5, 5.2.3.2.6 (Table 5.22A), 5.2.3.2.9. 5.2.3.2.10 and 5.2.3.2.12). These findings relate to what Byrne and Flood (2005) have found, namely that students' prior knowledge influences their academic performance, a factor that potentially raises concern about the admission requirements for PAS 111 at the EATI. The conclusion is thus that the entry requirements for the BAgric programme and PAS 111 module in particular may need reconsideration and attention.

Secondly, the findings showed that language use in tuition is very important (see sections 5.2.3.1.3, 5.2.3.1.5, 5.2.3.1.14 and 5.2.3.1.18). This finding could be linked to the finding in the curriculum analysis (5.2.1.10.A) where language is seen as a barrier to learning (6.2.1). It is evident from the literature that students' willingness to engage in learning may be adversely influenced if they find themselves in an environment where few or no others speak and understand their first language and they are expected to communicate in a second or even third language. In the PAS 111 module, lectures were mainly conducted in English; also, chemistry has a conceptual and technical language of its own which students seem to find difficult to adapt to. One may thus conclude that not only the language of teaching and learning, but also the technical language of chemistry will need attention in any re-curriculation effort.

Thirdly, the findings from the lecturer responses indicated clearly that little student support was available to students at the time of the study (see sections 5.2.3.1.6, 5.2.3.1.7). Many students seem unable to manage the level of learning expected of them; thus student support initiatives may be relevant and needed. Such initiatives are mentioned by Cruce *et al.* (2008) in particular who suggest possible intervention measures which may also help to prevent or limit failure in a module such as PAS 111. One may thus conclude that support programmes or support initiatives for students may be needed at EATI and for PAS 111 students in particular.

Lastly, the findings from the lecturer responses showed that there is a skewed reflection of performance by students coming from the results of the National Senior Certificate (see section 5.2.3.1.15). This includes an underestimation of the difficulty of the subject, inaccessible learning material, a poor understanding of the subject, a lack of integration of the module content with other modules, the need for tutorials and summer schools and the need for increased contact time with the lecturer. One may thus conclude that in order to address such perceptions or deficiencies the selection criteria for the BAgric programme may need to be revised. In the process, the PAS 111 module may need to be re-aligned within the programme and students need to be accommodated according to their learning needs after being selected into the programme.

6.2.2.3 Comparison between student and lecturer perspectives

The data generated by this study have indicated that the perceptions of students and lecturers largely correspond in terms of the factors that may influence learning in PAS 111 at EATI. These factors include the language of instruction, the admission requirements to the BAgric programme, that students who did not have Physical Science in high school struggle with PAS 111, a lack of proper student support, and that students are not interested in the module. As the perceptions of students and lecturers correspond on these issues, one may conclude that a strong case can be made for them to be further investigated or to be addressed by EATI in order to improve students' performance in PAS 111.

Synthesis

Two factors were prominent in all three sets of the empirical findings. The first was the issue of admission requirement for the BAgric programme where Physical Science is not a prerequisite for the programme. This has appears to have a major influence on academic performance. The second was the language of instruction, which does not correspond with the first language of many students. It is evident that this issue, which recently led to major student upheavals at EATI, cannot be ignored. A disturbing factor is that students do not seem interested in the PAS 111 module, especially because the module is not aligned with contextual examples or situations. This may be linked to students' different cultural and academic backgrounds, their preferred learning styles and lecturers' inability to take these into account when teaching the PAS 111 module.

6.3 IMPLICATIONS OF THE STUDY

Research findings and conclusions generally have practical and conceptual or theoretical implications as well as implications for further research. The implications of this study will thus be discussed next.

6.3.1 Implication for non-alignment of the PAS 111 module

The PAS 111 module is based on several documents that have been approved and evaluated by the Academic Programme Committee of Stellenbosch University. However, these documents were not completely aligned with the Physical Science Grade 10-12 (2003) outcomes-based curriculum. The documents were produced as teaching and learning guidelines rather than for research purposes and were created independent of a research agenda which made the analysis process difficult. Also, chemistry modules should probably not only incorporate basic general disciplines of Mathematics, Physics and Chemistry but may further advance to involve elements of chemistry disciplines such as Physical Chemistry, Organic Chemistry, Inorganic Chemistry and Analytical Chemistry.

6.3.2 Implication for language of instruction

The 50/50 English and Afrikaans language policy has never been properly implemented at EATI. The current (i.e. 2015) language debacle has forced the institution to re-examine its language policy, a process of diversity training for lecturers and conflict resolution interventions for students. In this case the lecturers' first language was English and almost half of the students agreed that only limited provision was made for Afrikaans tuition. Language is considered an important factor as one might naturally assume that students prefer communication in their first language. Therefore, if students find themselves in language unfriendly environments this may influence their willingness to engage in their learning. The implication may thus be that EATI should revise its teaching and learning language policy in order to create a more learning friendly context for students in general and PAS 111 students in particular.

6.3.3 Implication for low student interest

With the student interest towards the PAS 111 module being so low, strategies to be implemented to improve performance in Chemistry may be implicated. For example, to include the use of context-based learning approaches which seem to improve student attitudes towards Chemistry – more so than conventional approaches – may result in more positive attitudes towards learning in Chemistry. Context-based teaching approaches may incorporate interventions such as competence tests and other examples listed in Chapter 3. It appears as if other ways of improving student interest in PAS 111 were employed, which included the use of external lecturers. Such initiatives were only mentioned informally and no firm evidence of their effectiveness was provided.

6.3.4 Implication for admission requirements

The admission requirements for the BAgric programme do not indicate Physical Science as a prerequisite for the programme. For this reason, students admitted are students who either had or did not have Physical Science as a school subject. Those who did not have the subject at school have no prior knowledge and those who had the subject have misconceptions about the module. According to Mgajiorgu and Reid (2006), the best way to handle wrong conceptions or misconceptions may be to create cognitive conflict or by using anomalous data. The implication may thus be that lecturers need to check what conceptions students bring to their learning in Chemistry and create opportunities for these to be discussed and challenged as necessary. This process will probably depend on questioning, discussion, group work, and time allowed for learners to play with ideas as suggested in literature (cf. Mgajiorgu & Reid, 2006).

6.3.5 Implication for further research

The study has raised a number of critical issues related to the PAS 111 module which forms part of the BAgric programme. Therefore, the study could potentially pave the way for further studies regarding the challenges students face in their attempts to achieve success in the module. It is suggested that an in-depth inquiry be done in the form of a curriculum exercise. This might help transform the current PAS 111 module into a curriculum fit for the BAgric programme. A more in-depth study of the significance of teaching and learning techniques in Chemistry, especially in Agriculture, could render valuable information to further improve learning in Chemistry at EATI.

6.4 LIMITATIONS

The study was limited to students who were registered for the PAS 111 module in 2012 and 2013. This participant group included students who completed the module, failed the module and students who were repeating the module. These students were part of the BAgric programme at EATI, where I was employed as a lecturer at the time of the study. The study or learning material investigated in this study had been compiled by me, as the researcher, and other EATI staff. I therefore interpreted the findings of the study as an EATI employee but also as a researcher. By the end of 2014 I accepted a new job which made it challenging to communicate and interact with the relevant role players at EATI. In view of these potential conflicting concerns it was a challenge for me, in the role of researcher, to criticise the lecturers' comments and the material used. However, I associated myself as researcher as best as I could. I was aware of this possible limitation throughout the study. I also cross-checked the findings of the study with other professionals who are experienced in teaching Chemistry and first-year subjects. Despite the limitations, the data generated for this study highlighted important areas that may to contribute to a better understanding of the PAS 111 module and ultimately its improvement that may influence student success in Chemistry.

As this study was confined to EATI it cannot be generalised to other settings. It may, however, be duplicated in other modules. This would provide interesting comparative data and findings which may be used to improve academic results. Further aspects that may be inquired into and which were not stressed in this study include more emphasis on the transformation of a new BAgric curriculum and revising all modules in the process. Another research issue may be to delve more deeply into the language inequalities currently at the forefront of debate at EATI.

6.5 CONCLUSION

This study has shown what factors students and lecturers perceive to have an influence on student performance in PAS 111 at Elsenburg Agricultural Training Institute (EATI). In spite of the limitations of this study, I was able to note the challenges students face and how they deal with these challenges.

The overall research question: Why do students at Elsenburg Agricultural Training Institute not perform well in PAS (Chemistry) 111? was adequately addressed in this study. Based on recent theoretical and empirical research and by looking more closely into input, process and output factors influencing student performance, an overall perspective could be established and implications could be indicated for improvement of student performance in the PAS 111 module. The study also adds to the body of knowledge on student teaching and learning in Agriculture education and at EATI in particular, which includes the potential of improving the teaching of Chemistry contextualised in Agriculture education.

Finally, it my contention as researcher that series of workshops on teaching strategies in chemistry, language improvement and student support may be ways to further improve future student academic results. For long-term effectiveness the curriculum of the BAgric programme and all its sub-departments and modules may also need to be transformed, but this should be done on the basis of solid research and findings and not to serve the demands or needs of uninformed or less-informed constituents.

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Wes-Kaapse Regering
Landbou

ADDENDUM A: Student questionnaire

Academic factors influencing the performance of first-year students in chemistry at Elsenburg Agricultural Training Institute.

Section 1: Demographic information

1.1. Gender

Male	
Female	

1.2 Age

Less than 20 yrs	
21 – 25 yrs	
26 – 30 yrs	
31 – 35 yrs	
More than 36 yrs	

1.3 Year of study:

Year 1	
2	
3	
4	

1.4 First language?

Afrikaans	
English	
Xhosa	
Zulu	
Other	

Section 2: Educational Background

2.1 Did you have Chemistry/Science in high school?

Yes	
No	

2.2 What is your reason for studying at Elsenburg?

2.3 Main subject choice

Plant and Animal production	
Cellar Technology	
Cellar Management	
Agritourism and Plant	

Production	
Agritourism and Animal Production	
Extension and Plant Production	
Extension and Animal Production	

2.4 Did you pass the Chemistry (PAS 111) module in 2013?

Yes	
No	
Repeating in 2014	

Section 3: Academic Performance

Below are a number of statements regarding the Chemistry (PAS 111) module in 2013. Please read each one and indicate to what extent you agree or disagree with each statement.

#	STATEMENT	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
3.1	Chemistry should be an admission requirement for the BAgric programme					
3.2	There were limited provisions for Afrikaans tuition.					
3.3	There were a limited provision for English tuition					
3.4	Students were interested in the module					
3.5	Class attendance were good					
3.6	I had enough time to prepare for tests and exams					
3.7	I had enough contact time with the lecturer					
3.8	The examination paper was fair					
3.9	The module was presented in a high level					
3.10	The notes correlated with the presentations					
3.11	The standard of the notes was fair					
3.12	You received student support					
3.13	Tutorials helped improve your understanding of the subject					
3.14	Summer school can help you pass the module					

Section 4: Academic performance

4.1 Why did you decide to study towards a degree in Agriculture?

4.2 If you had problems with transport in 2013, indicate what the problems were.

4.3 If you had problems with accommodation in 2013, indicate what the problems were.

4.4 Did you have a problem with paying your fees (e.g. paying textbooks, traveling money, food, living expenses), briefly explain the nature of the problem.

4.5 Do you have family and friends that support you? If no, please explain why not?

4.6 What is good or positive about your studies?

4.7 What do you think about the subject Chemistry (PAS 111) that was presented in 2013?

4.8 What were your challenges in Chemistry (PAS 111)? Any suggestions on how to overcome these challenges?

4.9 What helped you to succeed in the Chemistry (PASS 111)?

4.10 Any suggestions on what the Institute can do to overcome the challenges in Chemistry (PAS 111)?

4.11 Any suggestions on what you could do and what the institute could do to overcome the challenges in Chemistry (PAS 111)?

4.12 Any suggestions on what the faculty should ask the lecturers to do to overcome the challenges?

4.13 Do you have any advice to students taking Chemistry (PAS 111)?

4.14 In your opinion, what are the main reasons OTHER STUDENTS are not doing well in Chemistry (PASS 111)?

4.15 What approach did you use to learn chemistry? See description of approaches below.

Surface approach	**Deep approach**	**Strategic approach**
- Learn without deep understanding - Learn to pass - Study to satisfy parents - Study to obtain a qualification - You don't see how chemistry can help you in the future	- Learn with the intention to understand - Relate previous knowledge in chemistry to new knowledge - Integrate knowledge from different subject areas - Relate what you have learnt in chemistry to everyday experiences - Distinguish between chemical concepts and examples - Define own goals and pursue them in one's own way	- Mainly interested in getting high marks - Are deliberate and careful in planning their study - Plan scheduled study times - Have organised note-taking methods - Practise exam questions to maximise scores - Stick closely to the syllabus

Any other comments

Thank you for taking the time to fill this questionnaire.

Lecturer: Kachné Ross

Wes-Kaapse Regering
Landbou

ADDENDUM B: First-year lecturer interview questions

Academic factors influencing the performance of first-year students in chemistry at Elsenburg Agricultural Training Institute.

The interview will particularly focus on the lecturers' perceptions of factors that may possibly influence academic performance of first-year students.

1. What module do you present at Elsenburg?

2. Do you think Chemistry should be an admission requirement for the BAgric programme? If yes, explain why?

3. Do you think language can be seen as a barrier - especially to first year students coming from an Afrikaans/English/Xhosa first-language background? How in your opinion does this affect student performance?

4. Would you say students in their first year are focussed on their studies? If yes, what factors could influence their academic performance?

5. What in your opinion could hinder students' interest in first year subjects?

6. Do students at Elsenburg receive student support? If so, what kind of support?

7. Do you think student support is important in the first year? How can student support help students achieve academic goals?

8. Do you think class attendance has an influence on the students' performance? If so, why?

9. Do you think the time table has an effect on the students' performance? If so, in what way?

10. Do you think the exam roster has an effect on the students' performance? If so, in what way?

11. Do you think student performance is affected if students have problems with transport? If so, in what way?

12. Do you think student performance is affected if students have problems with accommodation? If so, in what way?

13. Do you think financial issues can influence the students' performance? If so, in what way?

14. Do you think the support of family and/or friends could help students succeed? If so, in what way?

15. What would you ascribe the high failure rate in Chemistry presented in 2013 to?

16. What do you think are the students' challenges in Chemistry? Any suggestions on how students can overcome these challenges?

17. Any suggestions on what the Institute can do to overcome the challenges students have in Chemistry or any other first year subject?

18. Any suggestions on what the faculty could ask the lecturers to do to overcome the challenges students have?

19. Do you have any general advice to students taking Chemistry?

Any other comments

Thank you for your time

Wes-Kaapse Regering
Landbou

Interview with Ilse Snyman & Ilana van der Ham

Ilse: Lecturer in Chemistry and Soil science: 2009-2013

Ilana: Lecturer (consultant) in Chemistry: 2014

ADDENDUM C: Chemistry lecturer interview questions

The interview will particularly focus on the lecturers' perceptions of factors that may possibly the influence academic performance of first-year students.

1. In what year did you present Chemistry (PAS 111)?

____

____

2. What do you think about the students' interest in Chemistry (PAS 111)?

____

____

3. Do you think students have enough time to prepare for tests and exams? If no, explain why not.

____

____

4. Do you think students have enough contact time with the lecturer? If no, explain why not.

____

____

5. In your own opinion, what do you think can be done to improve the students' performance in chemistry?

____

____

6. Below are a number of statements regarding the Chemistry (PAS 111) module. Please respond to each one and indicate to what extent you agree or disagree with each statement.

#	STATEMENT	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
6.1	Chemistry should be an admission requirement for the BAgric programme					
6.2	There were limited provisions for Afrikaans tuition.					
6.3	There were a limited provision for English tuition					
6.4	Students were interested in the module					
6.5	Class attendance was good					
6.6	The students had enough time to prepare for tests and exams					
6.7	The students had enough					

	contact time with the lecturer					
6.8	The examination paper was fair					
6.9	The module was presented at a high level					
6.10	The notes correlated with the class presentations					
6.11	The standard of the notes was fair					
6.12	The students received student support					
6.13	Tutorials helped improve the students understanding of the subject					
6.14	Summer school can help the student to pass the module					

7. What do you think were the students' challenges in Chemistry (PAS 111)? Any suggestions on how to overcome these challenges?

8. What can help students to succeed in Chemistry (PASS 111)?

9. Any suggestions on what the Institute can do to overcome the challenges students have in Chemistry (PAS 111)?

10. Any suggestions on what the faculty could ask the lecturers to do to overcome the challenges?

11. Do you have any advice to students taking Chemistry (PAS 111)?

12. In your opinion, what are the main reasons students are not doing well in Chemistry (PASS 111)?

13. What approach do you think most students used in PAS 111 to learn chemistry? See description of approaches below.

Surface approach	Deep approach	Strategic approach
Students mainly: - Learn without deep understanding - Learn to pass - Study to satisfy parents - Study to obtain a qualification - Don't see how chemistry can help them in the future	Students mainly: - Learn with the intention to understand - Relate previous knowledge in chemistry to new knowledge - Integrate knowledge from different subject areas - Relate what they have learnt in chemistry to everyday experiences - Distinguish between chemical concepts and examples - Define own goals and pursue them in an own way	Students mainly: - Are interested in getting high marks - Are deliberate and careful in planning their studies - Plan scheduled study times - Have organised note-taking methods - Practise exam questions to maximise scores - Stick closely to the syllabus

14. Did you teach chemistry to mainly promote a surface , deep or strategic approach to learning? Please motivate why this was/is the case.

Any other comments

Wes-Kaapse Regering
Landbou

Kachné Ross
Elsenburg Agricultural Training Institute
Email: kachnep@elsenburg.com
phone: +27 21 808 7033 fax: +27 21 808 5484

ADDENDUM D: Example of student questionnaire data as generated from one student

3

Reference: Research

Dear Student

TITLE OF DOCUMENT

Titel: Academic factors influencing the performance of first-year students in chemistry at an agricultural training institute.

The aim of the study is to investigate perceptions about academic factors that may influence student performance in Chemistry (PASS111). You are selected as a possible participant in this study because you are a registered 2013 student at Elsenburg. Participation in this study is voluntary. The study and the information you will give will be treated with utmost confidentiality and used purely for academic purposes. You may withdraw from the study at any time. The findings and recommendations from this study are likely to benefit Elsenburg Agricultural Training Institution in areas such as student learning and teaching and student admission. Kindly please spare some of your valuable time to answer these questions.

Thank you

Yours sincerely
Kachné Ross
Master of Philosophy: Higher Education
Stellenbosch University

Wes-Kaapse Regering
Landbou

Akademiese faktore wat die prestasie van eerstejaarstudente in chemie aan die Elsenburg Landbou Opleiding Instituut beinvloed.

Afdeling 1: Demografiese inligting

1.1. Geslag

Manlik	✓
Vroulik	

1.2 Ouderdom

Jonger as 20 jaar	X
21 – 25 jaar	
26 – 30 jaar	
31 – 35 jaar	
Ouer as 36 jaar	

1.3 Jaar van studie:

Jaar 1	
2	✓
3	
4	

1.4 Eerste taal?

Afrikaans	✓
Engels	
Xhosa	
Zulu	
Ander	

Afdeling 2: Opvoedkundige Agtergrond

2.1 Het jy Chemie of Natuur- en Skeikunde in die hoërskool gehad?

Ja	✓
Nee	

2.2 Wat is die rede waarom jy by Elsenburg studeer?

Ek wil Boer

2.3 Hoof vakrigting keuse

Plant en Diere Produksie	✓
Kelder Tegnologie	
Kelder bestuur	
AgriToerisme en Plant	

Produksie	
Agritoerisme en Diere Produksie	
Voorligting en Plant Produksie	
Voorligting en Diere Produksie	

2.4 Het jy die Chemie (BLW 111) module in 2013 geslaag?

Ja	✓
Nee	
Herhaal in 2014	

Afdeling 3: Akademiese prestasie

Hieronder is 'n aantal stellings oor die Chemie (BLW 111) module in 2013. Lees elkeen deur en dui aan in watter mate u saamstem of verskil met elke stelling.

#	STELLING	Verskil volkome	Verskil	Onseker	Stem saam	Stem volkome saam
3.1	Chemie moet 'n toelatingsvereiste vir die BAgric program wees				✓	
3.2	Daar was beperkte voorsiening vir Afrikaanse onderrig					✓
3.3	Daar was beperkte voorsiening vir Engelse onderrig		✓			
3.4	Studente was geïnteresseerd in die module			✓		
3.5	Klasbywoning was goed		✓			
3.6	Ek het genoeg tyd om voor te berei vir toetse en eksamens				✓	
3.7	Ek het genoeg kontaktyd met die dosent gehad				✓	
3.8	Die vraestelle was altyd billik				✓	
3.9	Die module is op 'n hoë vlak aangebied		✓			
3.10	Die notas het met die aanbiedings gekorreleer.			X		
3.11	Die standaard van die notas was regverdig			✓		
3.12	Jy het studente ondersteuning ondervang	X				
3.13	Tutoriale het gehelp om jou begrip van die onderwerp te verbeter	X				
3.14	Die somerskool kan jou help om die module te slaag			X		

Afdeling 4: Oop vrae

4.1 Hoekom het jy besluit om te studeer vir 'n graad in Landbou?

Wat dit beteken meer vir jou Toekoms

4.2 Indien jy probleme gehad het met vervoer in 2013, meld wat die probleme was.

geen

4.3 Indien jy probleme gehad het met akkommodasie in 2013, meld wat die probleme was.

geen

4.4 Indien jy probleme gehad het van 'n finansiele aard (bv. die betaling van jou studiegelde, handboeke, kos en ander uitgawes), verduidelik kortliks die aard van die probleme .

geen

4.5 Het jy enige familie en/of vriende wat jou ondersteun? Indien nie, verduidelik waarom nie.

Ja, hulle ondersteun my.

4.6 Wat is goed of positief oor jou studies?

Produksievakke baie interessant.

4.7 Wat dink jy oor die vak Chemie (BLW 111) wat in 2013 aangebied was?

Kon meer interressant aangebied word.

4.8 Wat was jou uitdagings in Chemie (BLW 111)? Meld ook enige voorstelle oor hoe hierdie uitdagings oorkom kan word.

~~Be~~ Bewerkings, Bied dit beter aan.

4.9 Wat het jou gehelp om Chemie (BLW 111) te slaag?

Om te leer

4.10 Meld enige voorstelle oor wat wat die Iinstituut kan doen om die uitdagings in Chemie (BLW 111) te oorkom?

Gradeer Labretorium na nuwe vlak, ou toerusting.
Beter dosente

4.11 Meld enige voorstelle oor wat jyself kan doen om die die uitdagings (soos bo).

Kon meer klas bywoon en afsprake met dosent maak.

4.12 Enige voorstelle oor wat die fakulteit die dosente kan vra om te doen sodat uitdagings oorkom kan word.

Stel dosente aan wat 3 die volle curriculem van die vak ten volle verstaan.

4.13 Het jy enige advies aan studente wat Chemie (BLW 111) as vak neem?

Doen deeglike selfstudie en woon alle klas by het op in die klas

4.14 Na jou mening, wat is die belangrikste redes waarom ANDER STUDENTE nie goed doen in Chemie (BLW 111) nie?

Nie skeinat op skool gehad nie, ~~Doe~~ verstaan nie die werk nie.

4.15 Watter benadering of benaderings het jy hoofsaaklik gebruik om chemie te leer? (Sien die beskrywing van benaderings hieronder).

Mindmaps en opsommings

Oppervlakkige benadering	Diep benadering	Strategiese benadering
- Leer sonder diep begrip - Leer om te slaag - Studeer om ouers tevrede te stel - Leer net om n kwalifikasie kry. - Jy sien nie hoe chemie jou in die toekoms kan help nie.	- Leer met die doel om te verstaan. - Verbind vorige kennis in chemie met nuwe kennis - Integreer kennis van verskillende vakgebiede. - Verbind wat jy geleer het in chemie met alledaagse ervarings - Onderskei tussen chemiese konsepte en voorbeelde - Definieer jou eie doelwitte en streef daarna op jou eie manier	- Veral geïnteresseerd om hoë punte te kry. - Is doelbewus en versigtig in die beplanning van jou studie. - Beplan geskeduleerde studeer tye - Het georganiseerde notas neem metodes - Werk eksamen vraestelle uit om punte te verhoog - Hou by die sillabusgids.

Enige ander kommentaar?

Elsenburg het 'n Tekort aan opgeleide, goeie dosente wat nie net met 'n kwalifikasie wil kom klad gee om klas te gee en om die werk te ken en net op te sê, is 'n moerse werk!

Dankie vir die tyd wat jy geneem het om hierdie vraelys in te vul.

Dosent: Kachné Ross

Interviewees: First year lecturers

Hilton Abrahams

Pieter De Wet 26/08/2014

Nelius van Huysteen

Len Conradie

Aatika Shema

Wes-Kaapse Regering
Landbou

ADDENDUM E: Example of transcribed interview dataas generated from one first-year lecturer participant - Respondent 3

Academic factors influencing the performance of first-year students in chemistry at Elsenburg Agricultural Training Institute.

The interview will particularly focus on the lecturers' perceptions of factors that may possibly influence academic performance of first-year students.

1. What module do you present at Elsenburg?

WYN 212 + 242
BLW 111 first two cycles in 2014.

2. Do you think Chemistry should be an admission requirement for the BAgric programme? If yes, explain why?

Ja. Dis is te veel werk wat die 1ste jaars in een semester moet baas raak - veral die wat nie die vak op skool gehad het nie.

3. Do you think language can be seen as a barrier - especially to first year students coming from an Afrikaans/English/Xhosa first-language background? How in your opinion does this affect student performance?

Nee. Omdat voorsiening gemaak word vir beide Afr en Eng. Dak kan dit problematies wees vir Xhosa sprekendes. Beide Afr en Eng is volledige wetenskap tale in terme van terminologie. Nie die geval in Xhosa.

4. Would you say students in their first year are focussed on their studies? If yes, what factors could influence their academic performance?

Nie almal nie. Hulle kom uit 'n gedissiplineerde skool agtergrond na 'n hoer omgewing waar hulle meer selfstandig moet optree. Nie alle studente kan dit behartig nie.

5. What in your opinion could hinder students' interest in first year subjects?

Die feit dat hulle in 'n omgewing is waar daar v. hulle verwag word om selfstandig op te tree en dissipline te handhaaf en hulle is nie daaraan gewoond nie. Ouer studente is meer gefokus.

6. Do students at Elsenburg receive student support? If so, what kind of support?

Nee.

7. Do you think student support is important in the first year? How can student support help students achieve academic goals?

Ja. For sure, especially in the first year. Persoonlike + akademiese hulp.

8. Do you think class attendance has an influence on the students' performance? If so, why?

Ja. Want hulle kry meer kontak tyd met die dosent en het meer toegang tot die leermateriaal. Mees geleentheid vir vrae en onsekerhede!

9. Do you think the time table has an effect on the students' performance? If so, in what way?

Nee. Roosters word vroegtydig uitgegee so studente kan beplan daarvolgens. Hulle moet net sorg dat hulle in die klas uitkom.

10. Do you think the exam roster has an effect on the students' performance? If so, in what way?

Nee. Eksamen roosters word vroegtydig uitgee so studente kan daarvolgens beplan.

11. Do you think student performance is affected if students have problems with transport? If so, in what way?

Ja. maar kan oorkom word deur reg te beplan.

12. Do you think student performance is affected if students have problems with accommodation? If so, in what way?

Ja. Vir 'n goeie leer omgewing het jy goeie huisvesting en sekuriteit nodig om optimaal te kan funksioneer.

13. Do you think financial issues can influence the students' performance? If so, in what way?

Ja. Dit sal 'n negatiewe invloed hê indien daar finansiële onsekerheid is.

14. Do you think the support of family and/or friends could help students succeed? If so, in what way?

Ja. Deur ondersteunend op te tree in die sin van aanmoediging, hulp, raad, basies enige bystand – finansieel, emosioneel, moreel.

15. What would you ascribe the high failure rate in Chemistry presented in 2013 to?

① Konsepte is moeilik ② notas is verouderd ③ n.a.v. vraestelle is dit van assessering te hoog ④ klasse is te groot ⑤ wilskrag + belangstelling nie daar ⑥ senior student het hulle bang gepraat ⑦ presentations het nie korrek met notas.

16. What do you think are the students' challenges in Chemistry? Any suggestions on how students can overcome these challenges?

Om die vak baas te raak. → om chemie te beskou as 'n uitdaging en nie knelpunt nie. Studente moet dosente uitdaag.

17. Any suggestions on what the Institute can do to overcome the challenges students have in Chemistry or any other first year subject?

① Maak Chemie as 'n voorvereiste vir BAgric
② Beter leer kultuur te skep deur studente ondersteuning te vestig.
③ Maak klasse kleiner en stel meer personeel aan.

18. Any suggestions on what the faculty could ask the lecturers to do to overcome the challenges students have?

- Dosente moet meer pro-aktief optree en meer gerig en bewus wees van die studente se probleme.
- Vra Dosent om hele sillabus te herskryf met inagneming v. wat die behoeftes is van 2de + 3de jaar vakke.

19. Do you have any general advice to students taking Chemistry?

Hulle moet elke konsep waarmee hulle konfronteer word onder die knie kry en probeer verstaan – so sal hulle dit weer kan deurgee.

Any other comments

No

Thank you for your time

Kachné Ross

Ebsp 2

Wes-Kaapse Regering
Landbou

Interview with Ilse Snyman & Ilana van der Ham

Ilse: Lecturer in Chemistry and Soil science: 2009-2013

Ilana: Lecturer (consultant) in Chemistry: 2014

ADDENDUM F: Example of transcribed interview data: One chemistry lecturer participant - Lecturer 1

The interview will particularly focus on the lecturers' perceptions of factors that may possibly the influence academic performance of first-year students.

1. In what year did you present Chemistry (PAS 111)?
   2010 2012
   2011 2013 1st semester
2. What do you think about the students' interest in Chemistry (PAS 111)?
   Non existent – <5% have an interest or had done chemistry in Matric.
3. Do you think students have enough time to prepare for tests and exams? If no, explain why not.
   Yes.
4. Do you think students have enough contact time with the lecturer? If no, explain why not.
   Because big variation in chemistry knowledge – students /pass exposure. Contact time was dependent on this. Those that have not had chemistry before, NO.
5. In your own opinion, what do you think can be done to improve the students' performance in chemistry?
   Make Chemistry a min. requirement as entry to the BAgric course.
6. Below are a number of statements regarding the Chemistry (PAS 111) module. Please respond to each one and indicate to what extent you agree or disagree with each statement.

#	STATEMENT	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
6.1	Chemistry should be an admission requirement for the BAgric programme					✓
6.2	There were limited provisions for Afrikaans tuition.		✓			
6.3	There were a limited provision for English tuition		✓			
6.4	Students were interested in the module	✓				
6.5	Class attendance was good				✓	
6.6	The students had enough time to prepare for tests and exams				✓	
6.7	The students had enough contact time with the lecturer		✓			

6.8	The examination paper was fair				✓	
6.9	The module was presented at a high level				✓	
6.10	The notes correlated with the class presentations				✓	
6.11	The standard of the notes was fair				✓	
6.12	The students received student support				✓	
6.13	Tutorials helped improve the students understanding of the subject				✓	
6.14	Summer school can help the student to pass the module		✓			

Handbek gebruik.

7. What do you think were the students' challenges in Chemistry (PAS 111)? Any suggestions on how to overcome these challenges?
No background in chemistry high school. Fear of the subject.
Make chemistry a pre-requisite for the BAgric.

8. What can help students to succeed in Chemistry (PASS 111)?
Mathematics.

9. Any suggestions on what the Institute can do to overcome the challenges students have in Chemistry (PAS 111)?
Make it a requirement.

10. Any suggestions on what the faculty could ask the lecturers to do to overcome the challenges?
Introduce more tutors for tutorials.

11. Do you have any advice to students taking Chemistry (PAS 111)?
Work consistently and prepare for lectures.

12. In your opinion, what are the main reasons students are not doing well in Chemistry (PASS 111)?
No background in Chemistry.

13. What approach do you think most students used in PAS 111 to learn chemistry? See description of approaches below.
Surface approach – Just to pass.

Surface approach	Deep approach	Strategic approach
Students mainly: - Learn without deep understanding - Learn to pass - Study to satisfy parents - Study to obtain a qualification - Don't see how chemistry can help them in the future	Students mainly: - Learn with the intention to understand - Relate previous knowledge in chemistry to new knowledge - Integrate knowledge from different subject areas - Relate what they have learnt in chemistry to everyday experiences - Distinguish between chemical concepts and examples - Define own goals and pursue them in an own way	Students mainly: - Are interested in getting high marks - Are deliberate and careful in planning their studies - Plan scheduled study times - Have organised note-taking methods - Practise exam questions to maximise scores - Stick closely to the syllabus

14. Did you teach chemistry to mainly promote a surface , deep or strategic approach to learning? Please motivate why this was/is the case.

Deep approach.
It puts the work that you do into perspective.

Any other comments

ADDENDUM G: Ethics Committee Approval Notice

UNIVERSITEIT·STELLENBOSCH·UNIVERSITY
jou kennisvennoot · your knowledge partner

Approved with Stipulations

New Application

22-Aug-2014
Ross, Kachne K

Proposal #: DESC/Ross/Aug2014/4
Title: Academic factors influencing the performance of first-year students in Chemistry at an agricultural institute.

Dear Mrs Kachne Ross,

Your **New Application** received on **08-Aug-2014**, was reviewed
Please note the following information about your approved research proposal:

Proposal Approval Period: **18-Aug-2014 -17-Aug-2015**

The following stipulations are relevant to the approval of your project and must be adhered to:
1.Institutional permission
Students and lecturers at the Elsenburg Agricultural Training Institute will be approached for interviews. Permission is required from Stellenbosch University's Division for Institutional Research and Planning, as the Institution and their students/staff members are affiliated with SU.

2.Informed consent form_Lecturers
The researcher should indicate to the lecturers (in their informed consent form) whether or not the interviews will be tape recorded.

Please provide a letter of response to all the points raised IN ADDITION to HIGHLIGHTING or using the TRACK CHANGES function to indicate ALL the corrections/amendments of ALL DOCUMENTS clearly in order to allow rapid scrutiny and appraisal.

Please take note of the general Investigator Responsibilities attached to this letter. You may commence with your research after complying fully with these guidelines.

Please remember to use your **proposal number** (**DESC/Ross/Aug2014/4**) on any documents or correspondence with the REC concerning your research proposal.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

Also note that a progress report should be submitted to the Committee before the approval period has expired if a continuation is required. The Committee will then consider the continuation of the project for a further year (if necessary).

This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki and the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health). Annually a number of projects may be selected randomly for an external audit.

National Health Research Ethics Committee (NHREC) registration number REC-050411-032.

We wish you the best as you conduct your research.

If you have any questions or need further help, please contact the REC office at 0218089183.

Sincerely,

Clarissa Graham
REC Coordinator
Research Ethics Committee: Human Research (Humanities)

Investigator Responsibilities

Protection of Human Research Participants

Some of the general responsibilities investigators have when conducting research involving human participants are listed below:

1. Conducting the Research. You are responsible for making sure that the research is conducted according to the REC approved research protocol. You are also responsible for the actions of all your co-investigators and research staff involved with this research. You must also ensure that the research is conducted within the standards of your field of research.

2. Participant Enrollment. You may not recruit or enroll participants prior to the REC approval date or after the expiration date of REC approval. All recruitment materials for any form of media must be approved by the REC prior to their use. If you need to recruit more participants than was noted in your REC approval letter, you must submit an amendment requesting an increase in the number of participants.

3. Informed Consent. You are responsible for obtaining and documenting effective informed consent using **only** the REC-approved consent documents, and for ensuring that no human participants are involved in research prior to obtaining their informed consent. Please give all participants copies of the signed informed consent documents. Keep the originals in your secured research files for at least five (5) years.

4. Continuing Review. The REC must review and approve all REC-approved research proposals at intervals appropriate to the degree of risk but not less than once per year. There is **no grace period.** Prior to the date on which the REC approval of the research expires, **it is your responsibility to submit the continuing review report in a timely fashion to ensure a lapse in REC approval does not occur.** If REC approval of your research lapses, you must stop new participant enrollment, and contact the REC office immediately.

5. Amendments and Changes. If you wish to amend or change any aspect of your research (such as research design, interventions or procedures, number of participants, participant population, informed consent document, instruments, surveys or recruiting material), you must submit the amendment to the REC for review using the current Amendment Form. You **may not initiate** any amendments or changes to your research without first obtaining written REC review and approval. The **only exception** is when it is necessary to eliminate apparent immediate hazards to participants and the REC should be immediately informed of this necessity.

6. Adverse or Unanticipated Events. Any serious adverse events, participant complaints, and all unanticipated problems that involve risks to participants or others, as well as any research related injuries, occurring at this institution or at other performance sites must be reported to Malene Fouch within **five (5) days** of discovery of the incident. You must also report any instances of serious or continuing problems, or non-compliance with the RECs requirements for protecting human research participants. The only exception to this policy is that the death of a research participant must be reported in accordance with the Stellenbosch Universtiy Research Ethics Committee Standard Operating Procedures. All reportable events should be submitted to the REC using the Serious Adverse Event Report Form.

7. Research Record Keeping. You must keep the following research related records, at a minimum, in a secure location for a minimum of five years: the REC approved research proposal and all amendments; all informed consent documents; recruiting materials; continuing review reports; adverse or unanticipated events; and all correspondence from the REC

8. Provision of Counselling or emergency support. When a dedicated counsellor or psychologist provides support to a participant without prior REC review and approval, to the extent permitted by law, such activities will not be recognised as research nor the data used in support of research. Such cases should be indicated in the progress report or final report.

9. Final reports. When you have completed (no further participant enrollment, interactions, interventions or data analysis) or stopped work on your research, you must submit a Final Report to the REC.

10. On-Site Evaluations, Inspections, or Audits. If you are notified that your research will be reviewed or audited by the sponsor or any other external agency or any internal group, you must inform the REC immediately of the impending audit/evaluation.

ADDENDUM H: Informed consent form for students

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STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Topic: Academic factors influencing the performance of first-year students in chemistry at an agricultural institute.

You are asked to participate in a research study conducted by Mrs. K Ross, from the Department of Curriculum studies at Stellenbosch University.

This research study is partially conducted towards the completion of the researcher's Masters in Philosophy thesis at the University of Stellenbosch.

You are selected as a possible participant in this study because you are a registered 2nd year student at the Elsenburg Agricultural Training Institute, Department of Agriculture.

1. PURPOSE OF THE STUDY

The aim of the study is to investigate perceptions about academic factors that may influence student performance in PAS (Chemistry) 111 at Elsenburg Agricultural Training Institute.

2. PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

1. Students
    a. Complete a questionnaire during the second term in which you will be asked different questions, with the aim to investigate your perceptions of academic factors influencing your performance in Chemistry. This will take place in a scheduled classroom at the college.

    b. Give me permission to draw your biographical and geographical information from the institute's official database and your final results at the end of 2013 to use as part of the data collection process.

3. POTENTIAL RISKS AND DISCOMFORTS

No potential risk and discomforts are envisaged at this stage. However, if something might come up, it will be dealt with in a sensible and sensitive manner.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

Potential benefits could be that the students would feel valued and safe , and this could result in them acquiring a higher self-esteem and self-confidence in their own abilities, which could result in better performance in the courses that they are registered for.

The Elsenburg Agricultural Training Institute would benefit directly from the results and recommendations that will be made in that these recommendations will be implemented in the coming years hopefully, would assist more students to successfully complete their chemistry module. If this could happen, the faculty's failure rates would decrease. Lecturers could have a better idea of how students learn chemistry and what techniques might help the students succeed. Other faculties could also benefit in this way, and possibly other agricultural institutions.

5. PAYMENT FOR PARTICIPATION

No payments to the participants will be made.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of referring to students as Student 1, 2, 3, etc. and by means of themes and categories that will be identified and used in the analysis and discussions of the findings and outcomes, in the research report, the thesis, and in conference papers and articles that would be submitted for possible publication in academic journals.

The researcher further pledge that any information given by participants will be handled in the strictest confidence, and that the information students and lecturers give will not be used to reflect negatively on them in any way. The information will be stored in files that will be locked in the filling cabinet of the researcher, in her office in the old post office building.

7. PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so such as you not participating over the course of the research period.

8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact me at (021) 808 7033 (o); 082 309 7618 (cell); (021) 808 5484 (fax) and email kachnep@elsenburg.com.

9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to *me, the participant* by Mrs K Ross in *English* and *I am the participant* in command of this language. I was given the opportunity to ask questions and these questions were answered to *my* satisfaction.

I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

____
Name of Subject/Participant

____
Name of Legal Representative (if applicable)

______________________________ ______________
Signature of Subject/Participant or Legal Representative **Date**

SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to ______________ [*name of the subject/participant]* and/or [his/her] representative ______________ [*name of the representative]. [He*/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in [*Afrikaans/*English/*Xhosa/*Other*] and [*no translator was used/this conversation was translated into* __________ by ______________].

______________________________ ______________
Signature of Investigator **Date**

ADDENDUM I: Informed consent form for lecturing staff

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STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Topic: Academic factors influencing the performance of first-year students in chemistry at an agricultural institute.

You are asked to participate in a research study conducted by Mrs. K Ross, from the Department of Curriculum studies at Stellenbosch University.

This research study is partially conducted towards the completion of the researcher's Masters in Philosophy thesis at the University of Stellenbosch.

You are selected as a possible participant in this study because you are a lecturer at the Elsenburg Agricultural Training Institute, Department of Agriculture.

1. PURPOSE OF THE STUDY

The aim of the study is to investigate perceptions about academic factors that may influence student performance in PAS (Chemistry) 111 at Elsenburg Agricultural Training Institute.

2. PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

1. Lecturers
   a. To have interviews with a selected group of lecturers early in the second semester to investigate the perceptions of lecturers on the academic factors that influence the performance of first-year students in chemistry. This will take place in the conference room at the college during a time suitable for you.

3. POTENTIAL RISKS AND DISCOMFORTS

No potential risk and discomforts are envisaged at this stage. However, if something might come up, it will be dealt with in a sensible and sensitive manner.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

Potential benefits could be that the students would feel valued and safe, and this could result in them acquiring a higher self-esteem and self-confidence in their own abilities, which could result in better performance in the courses that they are registered for.

The Elsenburg Agricultural Training Institute would benefit directly from the results and recommendations that will be made in that these recommendations will be implemented in the coming years hopefully, would assist more students to successfully complete their chemistry module. If this could happen, the faculty's failure rates would decrease. Lecturers could have a better idea of how students learn chemistry and what techniques might help the students succeed. Other faculties could also benefit in this way, and possibly other agricultural institutions.

5. PAYMENT FOR PARTICIPATION

No payments to the participants will be made.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of referring to students as Student 1, 2, 3, etc. and by means of themes and categories that will be identified and used in the analysis and discussions of the findings and outcomes, in the research report, the thesis, and in conference papers and articles that would be submitted for possible publication in academic journals.

The researcher further pledge that any information given by participants will be handled in the strictest confidence, and that the information students and lecturers give will not be used to reflect negatively on them in any way. The information will be stored in files that will be locked in the filling cabinet of the researcher, in her office in the old post office building.

7. PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so such as you not participating over the course of the research period.

8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact me at (021) 808 7033 (o); 082 309 7618 (cell); (021) 808 5484 (fax) and email kachnep@elsenburg.com.

9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to *me, the participant* by Mrs K Ross in *English* and *I am the participant* in command of this language. I was given the opportunity to ask questions and these questions were answered to *my* satisfaction.

I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

____

Name of Subject/Participant

____

Name of Legal Representative (if applicable)

______________________________ ____________

Signature of Subject/Participant or Legal Representative **Date**

SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to ______________ [*name of the subject/participant]* and/or [his/her] representative ______________ [*name of the representative]. [He*/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in [*Afrikaans/*English/*Xhosa/*Other*] and [*no translator was used/this conversation was translated into* ________ by ______________].

______________________________ ____________

Signature of Investigator **Date**

Western Cape Government
Agriculture

Jerry Aries
Elsenburg Agricultural Training Institute
Email: jerrya@elsenburg.com
tel: +27 21 808 7709 fax: +27 21 808 5484

ADDENDUM J: Institutional permission letter

Ref: Mrs. K Ross (54844843) – Master's degree research studies (MPhil)

Prof. Eli Bitzer
Centre for Higher and Adult Education
Department of Curriculum Studies
Faculty of Education
University of Stellenbosch

To whom it may concern

I herewith grant permission for Mrs. K Ross to conduct her research on academic factors influencing the performance of first-year students in chemistry at Elsenburg Agricultural Training Institute.

Sincerely

J ARIES (MR)
DIRECTOR: HIGHER EDUCATION AND TRAINING **DATE**

ADDENDUM K:

DRAFT LANGUAGE POLICY OF THE ELSENBURG AGRICULTURAL TRAINING INSTITUTE

Preamble:

The Elsenburg Agricultural Training Institute is a multilingual institution that promotes the use of the three official languages of the Western Cape, namely Afrikaans, English and Xhosa. It adheres to the constitutional principle of affording the right to use the language of choice. Based on the Western Cape Provincial Languages Act (Act 13 of 1998), a Language Policy was compiled by the Western Cape Language Committee, a public entity of the Western Cape Provincial Government. This Western Cape Language Policy was accepted by Cabinet as the official Language Policy of the Western Cape and implemented since 2005.

The Elsenburg Agricultural Training Institute (EATI) of the Western Cape Department of Agriculture facilitates and provides structured agricultural education to students in the agricultural sector. In order to establish a knowledgeable, prosperous and competitive sector, the Institute is committed to educate and train -students in the agricultural industry, in line with the abovementioned Act. Being a multilingual institution, Elsenburg Agricultural Training Institute (EATI) is committed to serve diverse demands and strives towards being the best agricultural training institute on the African continent by being a model of excellence.

1. **A pilot project of interpreting into Afrikaans, English and Xhosa for first year students will be launched in 2016. This will run simultaneously with a language audit of staff and students.**

2. **Language of Teaching, Learning and Assessments:**

- **Parallel medium teaching in Afrikaans and English (100% Afrikaans and 100% English).**
  This will apply to:
  - Language used in lectures, tutorials and practicals;
  - Language used in the setting of tasks, assignments, tests and examinations;
  - Language used in writing tasks, assignments, tests and examinations;

  (The current parallel medium teaching in Afrikaans and English is an interim arrangement and will be expanded to include Xhosa. This will be adapted according to the availability of suitable lecturing staff and the provision of sufficient interpreting into Afrikaans, English and Xhosa to address all language and timetable requirements.)

3. Promotion of multilingualism and access to academic and professional discourse:

- Students will be assisted to develop their academic literacy in Afrikaans, English and Xhosa as far as possible. The Institution will actively develop terminology and avail learning material in Afrikaans, English and Xhosa through translation.

- Students and staff will be encouraged to improve proficiency in Afrikaans, English and Xhosa through language acquisition courses.

4. Languages of Internal Communication:

The main language of internal communication for academic and administrative purposes will be Afrikaans and English. The Institution will progressively make all information available in Afrikaans, English and Xhosa.

In spoken debate and deliberation, the objective is to be understood by everyone present.

Should a speaker prefer to speak in the language of his/her choice, use will be made of interpreting where it is practicable to do so.

The Institution will avail staff to assist enquirers in Afrikaans, English and Xhosa, particularly during advisory sessions and at registration and examination time.

The Institution will endeavour to continuously promote multilingualism, linguistic diversity and racial harmony at the Elsenburg Agricultural Training Institute.

5. Languages of External Communication

The language used for external communication will be in the language of the clients' preference where possible. If individuals request information in a specific language, the information will be dealt with in the language of the enquiry or request where feasible.

6. Signage will be in Afrikaans, English and Xhosa.

7. International communication will be in English or in the applicable international language where possible.

Addendum L: **Letter from the Acting Deputy Director General to parents and students of the Elsenburg Agricultural Training Institute**

Western Cape Government
Agriculture

Darryl Jacobs
Acting Deputy Director General
Agricultural Development and Support Services
Email: darryl.jacobs@elsenburg.com
tel: +27 21 808 5013 fax: +27 21 808 5251

Dear Parents and Students,

This letter follows on from our communication to you last week.

As you are aware, issues have been raised in recent weeks about language and transformation at the Elsenburg Agricultural Institute.

We have taken this very seriously, and it is being dealt with by the College Council. In the interim, in good faith, we have also entered into a series of negotiations and mediation, with professional facilitators, to find lasting solutions in the interests of the future of agriculture and our great country.

The behaviour of some of the students and other outside parties has not created a conducive environment for finding solutions. We call for cool heads and ask that we all work together to resolve this issue.

There have been incidences in the last two days of totally unacceptable behaviour which have resulted in us having to not only request the assistance of the regular police, but also the special public order police unit. These incidences will be dealt with in accordance with the law, and also in accordance with the code of conduct of the College.

We agree that there is an urgent need to find creative solutions which are in the best interests of all the students at the institution and which support quality and inclusive education.

To date, we have undertaken the following steps:

- The College Council instituted a task team to engage with students and key stakeholders to facilitate the development of a new language policy;
- As undertaken by Management, several engagements have already been held with the SRC, House Committee as well as students;
- Independent mediators have been appointed to facilitate the transformation process, diversity management training and conflict resolution involving students, lecturers and administrative personnel.

In addition to the above, Minister Alan Winde has visited the College regularly and is receiving daily updates on the status quo. I have been on site on a daily basis.

Following a series of discussions with the leadership groups at the Institute, and following the advice of independent mediators who have now been on site for two weeks, we believe the best course of action going forward to be:

- In the short term, lectures will be duplicated so that they take place in both English and Afrikaans, at different times. This gives students the choice to learn in the language in which they feel most comfortable; and
- In the medium term, a new language policy be developed. This process is already underway, and forms part of the broader transformation imperative being implemented to encourage inclusive and quality education.

The College recognises that despite the progress made towards developing an inclusive approach to learning, there remains a small group of students who have no desire to work with us toward finding solutions. They have refused to be part of the mediation process. This is their right. However, we will not allow any student to disrupt the continuance of education at the Institution. To ensure that order is maintained and classes can continue, we have arranged additional security at the institution, as well as instituted a process to secure an interdict to protect the rights of students and lecturers to proceed with normal class activity without interruption.

We want to assure you that we have the best interests of all the students at heart, and will continue to develop creative solutions in line with our broader transformation imperative. Institutions of learning are places where bonds should be formed, and not broken, and we trust the students of the College will, in good faith, do their utmost to be part of building a stronger democracy in our country.

Kind regards

MR DW JACOBS
ACTING DEPUTY DIRECTOR GENERAL:
AGRICULTURAL DEVELOPMENT & SUPPORT SERVICES