An evaluation of the 'Into Science' programme and materials designed by the Open University, using perceptions of South African Colleges of Education students taking this programme.

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Abstract

The aim of this study was to evaluate a distance education programme and materials called 'Into Science', designed by the Open University in the United Kingdom. The perceptions of selected KwaZulu-Natal college students taking the course were used for this evaluation.

The trialling took place in three KwaZulu-Natal colleges of education from February to June 1997. 120 students were involved, mostly year 3 primary teacher diploma students. Students' and lecturers' views were obtained through the use of: open-ended questionnaires, 5 point Likert type questionnaires, focus group interviews, individual interviews with lecturers/tutors and participant observation during the tutorial sessions.

The results show that 'Into Science' materials can be used for South African students, but with some recommended modifications. The language used in 'Into Science' was not a problem for most of the students who took part in the trialling; students' reactions to the materials and course were very positive; their confidence in handling the subject matter increased markedly; most students did not read everything contained in the study materials in the time specified; students did not say that their learning styles changed as a result of using these materials; students placed a low value on the practicals; the earth sciences is not recognised as one of the fields in science; lecturers had low expectations of their students; and finally, students and tutors or course providers will need extensive support in a variety of ways in order for the course to run successfully and to achieve desired outcomes in South Africa.

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I must also acknowledge the contribution of the students and lecturers who made up the research population for this study. It was their enthusiasm, contributions and commitment that encouraged me to go through this wonderful experience.

This whole dissertation, unless specifically indicated to the contrary in the text, is my own work. Sources used and quotations have been acknowledged.

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Chapter One
Introduction and Context

1.1 Proposed New Curriculum

This research was conducted during a period of major change in the South African education system. The government had announced and publicised the implementation plan for the new Outcomes Based Education (OBE) to be implemented from January 1998 throughout the General Education band, i.e. starting with grade one. This plan emphasises the achievement of broad generic outcomes by the learner, including those doing Natural Science. The following are the seven critical outcomes that a learner must achieve in his or her general education phases as stated in the Curriculum 2005 document (National Department of Education, 1997).

a. *Identify and solve problems and make decisions using critical and creative thinking.*

b. *Work effectively with others as a member of a team, group, organisation and community.*

c. *Organise and manage oneself and one's activities responsibly and effectively.*

d. *Collect, analyse, organise and critically evaluate information.*

e. *Communicate effectively using visual, symbolic and/or language skills in various modes.*

f. *Use science and technology effectively and critically showing responsibility towards the environments and the health of others.*

g. *Demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation.*

(1997, p. 10)

The fields of Science and Technology are seen to be important, especially as technology is a new area in the basic general education phase.

1.2 Some Deficiencies in the Present Teaching Force

The limited number of science teachers present within the Education and Training profession was noted long before the OBE implementation plan. Some of those teachers who were and are still teaching science, especially in traditionally Black schools, are poorly or not skilled at all to teach science and may not even have basic and essential teaching skills. Arnott et al. (1997, p. 2) reported that 58% of South African black science teachers in 1996 were un/underqualified to teach science and 50% were un/underqualified to teach mathematics (see table 1 below) These statistics exclude the provinces of Eastern Cape and Western Cape.

	PROFESSIONAL QUALIFICATION		SUBJECT QUALIFICATION			
SUBJECTS	QUALIFIED	UN/UNDER-QUALIFIED	QUALIFIED	UN/UNDER-QUALIFIED	MORE THAN 40 PUPILS PER CLASS %	ADDITIONAL No. OF TEACHERS REQUIRED
Mathematics Teachers	13 340	2 357	7 787	7 910	68%	2 052
	85%	15%	50%	50%		
Science Teachers	11 850	2 257	5 889	8 218	74%	2 230
	84%	16%	42%	58%		

Table: 1 **Professional and subject qualifications of science and mathematics teachers in South Africa (excluding the provinces of Western Cape and Eastern Cape). Summarised from EduSource Data News (June, 1997:2)**

Only 39% of a sample of teachers teaching biology in Secondary schools in the Pietermaritzburg region in 1997 had a tertiary (e.g. College of Education) biology qualification (G. Khumalo, personal communication).

1.3 Some Consequent Problems

From my own observations the presence and activities of these unskilled and semi-skilled science teachers contribute to a number of problems, including the following.

- Pupils develop a negative attitude towards learning Natural Sciences and Mathematics.

- High failure rates in Natural Sciences and Mathematics because these subjects are not contextually adapted to learners' contexts. As a result subjects become meaningless and impractical.
- A high drop out rate in schools.
- Some teachers are not satisfied with their work as science and mathematics teachers. Facing a lack of adequate resources at schools, they feel they are unable to do anything useful, then become demoralized and leave the profession.

The poor understanding of science and mathematics by school students is brought about by poor learning and also by teachers who are ineffective in their work place. This impacts negatively on South Africa's technological, economic, social and political well-being in the long-term, and on its competitiveness with other countries.

1.4 Why Should More People Learn Science?

1.4.1 Technological Perspective

Some people argue that high quality science teachers play an integral and central part in addressing technological problems since their skills in science make them a part of the technological workplace. The science teachers serve a function to educate that technological workforce resulting in a pool of technologically and scientifically trained individuals.

The presence of technological innovations means that South Africa has to undergo rapid advancement in science knowledge and skills. Some people believe that, the more scientists we have in the country, the more developed the country and citizens will be. This will also result in the country having to be less dependent on imported designs and technologies. Citizens will be able to adapt and modify those designs which are imported to suit the South African context. Therefore, South Africans need to develop their skills in science so that they can fulfil their country's requirements for a technologically trained workforce.

1.4.2 Economic Perspective

On the other hand, other people argue that there is no connection between school science education and the economic growth of the country. However, they support the idea that the benefit to a national economy from investments in the sciences also comes from the technological pressure as a result of technology expansion, because much technology stands on a firm scientific ground which includes education and training.

Arnott and Chabane (1995) acknowledged this view and state.

> *"The success in the reconstruction and development programme (RDP) is dependent upon developing human resources, and particularly in the fields of science and technology. This raises eyebrows because the production of pupils in these areas is very small and often inadequate in quality."*
>
> (1995, p.25)

The Implementation Plan for Education and Training, prepared in 1994 for the South African National Congress, as quoted by Arnott and Chabane, stated that a survey that was internationally conducted on education revealed that the higher the proportion of technology education in the school curriculum, the higher the gross domestic product (GDP) of the country. Therefore there are reasons why some people feel that those nations with the highest levels of scientific and technological literacy would be able to do well economically.

1.4.3 Social Perspective

People need basic science skills and knowledge so that they will be able to deal with some aspects of social and cultural issues. For example, it is a good thing for everyone to know different types of water pollution, problems associated with drinking polluted water and how to purify water. Whether that individual will use this knowledge or not is another issue. Solomon (1993) stated:

> *"All people need some science education so that they can think, speak and act on those matters, related to science, which may affect their quality of living"*
>
> (1993, p.15)

Peters (1966, p.307) contended that without education (including the fields of science and technology) an individual in a modern industrial society is unlikely to be able to proceed very far in developing the particular aspect of a worthwhile form of life to which is suited to that society.

He supported the idea that education should be distributed fairly amongst the community and should be provided to all people. He referred to science as a cultural activity, and most cultural activities, like history and philosophy, are to a large extent pursued for the sake of values that are intrinsic to human beings rather than for the sake of extrinsic ends (Peters 1966, p.160).

Our society perceives science education to be an important aspect of life. This implies that every one needs basic science education in order to have a better social life.

1.4.4 Political Perspective

In the past, it was argued that only a few carefully chosen scientists were required to play a role in the scientific and technological development of South Africa, so the country need not go to the trouble and expense of providing 'science for all'. Science became a specialisation field for the selected few individuals. This view was illustrated by the low priority given to science teaching by the former departments responsible for 'Bantu Education'.

It is also vital that science education is adapted and structured in ways that will enable the majority (Black South Africans) to pursue science studies, develop their potential in science and also to bridge the existing gap in science knowledge and skills between them and their previously advantaged white counterparts. In the past, access of black people to science studies was severely restricted and controlled. This prevented black people from obtaining many challenging and important jobs, and participating in shaping the country's future in science related fields. As a result there are not sufficient, skilled black science and mathematics teachers.

The new South African constitution (1997) supports the concept of 'Equity'. By this, is meant that people, regardless of race, gender and class structures, have equal access to opportunities including basic science education. Peters (1966) contended;

> *"Education, (which includes science and technology) is not simply for the intelligent.......the fact that some can progress further along these avenues of exploration and appreciation than others does not entail that others can*

proceed no distance at all. A quality of life is not the prerogative of an intellectual élite."

(1966, p.178)

Therefore, it is the right of every student to be equipped with science skills and knowledge during his or her primary and secondary education.

1.5 Problems with Science Education in South Africa

Some people argue that the former KwaZulu Department of Education and Culture did little to address this lack of unskilled and semi-skilled science and mathematics teachers. Instead more work was done by non-governmental organisations (NGOs) in offering redress, by providing support in the field and initiating change. This was done by running in-service training for teachers in the form of workshops, school classroom visits, supplying low-cost kits, etc. Although the NGOs have been forced to work within the prescribed syllabi, they have tried to introduce more pupil-centred teaching methods. These NGOs include the Science Education Project (SEP), Primary Science Project (PSP), Centre for Advancement of Science and Maths Education (CASME) and Urban Foundation. Some universities, like the University of Durban-Westville and the University of Natal-Durban, offer science studies during Saturdays and in Winter schools. These are usually free, or sometimes very cheap with free transportation. The existence of these initiatives provided the state with an excuse to withdraw the little education support service it provided to help Black people with science.

Some people (personal communication) comment that the former KwaZulu Department of Education and Culture had a tendency of not attending to critical issues within the mathematics and science teaching profession and environment, such as,

1. ensuring that a teacher is properly trained in the subject she or he is teaching;
2. ensuring that it is possible for the teacher to give pupils individual attention and help, in relation to class size and lack of resources.

By so doing the Education Department tended to overlook some of the things that could really make a difference in the quality of education, such as ensuring that all science teachers were qualified to teach science, keeping the number of pupils in every classroom low and manageable. Science teachers who are well versed in science subject matter and teaching skills, can bring about good quality science students. Instead the former Department implemented policies which put quality education at risk, such as cutting down the number of (science) teachers even where they are really needed. Personnel of the Department of Education tended to assume that if there was a teacher in the classroom then everything was going on well, whereas others felt that a lot of things that cannot be appreciated could be taking place, for example, teachers might not necessarily be teaching in class, but rather busy with their personal further studies.

Arnott et al. (1997) estimated that in 1996, 68% of mathematics classes and 74% of science classes had more than 40 pupils per teacher and an additional 2 052 of mathematics teachers and 2 230 science teachers were required. (The provinces of Western Cape and Eastern Cape are not included in these statistics, see table I.)

If one looks at table 1, it is clear that the number of pupils per teacher in science and mathematics classes is high and well above the government's recommendations average teacher: pupil ratio of 1:35 for secondary schools.

1.6 Rationale for undertaking this study

The Department of Education in the University of Natal-Pietermaritzburg, seeing this need to upgrade and equip un/underqualified science teachers with science skills and knowledge, planned to offer redress in the form of giving opportunities particularly to black secondary teachers who were not well versed in the science content, but wished to be retrained or upgraded in science teaching, improve their abilities to teaching science. The Department set about preparing to introduce a Further Diploma in Education (Science Education) through a distance education mode. The course was mainly aimed at teachers who might be poorly equipped or not trained at all in the teaching of science. Some of them might have no basic teaching and science skills, i.e be professionally and subject un/underqualified, therefore these teachers needed to be upgraded or retrained for the teaching of science.

The Department of Education decided to base the course on existing high quality distance education materials designed and used by the Open University in the United Kingdom. Part of these materials is an introductory course called 'Into Science'. The Department planned to use the 'Into Science' programme and material as the first part of the proposed 2-year distance education in Further Diploma in Education (Science Education). This 'Into Science' programme and materials would be used as a preparatory course, especially for those teachers who were new to the field of Natural Sciences and Mathematics with the aim of introducing them to basic scientific, numerical, writing and study skills, so that they would be able to cope with the remaining part of the FDE (Science Education) course and enable them to decide whether they wanted to proceed with the rest of the course.

Some observers raised some doubts (see section 1.8 below) about how well the 'Into Science' programme and material would work here in South Africa. As the FDE (Science Education) did not start in January 1997 as was originally planned, it was decided to trial the 'Into Science' programme and materials with a small group, but larger than the sample used in the University of Orange-Free State in November 1994, in order to find out whether the programme could be used, how the students perceived the programme and materials, and modifications needed for it to be implemented successfully in South Africa, before expanding to a larger scale.

1.7 The Nature of the 'Into Science' Programme

'Into Science' is a preparatory course for initially registered students who have little or no previous experience of studying science, educational qualifications before they enter the main level 1 science course S102, called the 'Science Foundation Course', with the Open University in the United Kingdom.

The Open University designed the 'Into Science' course in response to a high-drop out rate in their Science and Mathematics Faculty. The production of these materials occurred over a two-year period (1991-1993) with the aim of fulfilling the following.

- To design material which will help to develop scientific, mathematical and study skills.

- To produce materials that are relevant to the learners' experiences by beginning from their understanding and knowledge of science. The examples used are from British everyday life experiences.
- To introduce learners to all major scientific disciplines using an interdisciplinary approach which includes Physics, Mathematics, Biology and Earth sciences.
- To show that science is exciting, interesting and relevant to our everyday lives by providing opportunities for self-discovery through activities, experimentation and measurements.

(Metcalfe & Halstead 1994, p.261)

The 'Into Science' programme does not have any audio cassette or Science Kit and the equipment required for experiments can easily be made available from home, except for a jam-making thermometer. The provided 'Into Science' kit therefore consists of the learning text (including instructional activities, workbook and assignments) which was used and 3 Television programmes, which we did not have.

These learning materials consist of the following booklets:

1. **12 self-study modules.** There are 2 modules in each booklet. Throughout each module there are:
    - Cartoons.
    - Diagrams.
    - Self-Assessment questions (SAQs) with comments and answers at the end of the module. These help students to check how well they understand the concepts that are dealt with by practising the skills they have learnt.
    - In-Text questions and answers together. These help the students to stop and think before they proceed to the next step.
    - Summary and glossary of terms at the end of each module.
2. **A workbook.** This contains exercises, comments and answers on each module, which aims at giving students more practice on the skills learnt.
3. **An introduction and guide booklet.** This gives students an overview of the course, what is expected and some study guidance.

4. **An assignment booklet.** This has 2 Tutor-Marked assignments (TMAs), which are basically short answer questions and 2 Computer-Marked assignments (CMAs), in the form of multiple-choice type questions. Both aims to give students feedback on their progress.

According to the Open University, students are expected to complete all 12 modules, including all four assignments in 10 weeks. Students are to do one module a week, with the exception of modules 9 and 10 which are to be done in one week, and 11 and 12 also to be done in one week.

Metcalfe and Halstead (1994) argued that, throughout the modules, students are gradually introduced to managing and organising their study time. There is a steep learning curve as the quantity of written text increases and becomes more difficult in terms of concepts and skills that are covered.

1.8 The aim and objectives of the study

The following doubts about the programme and materials were expressed (by some observers) in relation to South African students having to take a British designed course.

- South African students are unfamiliar with this type of a learning approach, therefore the work would be too advanced for students to manage.
- The language used might be problematic for South African students.
- The material uses examples from the British local context, rather than South African. This could hamper understanding.
- Students here in South Africa would not be able to go at the standard Open University speed, given the difficulty of the content.
- The students would not be able to cope with the amount of reading involved.

(Knox et al. 1998)

These were considered as some of the factors that might cause the programme to impact negatively on South African students. Therefore, Dave Bailey and I decided to conduct a cooperative evaluation study with the intention of identifying all relevant factors which could negatively and positively affect the successful implementation of the 'Into Science' programme and materials here in South Africa.

Hence, in February 1997 the 'Into Science' course was trialled in 3 interested KwaZulu-Natal Colleges of Education. A total of 120 students took the course assisted by 8 tutors, with 93% of the participating students being "African" in the racial typing formerly used in South Africa.

Dave Bailey's research area was to assess whether there was a development in the participating students' scientific knowledge and process skills through using the 'Into Science' materials. He did this by giving students a pre-test and matching post-test based on questions adapted from those used by the United Kingdom Assessment Performance Unit (APU). The APU questions were paper and pencil test items covering a range of science process skills, and not linked to any particular syllabus. The students also took a pre-test and matching post-test using questions based on the content of the 'Into Science' course materials.

This dissertation aims to report on the evaluation of the 'Into Science' programme and materials using particularly the perceptions of participating KwaZulu-Natal Colleges of Education students, in South Africa.

It is acknowledged that perceptions are very important and powerful in influencing what people experience as a reality of their circumstances (Avery 1997, p.6) . Therefore it is imperative that the students' perceptions are investigated about the 'Into Science' course since the aim of the proposal for its implementation is to help and benefit them (as consumers).

At its outset this study aimed to look for any factors relevant to the successful implementation of 'Into Science' in KwaZulu-Natal. In particular the researcher bore the following questions in mind.

1. Why did the students chose to take 'Into Science'?
2. How did the students react towards the programme and materials?
3. What do they think about Independent and Distance learning mode?
4. How useful were tutorials and practical work?

5. Which assessment techniques or methods did the students prefer?
6. Did they understand the content and the English used?
7. How did the students feel about the interactive style of writing used in the study materials?
8. What type of study guidance did they need?
9. Were they able to cope with the amount of work and/or reading that was required?
10. Were they able to proceed at the speed specified by the Open University?
11. Which modules did they find difficult, challenging, interesting, easy and boring?
12. How did the lecturers/tutors react towards the programme and materials?
13. What modifications will be required if the course is to be offered on a large scale, in South Africa?

Also, this report aim to present findings that will:

- be useful in improving the delivery of science education to all interested and motivated Secondary school teachers, especially blacks as already mentioned; and
- enable the 'Into Science' course to be better adapted to a South African context so that teachers and others will benefit from taking a good quality course at a reasonable study cost.

The following part of this report is structured as follows.

Chapter 2. This section reviews the literature that was consulted in relation to the previous study that has already been done in South Africa based on the 'Into Science' course, also the literature related to Distance Education programmes and materials, students' perceptions of courses and kinds of evaluation methods that can be followed in conducting a study of this nature.

Chapter 3. This describes and explains in detail what was done throughout the 'Into Science' trialling period and the limitations and delimitations of using the data collection methods used. It also provides a full description of the sample group and data processing methods employed to analyse data that has been collected.

Chapter 4. This section reports on the results obtained from the study.

Chapter 5. This is the final section which discusses some implications of the results that are reported. Included are some conclusions and recommendations for future research, and requirements for implementation and modifications of the 'Into Science' programme and materials if it is to be implemented on a large scale throughout South Africa in a distance education mode.

Chapter Two
Literature review

2.1 Introduction

The aim of this chapter is to review some literature on studies which have been conducted on students' perceptions in relation to their study materials and the theoretical perspectives underpinning students' and observers' perspectives. It also aims to report on some issues regarding the provision of teacher education using a distance mode, especially in South Africa. It will also examine what the literature has to say about the role of distance learning materials and some reviewing approaches that one can employ in pursuing a study of this nature. However, I am starting it by defining and clarifying the following concepts, as this is necessary to avoid confusion.

2.2 Definition of terms

2.2.1 Perceptions

Perceptions refer to the process through which a person selects, organises and interprets information or events to understand or make sense of the world.

Appanna (1995) defines perceptions as,

> *".....frameworks through which people make sense of the world. They therefore provide people the means to conduct their realities and interpret situations.....therefore perceptions are inextricably linked to context (in which they find themselves and of which they are an integral part) and culture."*
>
> (1995, p.51)

This explains the fact that individuals can have different experiences, observations and realities of the same stimulus. For Becker (1961) quoted in Appanna (1995, p.51) the term 'Perception' refers to:

"a co-ordinated set of ideas and actions a person uses in dealing with some problematic situation, to refer to (that) person's ordinary way of thinking and feeling about and acting in such a situation"

2.2.2 Distance Education

Distance education is the type of education whereby learners use self-instructional study materials. This implies that learners are physically separate from their lecturers and institutions. The South African Institute for Distance Education (SAIDE, 1994) defines distance education as:

".....an educational process which is designed to minimise the many problems of teaching by classroom instruction. It combines some face-to-face education with education at a distance. It is therefore uses a variety of educational media, including print and electronic media such as the telephone, computer, radio, and television. The learner does not have to rely on a physical structure and the presence of the teacher all of the time. The learner relies on materials which have been adapted to distance learning and limited face-to-face interaction"

(1994, p.1)

Keegan, in Richards and Roe (1994, p.11) provided the following basic six elements of distance education:

- The separation of teacher and learner.
- The influence of an educational organisation which distinguishes it from private study.
- The use of technical media, usually print, to unite the teacher and learner and carry the educational content.
- The provision of two-way communication so that the learner may benefit from or even initiate dialogue.
- The possibility of occasional meetings for both didactic and socialisation purposes.

- The participation in an industrialised form of education which, if accepted, contains the genus of radical separation of distance education from other forms within the educational spectrum.

2.2.3 Open Learning

In Open Learning learners have a choice, freedom, and control of the way they learn (Race 1994, p.23). This implies the following.

- Open learners have more control over the pace at which they are going to work.
- They can choose the place to learn.
- They can choose the time to do their learning.
- They may choose the processes of learning they want to use.

Race (1994) further stated that open learning can be done at a distance, and in a lecture room as long as the environment and the study materials are causing effective learning to take place. However, other authors define 'Open Learning' with reference to the entry criteria, as they (open learning programmes) do not require the students to have certain prerequisite qualification or experience, although learners are made aware of what they should be knowing before commencing with the programme. Hodgson (1993, p.88) adds that in open learning a programme or curriculum is negotiated to suit learners' needs, which can be provided through multimedia packages, workshops, counselling and tutorial support. Others use the term 'Flexible learning' for this kind of system.

2.2.4 Correspondence Education

Titus et al. as quoted by Avery (1997, p.18) define correspondence education as follows.

> *"Education conducted by the postal services without face-to-face contact between teacher and learner. Teaching is done by written or tape-recorded material sent to the learner, whose progress is monitored through written or taped exercises sent to the teacher, who corrects them and returns them to the learner with criticism and advice".*

2.3 Quality Teacher Education and Distance Education in South Africa

In order for one to be able to consider whether a teacher education programme offered at a distance is of either poor or good quality standard, one will have first to understand the quality of distance education as practised historically in South Africa (The South African Institute for Distance Education [SAIDE] 1995, p.9) and the qualities of a good teacher education programme. Secondly there is a need to analyse the quality of course materials. SAIDE argues that meaningful and comparable evaluations by different reviewers are only possible if they can agree on what constitutes a good or bad course and material. As a result SAIDE has published a set of criteria that are specifically appropriate to South African contexts and needs, which highlight both good quality teacher education and distance education standards. These will then help programme designers and evaluators in their attempts to evaluate whether or not a teacher education programme offered at a distance is appropriate or not in this transforming context (SAIDE 1995, p.9).

2.3.1 Some principles and guidelines from SAIDE for a good teacher education programme

The following is a list of assumptions and principles about teacher education recommended by SAIDE (1995, pp.16-18). They are not arranged in any particular order.

- Teacher education is crucial to South Africa's reconstruction and development, because of a strong linkage between quality of teacher education and successful economic development.
- Teacher education should form part of the higher education system.
- Pre-service and in-service training should be seen as part of one continuum of professional development, i.e. moving away from career preparation but towards lifelong learning.
- Teacher education needs to develop innovative, cost-effective methods of educational provision.
- A diversity of approaches to improving teacher education and learning should be supported.
- Teacher education should integrate theory and practice. It is also generally agreed that teacher education should, at least, comprise the following four elements to be taught at

some level of integration: subject study, educational theory, teaching methodology and teaching practice.

- Greater accountability to a range of interested parties is required from teachers, schools, and teacher education institutions.
- Teacher education should be collegial rather than individualistic, so that the scarce skills available to South African teacher education can be widely shared and teacher educators can work to improve and monitor the quality of their education.
- There needs to be a focus on developing teachers in subject areas of national need. For example, the White Paper on Education and Training (1995), is quoted supporting the idea of preparing students for subjects in short supply, particularly science, mathematics and technology. There is also a need to give some second chance opportunities for those students who did not fulfil the admission criteria, and for them to be provided with special support. The White Paper on Education further states:

> *"....... Well-functioning distance education programmes can play an essential role in increasing the productivity of the small science, mathematics and technology base, and providing opportunities to very many students in as flexible a way as possible"*
>
> *(White Paper cited in SAIDE 1995, p.18)*

2.3.2 SAIDE's components of a well-functioning distance education provision

SAIDE (1994) argues that distance education has particular significance for open learning approaches, but distance education does not automatically give practical expression to open learning principles. According to SAIDE the components or features of a well-functioning distance education provision should include the following.

- **Well-designed courses**

  In this feature the course, rather than the educator, teaches the course. Learning materials should be designed with the following four basic elements. Firstly, it should contain conceptual pathways to mastery of its knowledge, conceptualising skills, and practical abilities. Secondly, it should contain educational strategies for helping the learner find his or her way through these pathways. Thirdly, both formative and summative assessment should be integrated in the learning process, and finally, the materials and the presentation of the course as a whole must excite, engage, and reward the learner.

Courses should be designed in a way that will involve learners actively in their own learning. This can be achieved through making use of a variety of media but not necessarily all possible media. Provision should be made for necessary practical work and the course should be arranged in modules and be as flexible as possible.

- **Team programme and course development**

  It is recommended that course design to be done in collaboration, whereby a group of people bring in their expertise, competencies and skills to develop the course.

- **Student counselling**

  Distance learners should be provided with advice and help throughout the learning process, especially help on study skills and programme choices.

- **Learner education support**

  Students should be supported in various ways if they are to adapt to the special requirements of self-study. For example, they might have access to tutors, opportunity to interact with other learners and access to necessary facilities. Furniss and Parsonage (1975, pp.10-11) suggest the following six attributes which characterise the independent learner.

  a. The ability to continue reading.
  b. Self-motivation.
  c. Self-assessment.
  d. Ability to learn from other people.
  e. The capacity to solve problems.
  f. The ability to think independently.

  Therefore, if distance education learners are not afforded the opportunities to develop the above characteristics, it will be very difficult for them to cope with this style of learning, i.e. independent learning.

- **Administrative support to learners**

  This will include support at different levels, such as for enrolment procedures, payment of fees, delivery of materials and in keeping channels of communication open.

- **Quality assurance**

  Various mechanisms can be employed to ensure the quality of learning programmes, one of which will be to get feedback from learners and tutors about the provision of the programme.
- **Effectively managed distance learning**

  This implies establishing performance criteria and targets for the institution and regularly evaluating performance and then using findings to improve practices.
- **Research, evaluation and development**

  These components are essential for the improvement of distance education provision and of the quality of performance.

2.4 Research methods and approaches to programme evaluation

There are various kinds of evaluation approaches, that can be used in programme evaluation. Nabil (1988, p.69) suggested that amongst the key differences are the differences in the purposes for which the evaluation is used and in the timing of such an evaluation, rather than in the methodology or analytical techniques used.

2.4.1 Purposes of evaluation

Firstly, with regards to the purpose, there are many different reasons why evaluators or programme designers and implementors may undertake a study of this kind. Below is a list of general reasons for evaluating programmes, adapted from Anderson (1990, p.171).

- To determine whether to continue or discontinue a programme.
- To determine if the programme is meeting its stated objectives.
- To measure the programmes' effects and impacts.
- Exploring the comparativeness of different ways of providing the same service.
- To improve the programmes' practices and procedures.
- To adjust specific programmes' strategies and techniques.
- To obtain data for use when instituting similar programmes elsewhere.
- To help decide how to allocate resources among competing programmes.
- To validate programme results to outside funders.

- To find out what the inputs to a programme were, eg. number of staff, time spent by the learner, etc.
- "Mapping" the perceptions of different participants, eg. learners, tutors, etc.

However, one must note that this is not a comprehensive list of all the reasons that can lead a researcher to conduct an evaluative study, and that the above reasons can be interrelated. This implies that two or more reasons can be included within one study.

2.4.2 Timing of evaluation

Timing is the second aspect that can be used to classify a programme evaluation study to a particular approach. By this, a researcher can choose to conduct the evaluation as the programme is still in progress or after it has been completely implemented. Calder (1994), Thorpe (1988), Anderson (1990), Hodgson (1993), Nabil (1988) and others, refer to the former as the **formative evaluation approach** and to the latter as the **summative evaluation approach**. These approaches are also related to the reason for a particular study.

One can summarise the following differences between the formative and the summative approaches (table 2 adapted from Thorpe 1988, p.10).

SUMMATIVE EVALUATION	FORMATIVE EVALUATION
1. Occurs towards the end of the programme. Concerned about the final product and the final picture of the development process.	1. Occurs during the implementation of the programme for the purpose of identifying any changes required to improve it and make it more likely to improve its goals.
2. Evaluated by specialist or outsiders.	2. Use practitioners or self-evaluation.
3. Often uses large scale surveys and statistically based sampling and analysis methodologies.	3. Not usually large-scale though often uses descriptive statistics.
4. May be nationally reported.	4. Locally reported (e.g. within colleges).

5. Driven by time constraints of the design and the methodology chosen.	5. Driven by decision-making and operational constraints of organisation.
6. Initiates data gathering to reveal longer term effects of the programme. Judgement about the merit of the programme (Nabil, 1988).	6. Relies heavily on monitoring and indicators of short term effects. Nabil (1988) argues that it helps the developers of programmes through the process of production by using empirical research.

Table: 2 **Differences between formative and summative evaluation (adapted from Thorpe 1988)**

2.4.3 One approach of evaluation: 'illuminative evaluation'

Parlett and Hamilton, cited in Nathenson and Henderson (1980, p.66), supported the idea that programme and material evaluators are to undertake a "Goal-Free" approach to evaluation. In this way the task of the evaluator is to be an 'Illuminative evaluator'. Philosophically, to undertake a "Completely Goal-Free' approach in evaluation is not possible. However, it is argued that when an evaluator start an evaluation process he/she must have certain important aspects that are to be explored, but the evaluator should also observe with an open eye so that those aspects which were not initially targeted would be considered, if they seem to be important. This type of an evaluation is thus referred to as 'Illuminative Evaluation'. According to Parlett and Hamilton as quoted by Nathenson and Henderson (1980) and Morgan (1984), the role of the evaluator in this case is to find out how the programme operates, how it is influenced by the various educational situations in which it is applied, what those who are involved in it regard as its advantages and disadvantages, and how the intellectual task and academic experiences of the students are most affected. Briefly their aim is to find what it is like to be a student or a teacher in relation to the milieu or context in which the learning occurs. This type of approach is to explore what is 'really going on' in an educational setting.

Parlett and Hamilton, further distinguished between two aspects in isolation which the illuminative evaluation should address without any separation, as the study on one aspect will ignore the factors that can be considered or illuminated by the other. These aspects whose interaction is important are the instructional system (e.g the syllabus, pedagogic assumptions, learning materials and their presentation) and the learning milieu (the social-psychological and the physical environment in which students and teachers communicate with one another).

Hodgson (1993, p.53) argued that illuminative evaluation,

> *"........emphasizes the more qualitative aspects of evaluation and has more in common with ethnographic and social anthropology. It is less likely to take any predetermined stance and tries to be flexible enough to modify its strategy in the light of experience gained during the actual investigation......"*
>
> *(1993, p.53)*

The common data collecting tools for illuminative evaluation include open-and close-ended questionnaires, informal questioning, student journals, face-to-face and/or telephone interviews, focus groups, participant observation, and diaries compiled during and/or after an observation.

2.4.4 Data collection techniques

Guba and Lincoln (1989) differentiated between four evaluation approaches with regards to the data collection techniques that can be employed in an evaluative study.

The first approach they term the 'first generation approach', which refers to the measurement data collection technique, whereby various attributes of school children, who are the target and objects of evaluation, are measured. This aims at discovering what is "True" or "Facts" and the data sources are taken as concrete evidence of the subject's achievements. It also has a purpose of measuring whether or not the students learned what was intended. The evaluator's role is to know the full collection of available instruments so that any variable named to be evaluated could be measured and, if appropriate instruments do not exist, evaluators are expected to have the expertise necessary to create them.

The second approach is termed the 'second generation approach', which refers to the description or objective approach. Also here the purpose of testing is to determine whether what was intended (learning objectives) have been achieved, but with the purpose of refinement and development of the curricula and making sure that they are working. Thus, the focus is on description of patterns of strengths and weaknesses with respect to certain stated objectives. The role of the evaluator in this approach is to be a describer, even though the other aspects of measurement evaluation are maintained.

The third approach is termed by Guba and Lincoln the 'third generation approach', referring to the judgement evaluation approach. This type of evaluation is characterised by the efforts to reach judgements. The evaluator assumes the role of being a judge while retaining the earlier technical and descriptive function as well. Objectives and goals are also to be evaluated and considered problematic, therefore standards against which judgements can be made are usually set.

If one looks at the above three evaluation approaches, one can notice that they are all committed to a scientific paradigm of enquiry, in which the evaluator acts as a judge of the evaluand's merit. Such an evaluation procedure could be considered unfair, as subjects are dis-empowered, and managerialism is practised in the sense that the evaluators' managerial qualities cannot be called to question and he/she cannot be blamed. In addition they fail to accommodate value-pluralism, by assuming that the society shares common values (Guba and Lincoln, 1989).

Finally, Guba and Lincoln conceptualised a responsive-constructivist evaluation called the 'fourth generation approach'. In their proposal they suggested that evaluation is a socio-political process, i.e. represents meaningful constructions that participants form to 'make sense' of the situations in which they find themselves, including the other stakeholders that might be put at risk by the evaluation. It is a joint collaborative process, a teaching and learning process, and is continuous, recursive, and highly divergent. Such evaluation is a process with unpredictable outcomes, and it creates reality. The role of the evaluator is to be a collaborator rather than being a controller, to assume a role of learner-teacher rather than an investigator and a shaper of reality rather than an observer. The product of the evaluation is not, in sharp contrast to conventional methodology, a set of conclusions, recommendations, or value judgements, but rather an agenda for negotiation of those claims, concerns and issues that participants have identified in a hermeneutic dialectic exchange.

A researcher can use a variety of data collecting tools when conducting a study of this nature. Amongst others, open-ended and closed questionnaires can be used, analysis of students' journals, telephone interviews, face-to-face questionnaires, participant observation, diaries compiled during/or after an observation, informal conversations with the respondents, and other techniques can be used to do a programme evaluation. However one must always keep in mind that there are general strengths and limitations of using any of the above stated tools, therefore a researcher must be on guard when constructing his/her data collection instruments. One guideline is to do what is termed 'Triangulation', whereby a variety of techniques are used to gather data on the same topic using the same respondents. This can be helpful in the sense that an evaluator can be in a position to identify any inconsistences with the responses.

2.5 Instructional material evaluation criteria

Dekkers and Kemp (1995, p.312) suggested that open and distance learning instructional materials or texts should incorporate a number of features to accommodate a wide range of students' learning styles. They then suggested that the features listed below should be seriously considered when designing materials for this type of education mode.

- Written to satisfy learners.
- Focus on learners' experiences.
- Aim to develop independent learning skills and strategies.
- Be intended for initial learning.
- Emphasise learning objectives.
- Be structured according to the learners' needs.
- Aim at a defined target audience of learners.
- Contain features that can motivate learners.
- Build on study skills attained or acquired by learners.
- Provide the prerequisite learning.
- Encourage application of knowledge and skills by learners.

- Ask the learner frequent questions.
- Provide teaching feedback.
- Confront or explore learner conceptions.
- Provide ample and progressive practice for learners.
- Demand reading and activities of learners.
- Allow the learner to check progress.
- Provide the layout which will facilitate and promote efficient learning.
- Contain manageable chunks of information for single learning sessions.

Again, van der Linde, as quoted in Lemmer et al. (1995) suggested the following interactive text technical features.

- The writer and the reader take turns 'speaking'.
- The content is divided into 'stages' to help the reader to assimilate the content of each 'stage'.
- Self-test questions are asked after each section of the text.
- The writer helps the reader to formulate schemas and conceptualise information by the use of overviews, paragraph headings, summaries and typological features (such as the use of boldface, italics, etc.) to highlight the text.
- Concrete headings which communicate the message effectively, the theme of a section and subheading can help the reader look for and select relevant material in a section or subsection. This can also help the writer to emphasize information to which he or she wants the reader to pay most attention.
- Advance organisers to help readers to find particular sections quickly.
- Objectives are set before sections. Objectives which can be realised are more satisfactory to the reader.
- Open spaces encourage the reader to answer questions, insert his/her own words and supply missing gaps, thus the reader becomes involved in the learning process.
- The tone of the text (register, attitude of a writer towards a reader, appropriateness for the reader, length of sentences, vocabulary and syntax) makes the reader willing to engage with the information.

- Concretisations (diagrams, charts, pictures, etc.) simplify facts as they make it easier to imagine, identify and respond to information.

(1995, pp.10-11)

The 'Into Science' materials essentially meet these criteria. The researcher did not undertake a detailed study of the materials themselves as the evaluation reported on here concentrated on what happened when the materials were used.

2.6 Advantages and disadvantages of using students' perceptions in programme evaluation

Studying students' perceptions towards learning materials is of vital importance so that the institution or those who are offering and/or who have designed the programme will have continuous feedback about how students feel and interact with the study materials as consumers. It is acknowledged that in the past this has been one of the aspects which were usually taken for granted or neglected when conducting programme evaluation studies, especially in a distance education mode of learning.

Leluma (1996, p.117) stated:

> *"The major clients of distance education programmes are students, and it is therefore important, if any effective quality standards for distance education are to be drafted, to involve them in contributing to processes to build and assure the quality of such programmes."*

Harley in Appanna (1995) argues that programme implementers or lecturers will benefit from studying their students' perceptions. Lecturers may benefit from the students' responses since lecturers may gain feedback and be assisted in the improvement of their teaching skills (Ziehl, 1996). Students are not passive receivers of knowledge but rather, as Appanna explains, are actively participating in the educational process.

Mapping students' ideas helps in understanding what the students feel about the programme and materials *per se*. This approach describes learning from the learners' perspectives or points of view and thus explores the way in which the students relate themselves to the learning situation, as Marton and Svensson elaborated (cited in Morgan 1984, p.254). This can result in making useful and important recommendations for future implementation of the programme and the use of study materials. Appanna (1995, p.49) further argued that the study of students' perceptions,

> *".....provides a qualitative researcher the opportunity of examining and establishing links between macro, sociological and historical processes on the one hand, and the individual on the other."*

Appanna thus inferred that by studying students' perceptions a researcher is not only trying to find out what and how the students think, but also whether they can understand these feelings on the basis of interpreting their culture, interaction and socialisation strategies. He further stated that one needs to acknowledge that students' perceptions particularly are socially constructed, thus they are not fixed or constant because students are human beings and that today they have different feelings compared to yesterday's or those of the other week. This is one of the limitations of studying students' perceptions as one cannot be sure whether the results can be replicable and it becomes difficult to generalise. On the other hand, no matter how well designed the materials can be, unless students and teachers share similar perceptions about methods of learning, the danger of students not responding as teachers expect them to, will exist (Avery 1997, p.95).

Printed text is still a primary medium of instruction in a distance education programme. Therefore, there is a valid reason why the studies of students' perceptions are considered important (Lemmer et al. 1995, p.12). Distance education providers need to remember that the role and nature of the printed material have changed over a period, therefore there is a need to continuously evaluate whether the learning text is still meeting the aims and objectives that it was designed to address within the process of education. In this way the students' comments can be used to inform some modifications in the printed text or learning materials. However the practical aspects of getting student's cooperation in this including the time involved can be problematic.

Avery (1997, p.6) argued that in South Africa there is a rapid growth in distance education, and there is a lack of research conducted on students' perceptions about support for students in general. This is a gap that needs to be bridged if an institution is planning to develop and offer an efficient distance education programme(s). He also acknowledged that perceptions are a powerful tool in influencing what the individual experiences as a reality of his or her situation.

Ziehl (1996) argued that in the minds of many academics, students are not competent to judge the content of the courses, and therefore finding their opinions in this field is considered of less value. Asking students their opinion of the materials, especially concerning difficulty, can mean a section that causes a problem, will require that an evaluator has to diagnose the nature of the problem. This is somehow problematic since this requires that he/she branches from the main theme and needs other information to be able to identify and diagnose the problem (McCornick, 1981).

Ziehl (1996), contended that students' observations can easily be ill-informed depending on their personal attitudes since they are much too kind and not critical enough. Therefore their responses need to be interpreted.

Others feel that students' feedback should not determine material selecting approaches, presenting and evaluating it. They argue that if one is working with unmotivated or inadequately equipped students, they might reflect an unwillingness to be involved in this process of evaluation rather than commenting on real problems with the materials and the way it is presented and taught (Ziehl, 1996). Another danger of using students' perceptions is, for example, if a researcher is interested in finding out how the students work through the material, and they are interviewed after they have used the materials, students might not be able to articulate exactly what they have done (McCornick, 1981, p.21). This is a problem because the questioning techniques usually assume that the students are aware of the processes they used.

In conclusion Nathenson and Henderson (1980, p.36) noted that data that has been collected from students has shown to be superior to that which has been collected from expert evaluators or instructional designers on the basis that the former aim to improve the learning materials on the basis of effectiveness and learnability, whereas the latter are usually focussing on the content dealt within the materials.

2.7 Some previous studies on students' perceptions on study materials

This section will briefly discuss the findings and relevance of some other studies that have been done in attempt to involve students' feedback in evaluation of programmes and learning materials. Below, is an overview of the studies reviewed in which students' and/or lecturers'/tutors' perceptions with regards to educational programme and materials evaluation were employed for different purposes. I have listed the studies and their contexts (section 2.7.1) and then discussed some issues arising from these studies (section 2.7.2). I have mainly chosen the studies that were conducted in South Africa because distance education is perceived as being of low quality and thus low status, partly because most of the issues listed in section 2.5 have been and are commonly not taken into consideration. Also because some of the evaluative studies which are conducted does not provide a holistic view, moreover, these were chosen because the situation in South Africa may differ from those of other countries.

2.7.1 A list of studies reviewed outlining their contexts

The dates which are given in this summary are the dates when the research was conducted and not report publication dates.

Study 1: Robertshaw, (SAIDE, November, 1994).

Aim of the study: Trialling imported distance education courses in South Africa for the proposed access programme. 'Accounting' from The Open College, United Kingdom (OCUK), 'Into Science' from the Open University, United Kingdom (OUUK), and 'S102: Science Foundation Course' from the Open University, United Kingdom (OUUK).

Sample and methodology: About 20 Students selected by the University of Orange Free State, to do the first parts of the courses for the first 4-5 weeks. Tutorials were provided, students were paid to participate. Informal discussion with students, questionnaires, assessment and tutors' impressions were used.

Study 2: Robertshaw, (SAIDE, January, 1995)
Aim of the study: Trialling imported distance education courses in South Africa for the proposed access programme. 'M101: A foundation Course in Mathematics' (20 students); and 'MDST: Statistics in Society' (9 students); both from the Open University, United Kingdom (OUUK).
Sample and Methodology: Students selected by the University of Natal-Durban. These were on-campus students who had been involved in short course programmes. They had to do the first parts of the courses for the first 5 weeks. Tutorials were provided, students were paid to participate. Informal discussion with students, questionnaires, assessment and tutors' impressions were used.

Study 3: Metcalfe and Servant, Open University (UK). The actual study date is not specified, but a March, 1996 article was used, so it is assumed that the study was conducted in 1995.
Aim of the study: Evaluation of the 'Into Science' materials by users outside the Open University, in order to discover the ways in which tutors or centres use the pack.
Sample and Methodology: The sample number is not specified but the pack was used by 40 centres when it was first available in 1994. Questionnaires were answered either by tutors or other members of the staff, to elicit how they used the pack, tutors reaction to it and students' reactions to the material as perceived by tutors.

Study 4: Avery, Natal College of Education (NCE) in Pietermaritzburg, May, 1996.
Aim of the study: To explore how students perceive the function and value of contact sessions in distance education.
Sample and Methodology: 24-26 students who had enrolled for the 2nd year in FDE (Administration and Management). Postal questionnaires and discussions with students.

Study 5: Lemmer, Bergh, van der Linde, van Niekerk and van Wyk, University of South Africa (UNISA) in February-March, 1994.

Aim of the study: To explore how UNISA students experience printed text and what influences their experiences.

Sample and Methodology: 10 volunteering UNISA B.Ed. students living in Gauteng area. In-depth interviews, two half-hour study sessions, and questionnaires. Students travelled to UNISA in Pretoria.

Study 6: Leluma, Soweto College of Education (Gauteng), date not specified but a September-December 1996 discussion document was used.

Aim of the study: To provide an opportunity for writers of the quality standards framework for South Africa to identify particular student problems under the headings of : Course materials, Learner support and Administrative support.

Sample and Methodology: 139 questionnaires were used from tertiary students in Gauteng, Eastern Cape, KwaZulu-Natal, Taung Area (Northern Cape) and Mpumalanga. 17 were enrolled in degree courses and 122 were involved in professional development courses related to teaching.

Study 7: Fraser and Nieman, UNISA, April 1993.

Aim of the study: To find the opinions of distance learners on their learning accessing modes, i.e. Learning Styles.

Sample and Methodology: 2 types of questionnaires from 2 different samples who were involved in 1st year distance education courses in 8 distance education institutions in South Africa, viz. College of education of S.A (175, 140), Lyceum Correspondence College (29, 24), Success Correspondence College (201, 125), Technical College of S.A. (400, 212), Technikon S.A. (182, 158), Transvaal College of Education: Laudium (109; 108), UNISA (52; 46), and Vista University (58; 57).

This makes sub-totals of 1 206 and 865 for questionnaires A and B respectively.

Study 8: Huddle, Bradley and Gerrans, University of Witwatersrand (Gauteng) in 1990.
Aim of the study: To improve the effectiveness of tutorial classes for Chemistry students.
Sample and Methodology: A total of about 530 students, 12 tutors (1 tutor for 20 students) and 7 lecturers involved in Chemistry 100, Chemistry 101, Chemistry 110, and Chemistry 111. Interviews, observation of tutorials and questionnaires were used to elicit students', tutors and lecturers' responses. During tutorials each group of Chemistry 100 and 101 students was divided into subgroups of 4-6 according to their matric results, to discuss the tutorial questions and prepare a group answer for the tutors on each question. These were collected and marked by lecturers and returned the following tutorial.

Study 9: Marland, Patching, Putt and Store, Australia, early 1980 academic year.
Aim of the study: To identify types and origins of students' covert mediating responses to Distance teaching materials during study sessions.
Sample and Methodology: 4 students who were enrolled as external students living within the close proximity of the campus, enrolled for approximately the same courses. All participants were married with 1 or 2 children, all had a prior experience of study at a distance and two were full-time teachers. Data on each student's mental functioning was gathered in 3 x 30 min. study sessions spread over three weeks. Each member of the research team was assigned a student to work with the student throughout. Stimulated-recall interviews (about 1 hour audio taped) were conducted immediately after an audio and/or video taped study session.

Study 10: Lemmer, Lemmer and Smit, University of Namibia (UNAM) and Australian students who were in their tenth year of schooling; University of Namibia and University of Potchefstroom (UP), 1990-1992 and beginning of 1993 respectively,
Aim of the study: To determine the school laboratory experience of students enrolled for Physics I at University of Namibia and to compare first year physics students' expectation of practical work studying at the University of Namibia and at the University of Potschefstroom.
Sample and Methodology: A total of 120 Australian students who were in their 10^{th} year at school, 84 Physics I students enrolled in the University of Namibia; and a total of 23 Physics I students from the University of Namibia and 133 Physics I students from the University of Potschefstroom participated. The cognitive aspects were investigated in 1990-1992 (UNAM

and Australian students) and the affective aspects were investigated in 1993 (UNAM and UP students). A reduced version of the Test of Enquiry Skills (TOES) was used to cover nine enquiry skills with 41 questions, which was compiled by the Australian Council for Educational Research. For the affective aspects, UNAM and UP students were requested to answer a few questions early in the practical course, interviews with UNAM students were conducted at the beginning of the academic year before the practicals started. Students were not given possible options to choose from, but they had to formulate their own.

2.7.2 Some issues arising in these studies

2.7.2.1 Pace of course

In Robertshaw's (1994 and 1995) studies the pace of the 'Into Science' and other courses except the 'Maths foundation course', were considered by the students to be too fast, preferring a rate of 6 modules in 6 weeks. What is worth noticing here is that these students were actually supposed to do 6 modules in 4 weeks, whereas the Open University expects its students to complete the first 8 modules in 8 weeks, which makes it 1 module per week. For the 'Into Science' course students claimed to have spent 4-15 hours on each module. They then suggested they should study the courses at half the project's speed. With the 'Mathematics Foundation course' there was one student indicating a need for the increase of the study period, most however felt it was at about the right speed. The 'Accounting' students felt that the course content included concepts that were too complex and they claimed to have spent up to 30 hours each week. The tutor felt the course was at the right standard or pitch for the students.

2.7.2.2 Advance Organisers

Lemmer et al. (1995) in their study found that all students relied on advance organisers or visual stimuli when they were using study materials. Advance organisers were also considered to be thought stimuli (p.45). Advanced organisers included objectives, headings, table of contents, asterisks/bullets, paragraphs, numbered points, open spaces and boldface.

2.7.2.3 Language Used

In Robertshaw's study (1995), students had only a few problems with regards to the printed texts and audio-visual components. Those who had little problems with the language used their dictionaries when they had problems. For them it did not matter that the materials were designed for UK students. For the students this did not affect their ability to transfer the knowledge to the local context. The tutor also did not see any problems with the language, and argued that there is no need for adapting the language used in the materials.

Even though in the study conducted by Lemmer and his colleagues, the students were considered advanced (employed as teachers), they still had problems with the complexity of the English used in the UNISA materials. Some of the students supported the idea of having terminology in both English and Afrikaans, and for the difficult words to be explained.

Lemmer's students supported the interactive text was a helpful strategy to engage the reader's attention. However in Avery's study (1997) students had problems with this style of materials at the beginning of the course, but later on some students commented that they started to interact with the text as if the lecturer was actually talking directly with them. Some students were able to identify certain study guides as written by particular lecturers.

In the various courses in the Fraser and Nieman's (1996) study, 71,3 % of the respondents did not have problems with the English used and claimed to have enough vocabulary to be able to cope with the text.

2.7.2.4 Student's cultural background, context of materials, In-Text questions and examples

2.7.2.4.1 Student's cultural background

Atwater (1994, p.560) argues that students learn at different rates and focus on different aspects of science.

> *"They bring with them a conceptual knowledge base of science to which they add new knowledge."*

According to Duit, cited in Atwater (1994), students develop their science understanding through sensual impressions, language, brain organisation, social environment, and instruction. Templin and Ebbs, cited in Atwater (1994), acknowledge:

> *"......students need the opportunity to test their ideas critically, discuss them with others, and have them evaluated by others.......(However some cultures do not require a student or learner to discuss ideas with others)."*

Students, regardless of ethnicity or class, construct their own knowledge, Novak (1985) and Strike and Posner (1985b) cited in Atwater (1994). Therefore, students from different cultures view the world differently, since cognitive abilities are socially transmitted, constrained, nurtured, and encouraged, as pointed out by Day, French and Hall (1985) cited in Atwater (1994).

2.7.2.4.2 Context of materials

In the 'Into Science' and other courses trialled by Robertshaw students were not concerned about the context to which the materials were written. There was a large number of UK references in the materials but that was not a problem for students. Robertshaw's impression was that in the 'Into Science' course students had difficulty with interpreting mathematical 'word problems'. On their answers to questions based on straight forward calculations they were good, satisfactory in Earth Sciences and poor in chemistry.

But 4 students who were involved in the 'Mathematics Foundation course' reported of having problems with references, examples and case studies used in the materials because they are predominantly British culture

2.7.2.4.3 In-Text questions

Robertshaw (1995) further argues in support of the inclusion of guidance with regards to the usage of the In-Text Questions (ITQ's). Such guidance helps and motivates students to interact with the material as compared to some of them having to skip their role of answering the questions, but just jump straight to the solutions and comments provided immediately after. Without the guidance it is assumed that students are capable of participating in this type of activity. This might not be the case for students who are new in independent learning approach. In Lemmer et al (1995) the ITQ'S and the self-text questions were considered by students to be "useful", "refreshing", assisting with revision and relating concepts and terms. It is interesting to note that in Avery (1997) 13 out of 24 students were found to be inconsistent in doing ITQ's, while 22 viewed such exercises to be quite or very important. This could be the reason that students perceived answering these as time wasting because they are provided with answers anyway. They also rated the problem solving activities as very important through interaction with the lecturers and fellow students.

2.7.2.4.4 Examples

Students expected the materials to be using rich examples and arousing interest of study, and examples were quoted as one of the aspects that can help to support the students as they are going through the material in terms of reinforcing better understanding of what is dealt with. Students appreciated having ready access to model answers for in-text questions, as some had just scanned through them to locate the answers and recorded them as they were (Marland et al. 1984).

2.7.2.5 Students' Learning Styles

In this report a 'Learning Style' refers to the way in which an individual absorbs and retains information and/or skills (Dunn, 1984) or the mode which is preferred by an individual student for taking information and processing it (Merrell, 1991) both cited in Fraser and Nieman (1996). Morgan (1984, p.261) supports that students' conception of learning and approaches to learning to study are a critical ingredients in influencing learning outcomes.

Pask (1976) cited in Marland et al. (1984, p.216) differentiate between two tertiary students' strategies to learning. Pask compare 'Holistic Strategy', whereby the subject matter is fitted with another related topics, with 'real life', and with personal experiences; and 'Serialist Strategy', whereby understanding is built out of the component details, logical steps and operations taken strictly in a linear sequence.

Marton and Säljö, cited in Marland et al. (1984) and Morgan (1984) identified two approaches to learning tasks: deep-level processing, where students are looking for meanings and relating ideas together, and surface-level processing, where students are trying to remember details and consider learning as a memorisation task. Mathias (1980) cited in Marland et al. (1984) described undergraduate science students' approaches to learning as, course-focussed or interest-focussed, dynamic and flexible for adaptation over a period of time.

Marland et al. (1984) identified three kinds of learning strategies that were used by all of their participants. These are firstly, 'Orienting Strategy' (gaining an overview of the module, content, scope, tasks required, using ITQ'S, table of contents, assessment details, study guide and objectives); secondly, 'Directing Strategy' (providing themselves with reading goals and purposes, using the advance organisers used in the orienting strategy); and finally, 'Gist Identification Strategy' (searching for relevant material which they see as relevant and discarded the remainder). Derry in Fraser and Nieman (1996) argued that it is highly unlikely that one single tactic alone will ensure the criterion of a well-structured knowledge, and therefore, multiple tactics are usually required.

Lemmer et al. (1995) in their study with 10 UNISA students noticed that students' approaches to learning texts depend strongly on their personal circumstances, such as family responsibilities, community involvements, work commitments and poor study facilities. In this study students also approached the text only for assignment or examination purposes. Only three students used the multiple approach, i.e to gain overview, read the text, and read again while making notes, and most of students worked according to the survival strategy, whereby they planned their studies primarily according to assignment deadlines. Other strategies that were used were identifying and underlining key words (Fraser and Nieman, 1996; Marland et al. 1984), making notes on the text. These were interpreted as enhancing recall.

Most students (86,4%) involved in the Fraser and Nieman study, confirmed that relevant subject matter is read repetitively until the work is understood and mastered. Therefore they identified reading as an important learning style, especially for distance learners who rely mainly on written materials. Most students also indicated that they prefer summarising important and essential facts and principles and also use what Pask, in Marland et al. (1984) refers to as a 'holistic strategy'. Almost half the students rejected a suggestion that they relied on pure memorisation of relevant facts, and almost the same number agreed that they also employ rote learning in their learning strategies. Others still believed in self-testing, by writing down after reading and memorisation, and very few memorised facts by saying them aloud.

2.7.1.6 Supporting Services

Leluma (1996, p.120) states:

> *"Students tend on the whole to see support services in terms of the provision of regionally accessible learning centres (campuses) and as formal classes, rather than as more informal and individualised tutor support."*

In this report 'support services' will be used to refer to both formal and informal, group and individual, face-to-face and remote assistance provided by the distance education provider. This will also include academic support, counselling, and administrative support available for students.

Robertshaw (1995) noted that the tutor for the 'Into Science' course was more of a 'teacher' rather than providing a student centred tutorial, but the students wanted this type of a tutorial. The tutors for the courses Robertshaw trialled, commented that students needed concentrated support and counselling, especially during the initial stages. Leluma (1996) had the same feeling as she noticed that year 1 students were more concerned about the lack of support in accessing course materials, whereas the year 4 students were more concerned with the content and instructional approaches. The students reflected that they used tutorials for gaining confirmation of the material from the 'expert', the tutor. According to Robertshaw, this suggested a lack of confidence in their ability to interpret the materials themselves. Some students felt that the tutorials are important for the learning, even if nothing much is learnt from these sessions (Lemmer et al. 1995). Those who were unable to attend gave distance and time as reasons and asked tutorials to be dispersed around the state, and those who were able to attend felt that if they were unable to attend their studies would be seriously affected (Robertshaw, 1995).

For the students who participated in Avery's project, some felt that contact sessions were useful in the sense that they provided a forum in which they discussed case studies and actual problem-solving most of the students encounter in their work situation. One response stated that study guides did not offer answers to specific problems, whereas the tutorials did. This is also the same feeling which Huddle et al. (1992) reported, where students regarded discussions during tutorial sessions as helpful for learning.

Huddle et al. (1992) found that half the students favoured staff-selected discussion groups as they argued that self-selected discussion groups tended more to discuss social events, and less about chemistry, and those who favoured self-selected groups said that they were free to discuss things with their friends. Tutors had noticed that some students tended to do work other than chemistry in the tutorial sessions, but still were able to participate while doing so.

2.7.2.7 Science Practical Work and Experiments

There is a need for science students and teachers to acknowledge that practical work is an important integral part of science teaching and learning. Lemmer et al. (1996), in their study of the presentation of practical work in Physics courses using the University of Namibia and the University of Potchefstroom physics students, have concluded that the cognitive and affective aspects of practical work are very important. They further stated that it is difficult to reach the cognitive aspect aims with a practical course if attention is not given to the affective aspects, i.e. students must find the practical work interesting. They recommended the following guidelines if both the cognitive and affective aspect are to be considered (Lemmer, Lemmer and Smit 1996, p.152).

- Setting clear objectives for each piece of practical work. The following are some of the possible aims and objectives that can be formulated for practical work.
    - To promote the ability to observe.
    - To generate confidence within the student.
    - To enable the student to handle apparatus correctly.
    - To help students to construct mental models and write a report based on observations.
    - To trigger the thinking process and to generate questions.

- Taking students' prior knowledge into account.
- Not overloading students.
- Designing exercises which have a purpose, goal and which are meaningful for students.
- Providing students with a sense of feeling that they are doing real Physics.

Hodgson (1988) contended that there is a need for scientists to differentiate between what is meant when talking about practical work, laboratory work and experiments. He further maintained that not all practical work needs to be carried out in a laboratory, and not all laboratory work consists of experiments.

Lemmer, Lemmer and Smit (1996), in the comparison study between University of Namibia Chemistry I students and Australian students who are in their tenth year of schooling, found that both groups were weak in abilities that featured graph and reading comprehension aspects. Australian students outperformed Namibian students in all other categories that they were tested in, with a large differences showing in categories of library usage, experimental designs and the drawing of conclusions from data. This indicated that Namibian students were unprepared for experimental work at their first-year level. This could be attributed to the lack of necessary facilities. In the comparison between Namibian and Potchefstroom students the study indicated that 26% and 27% respectively, regarded practical work as an interesting and "hands-on" activities, whereas 22% and 4% expected experimental work to be difficult. A few students from both groups were not sure what to expect from the experiments. Lemmer, Lemmer and Smit, attributed this to their lack of practical experience during school-going years, since a majority of participating students in the University of Namibia (57%) had never handled any apparatus at school.

2.7.3 Some comments on the studies reviewed

The diversity of students in distance education programme requires a study of a multifaceted nature in order for the programme providers to be able to illuminate students' and tutors' viewpoints and evaluate their courses on a continuous basis, in order to develop the understanding of the course consumers, since their expectations will have to be met for the course to be successfully implemented. Considering the variation in the courses evaluated means that it is dangerous to generalise across a wide field, and indeed the researchers reported have not attempted to do so.

The problems that can be identified with the studies reviewed are that:

- Most studies use very few students as samples. For example, the study done by Lemmer et al. with 10 UNISA B. Ed students. If one can ask herself/himself about the total number of B. Ed students registering with UNISA from within and outside the country, one really wonders how the results which were obtained from such a study can be used to inform change, since ten students cannot be considered as a reliable representative sample.
- Again some studies tend to use lecturers' or tutors' perceptions of how their students perceived the materials. This is not in itself a problem, however, one needs to be very alert to the conception that usually lecturers do not share the same values as their students and hence their responses might be totally in contradiction from the students' real perceptions. Therefore, it is usually recommended to combine students' view points with lecturers' and/or tutors' perceptions.
- Using tutors' perceptions of how the students have been interacting with the materials can be very misleading since a researcher will be involved in what Thompson (1990, p.288) refers to as 're-interpretation of the pre-interpretation'. At this stage a researcher is re-interpreting what the tutors has already interpreted.
- Finally, there are also problems associated with reliability and validity of any data collecting tools.

But despite the above problems these studies were useful as they provided some useful information about important areas in education and some of these studies used students' perceptions.

The next chapter will present the methodology that has been followed in conducting this particular programme and material evaluative study using students' perceptions. The sampling procedure, sample size, the strengths and weaknesses of the instruments used to collect data, data analysis technique employed and other relevant aspects will be fully presented.

Chapter Three
Research methodology

3.1 Early developments of the project

After it had been decided that the FDE (Science Education) could not be offered at the beginning of 1997 academic year, it was decided to use this opportunity to trial the 'Into Science' course (as previously mentioned). Some of the important issues that were to be investigated were:

a. How the sample group to be used in the trialling would perceive the materials.
b. What problems would they encounter when using the 'Into Science' materials (refer to section 1.8).

Therefore, the research team members had to meet late in the year 1996 and very early in January 1997 to co-ordinate the research process. It was then decided that both serving teachers and college students would be appropriate groups to trial the course, since the FDE (Science Education) course was intended for a distance teacher education programme which would only enrol in-service teachers who had majored in non-science or science subjects in their secondary school education and teacher training. Both situations (teachers' and students') were considered and it was then decided to use college of education students for the following reasons.

- A large percentage of the targeted population will be teachers trained at these institutions.
- It was too late to recruit in-service teachers, whereas with the college students the arrangements could be made directly with the college lecturers and rectors.
- Other complications that were foreseen in involving serving teachers were, firstly the difficulties that can be encountered when selecting the sample group (selection criteria), secondly the running of weekly tutorial sessions was going to be expensive in terms of administration, thirdly the shortage of the 'Into Science' course materials, and fourthly the problems related to data collection strategies since serving teachers would be from different schools and ideally from different areas also.

Following informal discussions with several potentially accessible colleges, staff at three colleges of education wished to join in. In this report they are referred to as Colleges A, B and C. There was discussion on how to choose which students in a college would participate in the trialling.

In the end in the two colleges where 'Into Science' was not part of a college course, it was decided to accept all interested students. The recruitment procedures are described below.

There was communication with relevant lecturers, who were either science or/and mathematics lecturers at the colleges during late 1996 and early 1997.

A3 advertisement posters (Appendix A) were displayed in colleges A and B, giving the name of the contact person within each college for all enquiries about the course. Dates for the research team's visits were arranged with the contact persons. The students who were interested were then notified to attend these sessions for a more detailed explanation about the whole project. Students of college A and B were to take the 'Into Science' course as an extra-curricular activity, whereas, at College C the course was taken as part of their newly proposed course called 'Science Support Group' and other students were not informed or invited.

3.2 Research setting and sample groups

3.2.1 College A

This college is situated in North-West KwaZulu-Natal, right inside a township and has African students only. Students are trained to teach either at junior or senior primary education level. The college was in the process of renovation and reconstruction of new buildings and there are very few educational facilities for students, such as science experiment kits. The staff is predominantly African with about 20% being white. The total number of self-selected participants in the project was 67 third year students out of 171 who attended the briefing session, and 2 female lecturers (Refer to table 3.1). In addition approximately 85% of these students were residing at the college residences. The students took the 'Into Science' course as an extra-curricular activity and it is interesting to note that there were no year 2 students who took the course even though they were also invited to the initial presentation. There were also no year 1 students because a controversy at the beginning of the year (about the colleges having to cut their year 1 students' intake) meant there were no year 1 students present early in the term.

3.2.2 College B

This college of education only admits female students and is situated about 35 kilometres from north Durban and 35 kilometres from the coast. The students are trained in the field of junior and senior primary education. The college staff members who were involved decided to invite year 3 senior primary students only. From the total of 60 students who attended the first briefing session by the project team members, 36 took the course. This college has a majority of African lecturers and the college has very limited resources. The students in this college took the 'Into Science' as an extra-curricular activity out of their own choice (see table 3.1). All students were residing at the college residences.

3.2.3 College C

This college is situated in Pinetown on the west of Durban. The institution trains both primary and secondary school teachers, and it is well resourced both in terms of facilities available for students and its lecturing staff's qualifications. The college has students from several ethnic groups and the lecturing staff is predominantly white. As already mentioned this college decided to include the 'Into Science' in their newly implemented 'Science Support Group' curriculum, which is offered to year 1 students. 23 students took the course (se table 3.1 below). This college has a higher status than colleges A and B.

	College A	College B	College C
Gender	32 males and 35 female students, 2 **female lecturers (54 completed).**	36 Females **(26 completed).**	9 female and 14 male **students (22 completed).**
Ethnic Group	All were Africans and 1 white lecturer.	Only Africans .	4 Indians, 3 Whites, 1 Coloured and 15 Africans
College Majors	Primary teacher's Diploma and majoring in both or either science, mathematics or biology.	Primary teacher's Diploma and all doing General science.	All of them are specialising in Chemistry (Physical Science) and/or Biology.
Total number of students who came for the first presentation.	171	63	23

Table 3.1 Sample groups at all three Colleges according to gender, ethnic group, major subjects at the college and total number who came for the first presentation.

3.3 Methodology

All colleges of education wanted the course to start early in the term. At Colleges A and B lecturers felt that the course should start early, before students had committed themselves to other out of hours activities. Two sets of visits to each college were planned before students started with the course.

3.3.1 First visit to the colleges

This was done before the students who would participate were identified and/or selected themselves. The aim of this visit was to address all interested students and explain the aim of the project and all the procedures. The research team (Dave Bailey, David Knox and Kitty Sokhela) covered the following issues in their presentation.

- What is the 'Into Science' course? (Refer to section 1.7).
- What are the implications and what is expected from participating students ? e.g. Being an Independent learner, submitting two multiple choice and two short answer assignments, filling in all relevant questionnaires, attending non-compulsory weekly tutorials, be willing to participate in focus group sessions, etc.
- What incentives will the students have to be involved in the project? Gaining science and mathematics knowledge and skills, participating and learning about this particular method of programme evaluation, and receiving a certificate issued by the University of Natal (Pietermaritzburg) should they complete the course successfully (Appendix C). This certificate will give them credits towards the FDE: they would not need to do the first part of the FDE (Science) should the FDE be implemented as proposed. Students are also getting the opportunity to do the course free of charge.
- Signing the form with the statement of interest in and commitment to the course and payment of the refundable R 25. 00 deposit towards the materials (Appendix B). At College C, where the materials were the responsibility of the college, students did not have to sign this form and they did not have to pay a deposit towards the materials.

Also the research team members intended to brief the tutors with regards to the running of the tutorials, which did not happen. All students who attended had to write a pencil and paper skills pretest, lasting about one hour, based on questions from the United Kingdom Assessment Performance Unit (APU). See the dissertation of Dave Bailey (1998) for further information.

It was agreed that the students needed some time to think about the implications of their involvement with the project. Therefore, the declaration forms were handed out together with the 'Into Science' background information pamphlet (Appendix D). Students were given approximately 3 days to sign and return their signed forms to the contact person within the college, to signify that they were willing to participate. After they had returned their signed declaration forms, during the second team visit, a meeting was held only with those students who had returned their forms, all of whom were included in the sample group without any further selection criteria. Students at Colleges A and B were self-selected, the 'Into Science' course was not part of their college work and was voluntary. Students from College C were automatically selected on the basis that they had registered with the 'Science Support Group' option offered by the college.

3.3.2 Second visit and the start of the 'Into Science' course

The purpose of this visit was to explain again to the students what was expected of them, the materials were issued after the deposits were received, students wrote a 1 hour 'Into Science' skills pretest (Dave Bailey's section), then the course started. In college C 1 pack of 'Into Science' materials was shared between 2 students, while in College A and B 1 pack was shared between 3. In college A most of the students used photocopied sets of materials while in colleges B and C all the copies were original Open University materials. The main difference between original and photocopied materials was that the study booklets in the former had card covers which were coloured with coloured photographs, while the photocopied booklets had photocopied paper covers with black and white photographs. This procedure was adopted so that all the students who said they wished to take the course could do so. Students were requested to choose their own partners in order to alleviate some of the problems that could be caused by students who do not know one another sharing a pack.

Students were requested to study the 'Into Science' course materials over twelve weeks without any break. This implied that the students would have to study one module a week and have a tutorial on that particular module after it had been studied (see table in Appendix E for the initially planned commencement and finishing dates for each college). The tutorials were planned to be in the form of discussions, in the presence of the tutor with each group of students helping one another in order to clarify points or they could call on the tutor if they had problems they could not solve themselves. A different format was followed at College C (see section 3.3.4 below).

3.3.3 Description of how the programme was implemented in the three colleges

The following took place as the programme was implemented.

- Students had to share copies of the materials. This was inconvenient for students; the Open University course designers intended each students to have his/her own study materials.
- Some of College A students had to use photocopied materials, which were less smart and did not have coloured card covers. Therefore working with photocopied materials was not the same as working with the original colourful glossy covers.
- Students were provided with weekly tutorials while these are not offered by the Open University.
- These students were expected to complete the course in 12 weeks, whereas the Open University students are expected to complete the course in 10 weeks.
- At College A the first four sessions were accelerated (Tutors' decision). Normal classes were not being held. Therefore the students did not have much college work load. Modules 1 and 2 were done in one week with one combined tutorial session, also modules 3 and 4 in one week with one combined tutorial session.
- At College B modules 5 and 6 and modules 7 and 8 were also accelerated (Tutors' decision) after a students' protest action (not connected with the 'Into Science'). Because students' attendance at College B tutorials was declining, at one session only 7 students were present. The 'Into Science' tutor (Dave Bailey) told the students that they had to attend the tutorials because attendance will also count towards the final mark.

This was a deviation since what they were told was not really true, but thereafter their tutorial attendance improved.

- As some students did not want to continue studying during Easter holidays, then the programme had to stop during this period for all colleges.
- College C students did not want to continue with the course during their college first semester examinations (early in May 1997). They felt that they could not pass the 'Into Science' whilst failing their college courses. Therefore the course had to stop again. But at College B students felt they could continue with the 'Into Science' even when they were on their teaching practice block session, so they did.

3.3.4 Format of tutorial sessions

A Mathematics lecturer who volunteered was co-ordinating tutorial sessions at College A on Tuesday in the afternoon after college classes, Dave Bailey was co-ordinating the tutorial sessions at College B on Monday in the afternoon and while the researcher was at College C on Thursdays during science support group lectures. Colleges A and B had tutorials (2 hours long in both colleges) which were mostly discussion amongst students. Students were divided into groups, discussing their problems and the tutor would attend to each group's problems if the students could not solve it themselves. However, this was not the case at College C, because the lecturer who was taking the science support group raised the concern that the college staff members involved wanted their students to gain more than just participating in the project. There was therefore a suggestion that a pair of students should lead the tutorial sessions (80 minutes long) for a particular module and be graded for their presentations. These grades were to be used towards their overall year mark for the science support course. The researcher/tutor then proposed that the tutor would not award marks for these presentations, but a peer evaluation was to take place. The students agreed with the proposal. However, when we were then listing and discussing the evaluation criteria to be used for each presentation, students felt that they would not be happy to be assessed by their peers since they were not skilled to do this. Their suggestion was that the lecturer concerned or the tutor should assess them. The final decision was that students had to submit their 'Into Science' portfolios to the lecturer in charge of the course. Then the tutor conducted the first two tutorials which followed the pattern at the other colleges pairs of students led the rest. In a typical format students attempted to teach the topic for the rest of the session following a format more like "teaching practice", as students felt they needed to be seen teaching. This format was quite different from Colleges A and B and the researcher was playing a role of being an observer and checking with them after each presentation which areas were problematic.

It is the researchers' comments that the situation in College C was much less representative of possible future use for FDE materials than situation in Colleges A and B. This said because during the tutorial session there was less students' involvement and the amount of thinking which seemed to be going on compared with the other two Colleges.

At colleges A and B there were approximately two practical experiments that were conducted during tutorial sessions. At College C the practical experiments were not done at all, even though the tutorials took place in a well equipped laboratory (see section 4.2.8 to follow). The following time line type diagram show the dates on which every college were conducting tutorial sessions for modules 1, 4, 8 and 12.

	Module One	**Module Four**		**Module Eight**	**Module Twelve**
Coll. A	❖ 11 March	❖ 18 March	➔-----⬅	❖ 6 May	❖ 3 June
Coll. B	❖ 3 March	❖ 21 March	➔-----⬅	❖ 21 May	❖ 17 June
Coll. C	❖ 6 March	❖ 20 March	➔-----⬅	❖ 29 May	❖ 26 June

Keys: ➔-----⬅ Easter vacation period (27 March to 8 April).

❖ Module or tutorial numbers.

Fig. 1 A time line indicating dates for tutorials on modules 1, 4, 8 and 12 in each college.

3.4 Data Collection Strategies Employed

3.4.1 Open-Ended Questionnaire for students

In the second week of the programme students were issued with an open-ended questionnaire (Appendix F). They were asked to fill it in as they were going through the materials and requested to submit it at the end of the 'Into Science' trialling period. This questionnaire provided enough spaces for students to write their comments and they were encouraged to insert other sheets if they felt the spaces were not enough for their comments. The idea of this questionnaire was to identify the problems the students were having as they were going through the 'Into Science' programme, particularly the use of the study materials. Students were expected to comment on the following issues:

- Their initial reactions to the course.
- Study guidance provided in the materials.
- Design and appearance of the materials.
- Language used in the materials.
- Introductions, summaries and objectives.
- Examples used in the materials.
- Weekly tutorial sessions.
- Practical work featured in the materials.
- Assessment.
- Knowledge and skills gained.
- Self-studying compared with college and classroom education.
- Who would be suitable learners for the 'Into Science' course.
- General information on the learners themselves.

One of the problems that was encountered with these questionnaires was that the questionnaire was very long (19 pages), and only 70 completed questionnaires (53%) were returned. Some of the reasons for not returning the questionnaires were that they were misplaced, there was no time to fill them in because of other commitments and work for college studies. Another problem was that some questions were not answered. This raises the issue of the representativeness of the perceptions reported since almost half of the sample did not return their questionnaires. This is discussed later in section 4.1.

3.4.2 Semi-structured questionnaire for students

This questionnaire (Appendix G) was issued to students during the second last week before the course ended. They were requested to fill it in during the tutorial session and they were given 30 minutes to do so. 83 students completed these questionnaires as others were absent from the tutorials on that day.

The questions aimed to investigate the approaches they have adopted in using the materials and to check if this influenced the way they studied for other college courses or not. The following were four broad areas which were addressed by this questionnaire.

- Students reasons for taking the 'Into Science' course.
- The approaches they used to study the 'Into Science'.
- Preferences in tutoring style, examination and assignments.
- General course presentation.

The open-ended option was added to most of the questions to reduce the bias of being over restrictive for the responses.

Students were provided with 47 statements and for each asked to tick a response on a 5 point Likert type scale. For some items an open-ended, 'other' or 'why' option was added. They were expected to mark the response which they saw as being more appropriate to them, from 'strongly agree' to 'strongly disagree' or 'from very important' to 'almost irrelevant'.

Some people argue that the use of this type of data gathering method is not effective since the respondents are restricted in their responses, and other important categories can be ignored (Bless and Higson-Smith 1995, p.122).

3.4.3 Study time recording sheets

At the beginning of the project students were given a study time recording sheet (Appendix H) and they were requested to record the amount of time and the number of sessions they were spending on each module, in hours and in minutes. Only 10 of these time recording sheets were completed and returned, of which 2 were group and 8 individual responses. By mistake the last page was unfortunately not given to students. For this dissertation this data was not used as the returns were very poor hence they do not represent the amount of time most of the students have spent on each module and minimal conclusions can be drawn.

3.4.4 Semi-structured focus group interviews with students.

There were focus group interviews which were done with groups of self-selected students from each college. Each group consisted of about 5 to 8 students, except in college A where the numbers of students who were participating in one session kept on growing to a final total of 15 students. At College C one group took part, at College B two groups were involved and three groups participated at College A. This was done because of the different number of students participating in each college, so that the focus group discussions could more fairly represent the whole sample.

These focus group interviews were done to cross check on the answers given on the open ended questionnaires (Appendix I). The sessions were informal, lasted for about one hour and they were audio-tape recorded with every group's permission.

This enabled the individuals to share their ideas and check if they agreed with what was said by others; hence they could reach consensus about some issues. Sometimes some students did not participate freely in the discussion as one or two tended to dominate with their inputs or comments. The feeling of rapport, comfort and language were also other issues since at College A students did not want to be interviewed by a more elderly 'white' University science education lecturer. One of the reasons they highlighted was that they would not be free to express themselves clearly, whereas with me they could also speak isiZulu and its slang and hence the researcher would understand what they were saying. Both isiZulu and English were used freely in these discussions. Almost all College A students wanted to be involved in these discussions and the numbers of participating students in each group kept on increasing as students were coming in one by one. In the other two colleges, students needed more convincing to participate in these discussions. One student from College C commented that they thought they were going to be asked about the content of the course, which is why they were reluctant to volunteer.

3.4.5 Open ended questionnaire for the college lecturers

The questionnaire (Appendix J) was designed for tutors so that they would comment about the 'Into Science' course and materials. The questions were mostly derived from the open ended questionnaire given to students and structured in a way that would elicit the responses about the problems that they initially thought the students would encounter as they were using the materials. The questionnaire was given to the tutors after the 5th or 6th week and collected after the piloting period. They were also encouraged to make some suggestions about what would be needed for the course to be successfully implemented in South Africa. Two College C lecturers completed the questionnaires, as did a tutor at College A and Dave Bailey for College B.

3.4.6 Semi-Structured Interviews with college lecturers

The college lecturers who were assisting with the coordinating of the project in the colleges were interviewed for about one hour (Appendix K). These interviews were to check on their responses from the open-ended questionnaires and the interviews were audio-tape recorded with their approval. Many useful comments emerged from these discussions.

These interviews required certain skills that the researcher did not have, especially since the researcher was interviewing people who were more 'powerful' and had higher status. The researcher particularly felt like this when interviewing two College C lecturers (both at the same time) and was rather intimidated by the responses they were giving to some statements. The researcher did not feel able to probe their comments further. It is worth mentioning that these lecturers and those from College B did not actively participate in the discussion during tutorial sessions, and perhaps were less familiar with the materials than the main tutors.

3.4.7 Other strategies

Unstructured participant observations were done during the tutorial sessions. Most tutorials were audio recorded and notes were made during sessions. Video recording these sessions was considered ideal but would have been more expensive. However, audio recording the sessions alleviated the biases that were possible when writing down my observations and enabled me to reconstruct some comments after the session. Exchanges between the tutor and the whole group were recorded in this way, and small group discussion was not. It is the researcher's perception that the students were able to comment freely without their lecturers nearby as the relationship became stronger. Informal discussions with students and lecturers were also used, and important points and comments raised in these talks were written in the researcher's diary afterwards.

Despite all the problems that were encountered the running of the project and the data collection methods, the researcher is convinced that the data which was obtained from this project is reliable and valid. This reliability and validity is strengthened by the usage of several cross-checking methods (i.e triangulation).

3.5 Certificate presentation

During October 1997, at each college those students who had successfully completed the course were each given a certificate in a presentation ceremony. Because the programme had to finish towards the end of June 1997 (later then anticipated), it was not feasible for us to give the students a full presentation on the results of the pilot as was initially planned, because when the team went for certificate presentation for those who successfully completed the course, the process of data analysis was not finished. However, the tentative patterns and comments were briefly outlined at each college.

3.6 Data processing measures used

Themes were identified in students' and tutors' open ended questionnaires, focus group interviews with students, and interviews with lecturers. The major perspective was that of an interpretative paradigm, therefore no complicated statistical formulae were used, only percentages and/or frequencies were calculated. For the 5 point Likert scale questionnaire, frequencies of different responses and overall percentages were calculated for selected questions in relation with the research issues to be investigated. The results were recorded in a computer spreadsheet file.

In conclusion, the triangulation approach proved useful as no one method was completely successful, but together the methods provided reliable findings (see section 4.1). If the researcher was to repeat the study with another group, the following would be done to improve data collection strategies.

- Making use of shorter questionnaires.

- Making sure that both students majoring in science and those not majoring in science subjects are included in the sample for comparing responses.
- The course to run at exactly the same time and the same tutorial style to be used for all groups.
- Video-taping most tutorial sessions.
- Giving students enough time during contact sessions to fill in the questionnaires and return them.

The next chapter presents the findings of the data that has been collected on the main research issues (section 1.8).

Chapter Four
Data analysis

4.1 Introduction

The main basis of the data reported here are the data gathered through the open-ended questionnaire (completed by 70 students altogether) and 5 point scale questionnaire (completed by 83 students). The numbers of the responses from each college are summarised in table 4 below. The information from the focus group and other interviews supported, and never contradicted, results from the questionnaires. Not all questions were used for this data analysis, but they were selected to address the main issues.

College	Total number of students taking the course	Open ended questionnaires returned	5 point Likert type questionnaires completed	Focus group interviews with students	Interviews with the lecturers or tutors
A	69	32	40	3 groups	1
B	36	24	23	2 groups	2
C	23	14	20	1 group	2
Total	128	70	83	5 groups	5

Table 4 **Total number of responses obtained from the questionnaires and interviews.**

4.2 Respresentativity of sample

The post test scores of these students were more or less evenly distributed throughout the whole mark range, suggesting that their views might be reasonably representative of the students completing the 'Into Science' course.

4.3 Results

As the data was analysed, key points emerged. The headings of sections 4.3.1 to 4.3.10 proved convenient for describing them.

4.3.1 Reasons for taking the course

This data has been drawn from the 5 point scale questionnaire. 82 (99%) students said they took the 'Into Science' course because they thought it would give them useful skills and no one opposed this statement, 60 students (72%) said they chose it because it sounded interesting (See figure 2). Peer pressure was denied to have been an influencing factor for their choices. When the course was introduced at College A, there were no college lectures, for other reasons, so the students were given a statement stating that they had decided to take the 'Into Science' to fill up their time because there were no lectures. 28 College A students (70%) indicated this statement as not true for them.

Asked whether they had done the course so that they would a certificate with the University name on it, 35 (45%) of the 77 students who responded to the statement disagreed and 31 (40%) said this statement was true for them. After the course had been completed and the research team members went for certificate presentation at all three colleges, students from Colleges A and B were celebrating and taking individual photographs as they were handed the certificates, compared with College C students who were just cool, without any visible excitement.

All students were consulted when the certificates were drafted to be printed, one of the questions was, "should the name of the colleges be printed in the certificates?" All students from College A and B did not like the idea of having the college name imprinted in the certificates, with the reason that these colleges are not reputed to offer high quality teacher education, and the students could use these certificates to make themselves more employable. Whereas, the students from College C wanted the college name to be imprinted on their certificates, saying that they have done the course as College C's students, so it will be good to have the name of the college. This signified that these students are proud of their college. Maybe this is due to the reputation the college has with regards to the quality of education offered. One other possible explanation of College C students' perceptions, as first year students, was that these students through their responses are not reflecting anything in relation to their prospects after college education, because they have not yet been thinking so much about the working world.

Lecturers at Colleges A and B said that they thought the students had chosen to do the 'Into Science' firstly, because it was linked with the University. Secondly, after students have seen that the value of these two colleges is not good, therefore what the outside organisations have to offer is usually taken seriously to help them get better jobs, as science teachers are better employable. Thirdly, some students saw the opportunity to further their studies, i.e giving opportunity to automatically qualify for the F.D.E (science).

Amongst other reasons that were given, 3 students from College C said that they had no choice whether or not to enrol for the course as it was incorporated in their science support curriculum. Others were as follows:

> *"Revision, improve science and teaching methods."*
> *"I want to be a science teacher in future."*
> *"It is easy to go to the University because of this certificate."*
> *"To realise whether will I be able to cope with further studies in the next years."*

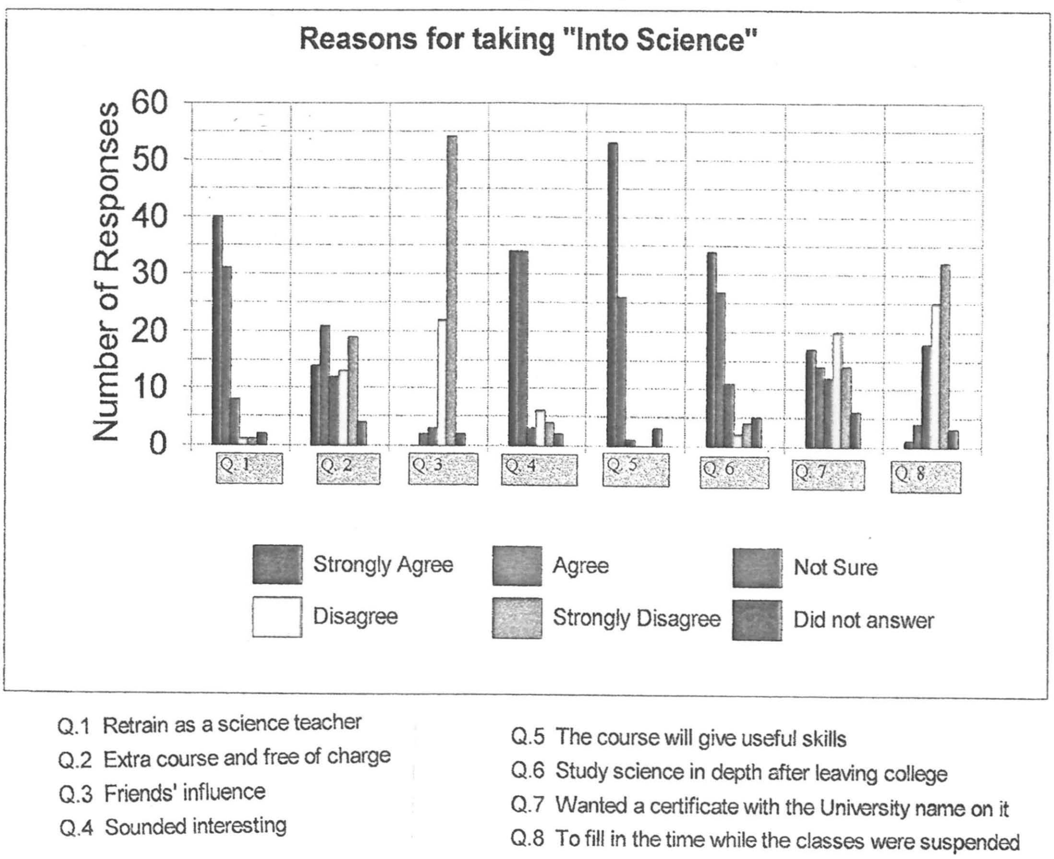

Fig. 2 Reasons why students chose to do 'Into Science'

4.3.2 Students' initial reactions to the 'Into Science'

A total of 63 students responded to the question about what they thought the course would be like before and after the project team members came for presentations. 25 (40%) of these students were more concerned about the level of difficulty of 'Into Science', as they were expecting the course to be difficult since it will be dealing with science related content which is generally perceived to be difficult. 3 students said that they were expecting the course to be difficult because it was offered by the University. 5 expected the course to be easy, and 3 students expected to have lectures, with one student expecting to study on her own. The following are some typical responses.

> *"I expected it to be helping in science especially I expected it will be a little better with Chemistry."*
>
> *"Difficult but helpful."*
>
> *"I thought it is course introducing us to the world of science and that it is hard and difficult to be done by science students."*
>
> *"I was expecting this course to be like science."*

After the research team members came for presentation, 8 students expected the course to be helpful in their science related subjects and to reinforce some science concepts that are dealt with in their college studies. 31 students then expected the course to be easy, with 3 others saying that they thought it would be easy because even those students who were not majoring in science subjects could also do the course. 6 students were still expecting the course to be difficult. Some of the representative responses are as follows.

> *"I expected it to be easy and interesting."*
>
> *"I thought it will be a bit easier than it is."*
>
> *"I thought it will not take too much time."*
>
> *"More interesting, more enhancing, more encouraging, skilful and have development in other part of it."*

4.3.3 Independent and Distance learning mode

59 students out of 66 (89%) said that this type of learning, i.e. Distance and Independent learning, was good, and 7 (11%) said it was not good. 50% of those who said it was good, motivated their statements by highlighting that this learning style improves independent self-study habits and boosts one's confidence and motivation. 3 students felt that it is good because one can check himself/herself through using the Self-Assessment Questions (SAQ's) and In-Text Questions that are offered in the materials. 3 students amongst those who said this method was bad, contended that if a learner had a problem with a particular aspect that is covered in the materials, that person could not get immediate help, because he/she had to wait for weekly tutorials, which could be taking a risk for students. 2 students, said that science is a difficult subject, hence a teacher should be available. Most students (56%) said that, the 'Into Science' materials can work best in conjunction with lectures, rather than by self-study. Group discussions were also regarded as a new experience by 4 students, and studying using self-explanatory modules rather than one whole course using one thick textbook was highlighted by 5 students as a good feature. 2 students said that studying at their own pace and choosing where they want to do their studying was convenient, 4 students said that doing practicals on their own was a new experience for them.

The five point scale questionnaire, revealed that 45 out of 81 (56%) students agreed with the statement that the 'Into Science' would work best in conjunction with lectures, as opposed to a self-study situation alone, and 19 (23%) students were not sure about this statement. But when lecturers were interviewed they said that the materials would not work together with lectures, as they were not meant to, but some ideas could be 'stolen' and adapted for a lecturing situation. They said that these materials can also guide lecturers to design their own courses. Colleges C lecturers, by contrast, contended that their college was not a college that had a problem in designing good quality science courses as they had qualified staff and people from the University who were acting as advisors. 67 (81%) students agreed with the statement that they have now realised (after doing 'Into Science') that it is possible to do much more work than they were used to.

4.3.4 Tutorials and practical work

15 students initially expected to have a lecture during tutorials, whereby somebody would come and 'teach' them, define terms and explain some of the important points. 5 were expecting to be asked questions and to write short tests. Contact sessions or tutorials were seen as an important element of this learning method. One of the reasons that was given, was that if one had a problem with a certain section of the course one could come to a tutorial and get some help from the peers and the tutor. Sharing of ideas during tutorials was generally appreciated, but others were arguing that some students were not participating in the discussions, instead they were making noise whilst others would sit down quietly without participating, but benefit from those who were participating.

College C's students were happy about leading tutorial sessions with the argument that they were having an experience of standing in front of the whole class to 'teach'. The reader will recall that their tutorial structure was different from the other two colleges. Students were divided into pairs and they had to lead each tutorial session. These students thought that they needed to be seen 'teaching' others. The researcher/tutor noticed that more than half of the students who were coming for tutorials at College C, would come to the tutorials not being prepared for the session. The students who would be prepared and pre-read the module would be those who would be due to lead the session.

Another interesting observation was that at Colleges A and B the practicals were not done at the Laboratories, but the equipment was brought to the lecture or tutorial rooms. In contrast, at College C, where there was all the resources the students needed to perform better in science, and the tutorials were taking place at the laboratory, no practicals were done during the tutorial sessions.

50 students out of 57 (88%), said that the practicals or experiments that are featured in the 'Into Science' were stated on a step-by-step basis and easy to follow, with 5 saying not all of them were easy to follow. However, it was mentioned that they took a lot of time to do compared to the practicals they normally do at the College, and 12 students said these were not different from

those they conduct at college. There was a suggestion from one of the college lecturers to include a set of experiment kits with the printed study materials.

It is the view of the researcher that the practicals included in 'Into Science' would take a student little time to do.

During the tutorial sessions, including College C, the following areas seemed to be a problem for most of the students: significant figures, plotting and interpreting graphs, multiplying by the powers of ten, word sums and basic chemistry. See Dave Bailey's report for more details.

4.3.5 Assessment

Most students were comfortable with the use of 2 multiple choice questions and 2 tutor marked assignment questions for final assessment purposes. The responses received from the 5 point scale questionnaire showed that most students would prefer to be assessed in a variety of ways, i.e examination, individual assignments, tests, group-work participation, portfolio, oral work, and practical work. 77 out of 82 students (94%) said that they preferred assignments that had general questions, which allowed them to show their ideas on a subject. 73 (89%) students said that they preferred very specific questions which will help them to realise whether they have understood or not. This may indicates inconsistency in response, as students indicated that they preferred two different assignments styles. One of the lecturers from College C also indicated that the students would prefer to be assessed in a variety of ways.

When the students were asked which strategy did they employ to answer the assignment questions, most of them, if not all, said that they would study all the modules that were specified for that particular assignment, and then they would start tackling their assignment questions. They were also asked what did they do if they were having problems. 15 students said they would ask the tutor, 3 (only from College C) said they would ask their parents, 20 said they would consult other group members, 6 students said that they would ask other students from the college who are majoring in science subjects or friends, 11 said they would go back to the study guide, and 2 said that they would just ignore the problem and proceed.

4.3.6 Language and writing style

61 out of 63 students (97%) of the students who answered the question about the language and the style of writing that is used in 'Into Science' felt that addressing learners on a first person basis was good and user-friendly. Only 2 students opposed this style of writing but failed to give reasons. 17 students (27%) said this style of writing made them feel as if the lecturer was personally and really communicating with them, and 6 said this style of writing mad them feel practically involved in the learning situation. Some typical responses are as follows:

> *"Yes it is as if the book is talking to you. And you answer it by responding what they want you to do."*
> *"It helps to encourage the reader to search for more information."*
> *"The language "you" and "I" or "we" makes you as a reader feel involved in the portion of module."*
> *"It is challenging because it uses the first person you know that it is talking to you, its like a teacher when is talking to you."*

But 3 students mentioned that this style of writing did not have any effect on them, because the were only concentrating on the content the materials had to offer. One student writes:

> *"It doesn't have any effect because we do have other books which are not specifying to whom they are addressing and we actual know it refers to us although it is not innocent/using 'I' or 'we'."*

60 (91%) of the 66 students, said that the English language used in the materials was easy to understand, and 4 students said that if they were having difficulties with some terms they were using the dictionaries. 4 (6%) students said the language was not easy to understand as there were difficult terms, ambiguous terms and long sentences. When the students were asked to state what type of students they thought would be able to cope with the 'Into Science' course, the responses were divided into three categories.

Category 1. One group of students were considering the subjects that a student should have done. 5 of the responses was that students should have done science up to at least high school level, and 5 students said the materials are suitable for non-science students only, with 24 students saying that both non/science students can do the course.

Category 2. The second group was looking at the level of education a students should have at least completed. 5 said these materials are suitable for students who are at the secondary level of education and 4 said they should have completed their secondary school education, with 1 arguing that anyone could cope with the course as long as she/he understands simple English.

Category 3. Finally the third group was looking at the intelligence level of a student. Being a hard worker, dedicated, studious and motivated was stated as important by 22 students. 3 students said that only highly gifted, diligent, and intelligent learners would be able to cope with these materials. In contrast 5 responded that both slow learners and fast readers can cope with the amount of reading that is required. In the five point scale questionnaire, 91% said that group discussions were helpful to understanding. More than half disagreed with the statement that it is not necessary to have time consuming tutorials for every module, and 78% said that tutorials were extremely helpful and all students should attend.

4.3.7 Students' comments on the study guidance

More than half of the students said that the study guidance provided in the materials, was good, useful, appropriate, realistic and sufficient. 16 students (25%) said that the study guidance had made their studying much easier and it gave a broad introduction for each module and told a learner exactly where to start, stop and what to expect from each module. However the 'study guidance' was sometimes confused with the 'study guide booklet' (which is part of the materials and has revision questions and answers for each module). The completion of these is not compulsory and is not checked. 2 students said that the study guidance was not good and needed some improvements, and 1 student felt that the help of a tutor is necessary to summarise each module for the learners. This illustrates the need for students to get an 'expert's' approval of what they have been doing before they can be confident and believe that they can manage with individual studying. Many students during the focus group sessions, said that they did not really stick to the study guidance that was provided because it was not working for them. When they were asked whether this aspect should be removed, the majority, if not all, said that it must not be removed because other students might need to use it and it could be helpful for them. One students commented that the idea of recording how many hours are spent on each module, was good and helpful, and one student said that the study guidance could also be used in other courses. The following are some typical responses.

> *"It is not good it needs to improve to have separation like when module 10, 11 and 12 must be clear visible."*
> *"It helps a lot, it guides us to know what I am going to read."*
> *"It is good it helps you answering some SAQ's."*
> *"Very important to give us the guidelines of using the module and gives the outline of the work you are going to do."*
> *"It is good because it guides you how to study, how to settle your time."*
> *"Yes it is it guides every learner it serves the purpose of the tutor."*
> *"Yes. But on the other hand it's no good because someone can come with his good method of studying."*

4.3.8 Design and the appearance of the materials

All students (69) who answered questions based on the design and appearance of the materials, said that the materials were attractive and easy to handle. 5 of these students said that even though the materials were too wordy, it encouraged learning and served the purpose of the tutor. The idea of having a plastic case was commonly liked, with one of the rationales being that it made carrying the materials easy because it protected them from rain. The wide margins were not seen as a waste of paper. Almost all students valued the large margins in the materials, saying that they were useful for students comments and working out of answers to the SAQ's and In-Text Questions. This was despite even being told not to mark the materials. Diagrams, cartoons, tables, glossary at the end and summary were highly appreciated. The following modifications in relation to contextualization of the materials were suggested.

- To have pictures of 'Blacks' on the outside covers, rather than 'Whites'.

- For each module to have a cover picture which corresponded with the content of that particular module, rather than the same picture on all booklets. For example, for the module which deals with surveying, the cover could have a picture of a building and other related pictures.
- Each student to have his/her own copy of the study material, rather than sharing the copies as it was with these three groups of students.
- For the materials to use examples that are relevant to a South African context, compared to British examples that are featured in the materials. However most students felt that the examples were clear and appropriate to the content that was covered. 13 students (21%) said the examples were not enough and that more should be added, while 49 (79%) said they were enough. 4 students argued that module 3 (which deals with different types of rocks) was irrelevant, easy, boring and unnecessary. The use of rands instead of pounds, kilometres instead of miles, and South African large cities in word problems was widely recommended by students and lecturers. In the five point scale questionnaire, the statement, "The fact the 'Into Science' material does not use South African examples does not hinder my understanding", revealed that 45 students out of 81 (56%) who responded to the statement agreed with the statement, and 27 disagreed (33%). However, 79% and 63% said that they would prefer study materials which show what they are learning relates to the outside world and tells them exactly what is important, respectively. The following are some typical responses.

"Some that are used are not from SA but when you change it and used unit or money from here are very good."
"Other examples are easy and other examples complicated."
"Examples are easy to follow but there are some other difficulties that we students do come across e.g. We are not familiar with dollars we are using Rands."

- Almost all students and lecturers commented that the fact that the materials consists of several separate booklets made studying easier. This was explained by making comparison between the 'Into Science' booklets and normal school textbooks. The rationale here was that studying separate booklets meant that students felt that there was not as much work that needed to be done and one will be eager to study because the target for finishing each module is running over fewer pages. Also when one is through with those particular modules that booklet will not be carried anymore. Unlike 'Into Science', the ordinary textbooks which usually has more than 100 pages, were perceived as de-motivating some students, and it made their learning difficult. Some students even highlighted that they usually thought they would finish each module faster by looking at the page numbers, only to find out that it was taking them more time than they anticipated.

4.3.9 Comments on specific modules

A lot of students said that Modules 8 to 12 were difficult and challenging, modules 1 and 2 were easy and module 3 was boring (see figure 3 below). During the focus group discussions, most of the students did not understand what module 3 (about rocks) had to do with science, this was raised very negatively and students suggested omitting this topic. Figure 3, below indicates the students' rating of all modules. Modules 9, 10, 11 and 12 were rated as difficult.

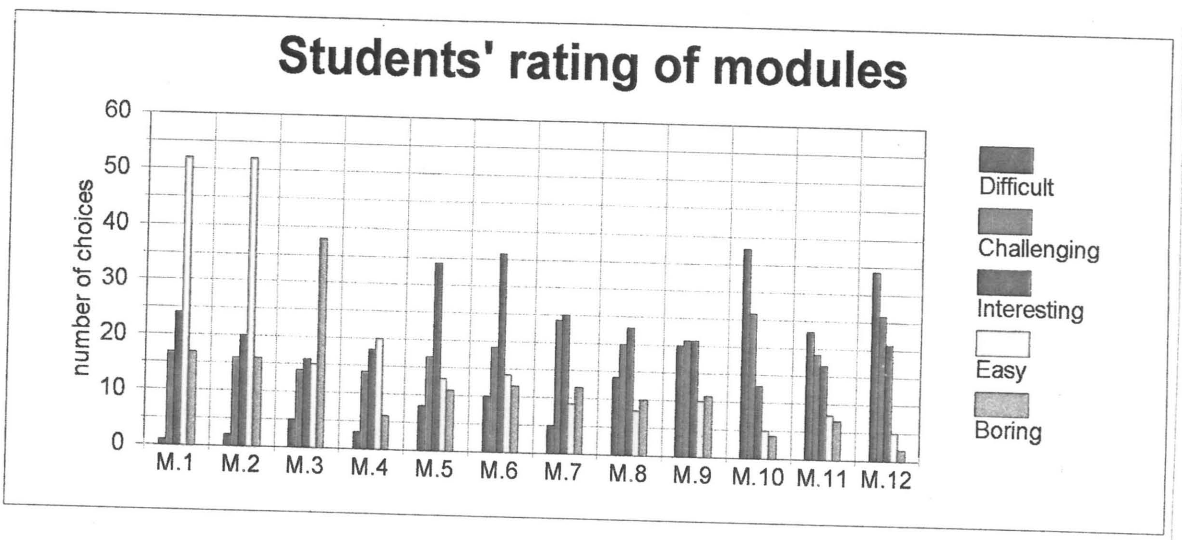

Fig. 3 Students' rating of the modules according to: challenging, interesting, boring, easy and difficult.

4.3.10 Lecturers' reactions to 'Into Science'

Lecturers from College A and B said that they initially expected more than half of their students not to be able to cope with the amount of reading that is required by 'Into Science'. In College C lecturers said that out of 23 students who had registered for their 'Science Support Group' 3 students were never going to make it because they 'just don't have it'. Lecturers at Colleges A, C and a tutor at College B (Dave Bailey), were initially worried about the language used in the materials and/or the relevance of examples in a South African context.

But as the course was running they realised that more students who took 'Into Science' are doing better than they initially expected. When some of the lecturers (3) were asked how they thought the 'Into Science' students were doing, they said that they were doing better than they expected. The following reasons were given. Firstly, because the materials were self-contained i.e. the students did not have to do extra readings; secondly, because the ideas were presented in a new way; and thirdly, that the programme was carefully controlled. The following descriptions were included in the lecturers initial reactions towards the materials.

- Neatly packed.
- Comprehensive.
- Compact.
- Professionally presented.
- Lots of reading required.
- Good presentation.
- Cover a range of science concepts.

In conclusion, this chapter has attempted to summarise what the researcher consider to be the key data for this research. Chapter 5 will now attempt to interpret this data and provide conclusions and recommendations.

Chapter Five

Discussion, conclusion and recommendations

5.1 Discussion

This section will discuss some important aspects of the findings which emerged from the data analysis.

5.1.1 Students' reasons for taking courses

It is evident that most students choose to do certain courses in order to gain certain skills and knowledge so that they would be more employable. Most students said that peer pressure did not contribute to their decision in taking 'Into Science'; if it is the case it was denied. This makes one say that there is a high possibility that students enrol for courses they see as useful, regardless of the costs required to enrol for such courses: if they can afford it, they enrol. Also some students perceive some courses as being more useful than others. Some students do not take courses because they are offered for free or to fill up their free time. This also shows that there are few students who take courses for 'fun' or 'pleasure'. There is a need for the course designers to keep on modifying study materials and address students' needs through their courses so that students will have very good reasons why they choose to enrol for such courses.

5.1.2 Students' initial reaction to courses

It has been noted that some students think that science subjects and those courses which are offered by the Universities are difficult and can only be done by intelligent and hard workers. In the trialling of 'Into Science' it was clearly revealed that if a subject does not fall under the field of science, it is perceived as easy and therefore anyone can cope with it. This is one of the problems with science education because some students firmly believe that science is difficult. The consequence of this perception is that some potential students who are interested in doing science in schools are discouraged from doing so as they themselves and/or others do not see themselves as being competent enough to cope with science. There is therefore a need for students and teachers to be re-orientated towards the teaching and learning of science subjects.

It is the researcher's perception that Physical Science is often incomprehensibly taught, thus it is difficult for students to understand. Also a lot of prerequisite skills and knowledge are required which causes further problems for those who had problems understanding the content, knowledge and skills dealt with before.

5.1.3 Distance learning for South African students.

In South Africa the distance learning mode is still developing. Responses obtained from this pilot project showed that most students do not dislike studying at a distance, at least in a situation with frequent tutorials and being in contact with other students rather than being relatively isolated. Most students argued that this instructional mode is good and encourages independent learning habits. It is also evident that through this instructional mode (material-based learning) students or learners determine their own learning pace. Distance Education encourages self-study habits and boosts learners' self-confidence and motivation. But a distance study mode requires a lot of support for students in a variety of ways in order for learners to be successful. Usually students need 'an expert's approval' on what they are learning, which enables students to continuously check whether they are on the right track. The students indicated clearly their view that if a learner is to be successful in independent learning, self-motivation towards studying is a pre-requisite.

5.1.4 Practicals

In this study students gave little value to conducting practical experiments. Most students who were doing 'Into Science' felt they did not have to conduct the experiments that were incorporated in the materials. These students felt that performing these experiments is a waste of time as they know from experience what the results will be. Some students argued that the experiments were so easy that they would see themselves as being 'insane' if they do them as they could tell what would be the results without practically performing the experiments but relying on their imagination and past experiences.

At College C when the students were asked to lead the tutorial sessions, they were initially supposed to be awarded marks for their presentation (but this never happened), and they were not specifically told to conduct the experiments. Although the tutorials were conducted in a well-equipped laboratory, not a single experiment was conducted. This in a way signifies that students did not consider practicals as having high value. Possible reasons include the following.

- They were more keen to practice their teacher-talk skills.
- Experiments provided in the 'Into Science' were not glamorous and not as attractive as college level experiments.
- They thought that other students will mess up their spotlessly clean laboratory.
- The experiments were too long therefore they would take most of the time.
- Practicals do not matter because other students know what the answers should be. This means that education is for learning the right answers rather than learning the skills of arriving at the right answer.

At the other two colleges some experiments (about 1-3) were conducted in the lecture theatres, where the apparatus was brought in. But still the students showed that they did not conduct experiments on their own and conducting these experiments during tutorial sessions were the tutors' initiatives. This again shows that in most of our schools and colleges there is a common perception that an experiment is worth conducting if it requires fancy and complicated apparatus, chemicals and a white 'lab' coat. If an experiment does not require these, it is not worthy to be performed as one can just predict what will be the answer. This raises a need for our students, teachers and lecturers to put a higher value on practicals so that skills that are required and gained through experimenting, like observation, manipulating, accurate measurement, etc. will be further and properly developed. One of the ways of instilling these values is to continuously assess these skills, and for these assessments to be considered for the final assessment in any science course.

5.1.5 Assessment

Students preferred to be assessed in a variety of ways. It is a common practice in distance education for the students to be assessed through assignments and/or examinations. It is then important that students, especially Science students, be assessed in other ways like conducting practicals, writing a report, oral assessment, compiling a portfolio, etc. The usage of these assessment techniques can be helpful especially for teachers, as they will learn how various types of assessments can be carried out and what are their uses, strengths and weaknesses: they can also use these assessment techniques for their pupils.

5.1.6 Language and writing style

If the materials are to be used for independent study purposes, they have to be written in a conversational style so that the text will perform some of the tutors' or lecturers' roles. This can also be done by the writers after they have identified and/or anticipated most of the learners' problem areas and they will have to address these in the study materials. The majority of students considered themselves as being part of the course presentation if they were addressed on a first-person basis as this could encourage them to actively participate in a learning situation. In this pilot project students argued that the inclusion of the SAQ's and the In-Text questions made them feel as if the lecturer is personally communicating with them as they usually found themselves having to say some answers aloud, as if they are attending a lecture.

5.1.7 Study guidance for students

Most students did not use the study guidance (introductory comments) provided by the study materials, but they decided to embark on their personal study methods which suited them. However, in this study, students appreciated having the study guidance in the materials as they argued that other students could compare this with their own methods. Some students also felt that the provision of the study guidance was essential even if they personally did not follow it, but others would feel comfortable to follow the guidance that is suggested. Therefore, the study guidance was useful for those who might need and want to try it out.

This aspect of providing students with appropriate study guidance seems to be neglected by most of the South African material-based learning materials developers, and it needs some concentrated attention as one of the ways of supporting learners.

5.1.8 Design and appearance of study materials

The size of the print and paper, pictures, margins, colourful and glossy covers, packaging, etc makes a difference in encouraging and motivating students to study. Students who participated in this trialling were happy about the above aspects of the 'Into Science' materials as they said the materials were attractive. The kit also made studying easier because the modular set up would help students think that there is little to read but after some time they would observe that they have spent more time than initially anticipated. Generally materials developers do not want to spend extra expense on some of these aspects, but if one considers the returns that these will bring for students, one can argue that the amount of extra expense required is very small compared to what the students will achieve from using the materials, especially if materials will be produced in bulk.

5.1.9 Perception that 'Earth Sciences does not count'

It has been reflected that Earth sciences are not considered as one of the fields amongst sciences by most students. For some students Biology, Mathematics, Physical Science and Chemistry are the only Science subjects. One possible explanation for this misconception is that Earth science is not in the school and college syllabi, therefore it 'does not count'. This is a very limited 'product centred' rather than process centred view and it can be remedied by re-orientating our community in the fields of science and opening out the gates for everyone to explore and have some experience in this field of study.

5.1.10 Topics students found difficult

Word sums (both for decimals and time), graphical skills, density, substitution and scientific notation were common problem areas which were identified in all three colleges. This is worrying as most of these students (except from College C) will be/are teachers this year (1998), and yet they do not have basic mathematical and science skills that are required in the above-mentioned areas. The question then is, 'What will these teachers teach in schools?' Some people argue that teachers cannot and will not teach what they do not know. It seems likely that these teachers will not teach the above quoted aspects as they themselves do not know them. For this reason, there is a need to retrain (inservice) teachers in order to ensure that the pupils are taught what they need to know.

If it happens that they do teach these aspects, a lot of misunderstanding especially by the students will be encountered and this continue a situation where teachers who do not know, for example, how to plot and interpret a graph will be responsible for pupils who will also not know. When one day some of these pupils are teachers, they will also lack graphical skills, knowledge and again their pupils will be lacking these skills, etc. The cycle will continue.

This does not only affect the quality of science teachers, but also the quality of education and quality of the county's citizens. Therefore, there is a need for course designers to be able to identify common deficiencies so that they will be remedied soon in order to improve the quality of education.

Thus, for this reason 'Into Science' was used for teachers to investigate whether their science understanding will improve and also to identify some common problem areas. However the course was not initially designed for teachers and this purpose. It has been observed that the course has failed to rectify these problem and therefore, students require a lot of practice to be able to address these needs effectively, since just a twelve week course cannot perform this role independently, see Bailey (1998) for a fuller discussion.

5.1.11 Study methods which students actually use

It is also highlighted that usually students do not read every word in their textbooks and/or study guides. Most students from this sample said that they were not reading word by word, but rather they were using advance organisers like headings to skim through the text, then they would skip what they 'know' and read what they do not know and what is appealing to them. This is normally a good idea, however there is also a danger in following this method as one can ignore some of the most useful and important aspects because a student can think that she/he knows what is dealt with and yet he/she does not really know. This technique also limits what students choose to revise. If students reduce the amount they read they also reduce their language proficiency and vocabulary.

It is also worth looking at some of the reasons that contributed to the students having to use this study method. It is clear that the most important one is the fact that students did not have automatic access to the materials, as the course designers expected, since the students had to share the study materials. Hence they then resorted to using survival strategies in order to make best use of the little time they had with the materials (especially shortly before tutorial sessions). Some students argued that the materials were too wordy, and they did not have time to read everything. This implies that course designers will have to seriously consider the use of advance organisers when developing study materials. The advance organisers provides the reader with the information that the students are expecting to come across, therefore these are helpful for the students.

Most importantly students must have their own copies and should be able to use the materials however they want, in order to make best use of the them without any limitations. In this trialling students' study techniques were subordinated in a way as they were sharing the materials, some students were not using the original copies of the materials and students were not allowed to mark the materials.

5.1.12 What do lecturers expect from their students?

One of the common problems in our education institutions is that lecturers and/or teachers have very low expectations for their students especially 'black' students. This then leads them into designing poor quality courses so that the targeted group of students will be able to cope with the content and not 'fail'. This in turn affects the quality of education that is offered for these students, as some important aspects are not included in their curriculum because of the course designers' low expectations. These issues are discussed in greater length by Knox, Bailey and Sokhela (1998).

This may induce an inferiority complex in students as they do not trust themselves and do not believe that they can really do much better. The lecturers indirectly force students to depend on them by not providing their students with challenging tasks. In this trialling, lecturers from Colleges A and B initially expected most of their students not to be able to cope with the amount of work that is involved in 'Into Science', but as the course progressed lecturers observed that most students were coping. However, there were also low post-test scores for some students (Bailey, 1998; Knox, Bailey and Sokhela, 1998). The following were some of the speculations by the lecturers who were interviewed as to why the students were doing better than they initially expected.

- The 'Into Science' course materials are very well designed, they explain things very clearly and use an interactive language style which encourages students to think.
- The students were prepared to work hard since it was their own choice to be involved in the trialling process.

- Some students wanted to test their abilities whether they will be able to cope with University studies when they study further.
- The programme was well co-ordinated with weekly tutorials which were helpful for students.

Whilst acknowledging the above reasons, it is the view of the researcher that students were also doing better because they were given trust and support throughout the trialling period.

5.1.13 Contextualized study materials

The study materials that have been designed for students in one country, might pose some problems if used by students in another country. The 'Into Science' materials proved to have minimal problems in this aspect as the students stated that the use of British examples, different units of measure and currency did not hamper their understanding of the content that is presented. However the usage of the names of the South African cities in word problems and examples, rands instead of pounds and kilometres instead of miles was highly recommended by both students and lecturers/tutors.

5.2 Summary of findings

- Most students consider courses that are offered by the Universities to be difficult.
- Most students considers subjects which are under the field of science to be difficult.
- Most students enrol for courses that will offer useful skills and knowledge and thus make them more employable.
- Most students need a lot of support in a variety of ways in order for them to be successful in independent study. Weekly tutorials were helpful for those who had problems as they were studying alone, however they cannot perform a supportive task alone: some other support systems are required, like face-to-face contacts, telephone help-lines, etc.
- Most students do not consider Earth science as important and as one of the fields in science.
- Plotting and interpretation of graphs, word problems and density are some of the areas which most students have a problem with.

- Most students do not read every word in the text but they commonly use a Gist Identification Strategy, to identify what they think is important and discard the rest.
- Students, studying both at a distance and face-to-face, need to be provided with some study guidance.
- The design and appearance of the study materials can motivate or de-motivate the learners towards studying.
- The study materials that are designed for self-studying should be written in a conversational style so that the written text will play some of the roles that can be played by a tutor or a lecturer.
- Students should be assessed in a variety of ways.
- Students place a low value on conducting practical work, and instead tend to rely on their past experiences.
- Many lecturers have low expectations for their students, and so design or offer poor quality courses.
- Most students prefer to use contextualised study materials, even though their understanding is not seriously affected by imported examples.

5.3 Recommendations for future actions

Rowntree (1997, p.55) argues that time, money and energy surely will be wasted in materials-based learning if course developers design their own materials when there is no need to do so. Materials writers need to be careful not to dismiss usable materials simply because it is not exactly how they would have written it: they can modify the materials by providing alternative or supplementary materials where they find deficiencies to suit their learners' interests, needs and are careful about the copyright. However, one must not feel obliged to use the already available materials if they do not fulfil the set goals.

The following are broad long-term issues which were observed in this study and require further research:

- How can distance education course designers and providers offer support to students so that they benefit from studying?

- How can distance education providers incorporate the practicals or skills-training component into a science course?
- What needs to be done in order to change lecturers' low expectation of their students?
- What could be done in order to reorientate students into the Earth Sciences as one of the fields in the sciences?
- What needs to be done in order to make learners cover all the topics in the study guides or textbooks?

  What should be done in order to take away a desire from our students to depend on their lecturers, and instead promote self-studying?

It is the view of this researcher that we can develop our own contextualised science materials and ideas from 'Into Science' can be used. Some of the advantages of doing this are that we will be doing capacity building for our own materials writers and our students will also identify themselves with the materials. On the other hand it does not make sense for study material writers to keep on writing new study materials when good ones exist, as this can take a lot of time. Change in the provision of distance and science education is urgently required and writing new materials takes both time and money. Hence, it is evident that the Open University's 'Into Science' programme and materials can be used for South African students, but with the following recommended modifications.

- The course providers need to set up learner support systems in a variety of ways, for example, face-to-face sessions, entry counselling, help lines through e-mail, fax facilities, mailing, telephone, self-study groups, libraries, etc.
- It is advisable for students to have access to a laboratory which is equipped with all the chemicals and equipments that are needed for the experiments that are included in the materials. In this laboratory an assistant or tutor should be always available when the students are working, for control reasons and to offer help to students if they encounter problems. This laboratory could be opened before, during and/or after tutorial sessions. The usage of this laboratory will depend much on the students' self-motivation to do the course, as it is one of the necessities for a student to succeed in a distance education mode.

- The 'Into Science' course material is not enough alone to rectify poor performance in identified problem areas, therefore, the students will need more practice. Exercises can be added in the workbook, or another booklet with additional exercises can be compiled and practical exercises can also be added to be done in groups during face-to-face contact sessions, or presented in a booklet to be part of the materials.
- Students must have open access to the study materials, i.e no sharing of the materials. Each student must have her/his own copy of the study material as anticipated by the course designers.
- The materials should be contextualized i.e. use examples that are relevant to a South African context, such as rands instead of pounds, kilometres instead of miles, etc.
- Cover pictures to be relevant to the content of each module, rather than a same picture for all modules. For example, if a module deals with surveying, a picture of a building might be appropriate.
- The people who appears on the cover pages should not only be 'Whites': a range of ethnic groups should be featured.
- There should be a range of assessment techniques that are used, e.g. project writing, submission of profiles, reports on practical work, etc.

It seems likely that only a minority of present teachers will be able to succeed using university level courses, particularly at a standard university pace. This then brings the issue of 'Who is the planned FDE (science education) for?' If it is aimed at a minority then the pace can be retained but if the aim is to open up opportunities for teachers who are not of 'university calibre', then the pace will have to be slower, e.g. one module in two weeks, or the course revised . Knox, Bailey and Sokhela (1998) avoid this issue by supporting several exit points. In so doing, they may be failing to address the problem of upgrading the performance of a large number of teachers. There is no time within this dissertation to address this issue, however it is very important and needs more attention.

5.4 Some concluding remarks

It is the conclusion of this researcher that 'Into Science' can be used in South Africa. This research has proved that the students who participated in this study did not have a problem with

English used in the materials, they did not have a problem with the Independent learning mode as they were given support in the form of weekly tutorials, and they can cope with the amount of reading that is expected, provided they are given enough independent study period (and time from other commitments). These results have also shown that distance study materials writers need to pay attention to the following aspects.

- Provision of necessary student and tutor support.
- Looking at the possible reasons that can contribute to the students enrolling for their courses and meet the students' needs and interests.
- The need to know how students work with independent study materials, so that the materials will provide necessary textual support.
- Designing study materials which are as attractive as possible in order to encourage readers.
- Using simple language.
- Using an interactive style of writing.
- Providing students with opportunities to be assessed in a variety of ways.
- Structuring practical work in a way that will make students see the need to do the practical activities and to master the practical skill (including data interpretation) rather than simply look for a 'right answer' to be learned.
- Finally, bearing in mind the context in which the materials will be used.

Some materials, e.g. some UNISA courses, appear to disregard several of these aspects.

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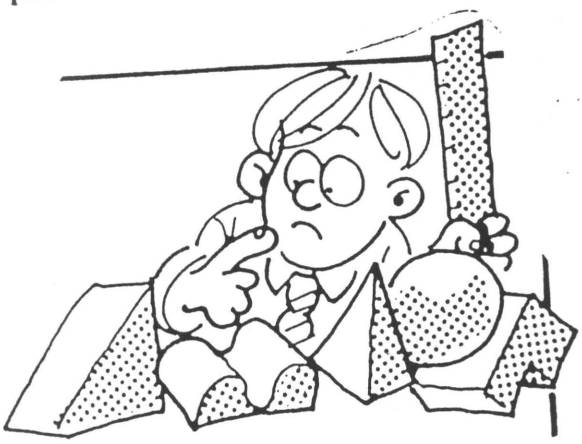


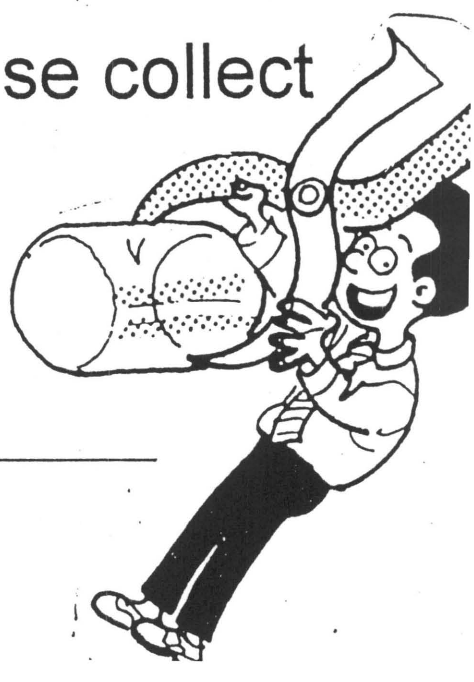
Are you interested in improving your scientific skills ?

Why not consider :

INTO SCIENCE

A self-study programme designed to increase your confidence with regards to the teaching of basic science principles.

For further information please collect a pamphlet from :



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Appendix B

'INTO SCIENCE' REGISTRATION

Please read the following very carefully before you sign it.

I wish to take the 'Into Science' course and, if selected, undertake the following:-

1. Pay the returnable deposit of R50 upon receipt of the 'Into Science' material.
2. Work carefully through each module, answering any exercises in the text, before attending the tutorial session.
3. Complete all the necessary assignments , as well as any other tests set, by their respective closing dates.
4. Answer any questions from tutors or members of the University team who are evaluating the course for the benefit of future students.
5. Return all materials in a good, unmarked condition, for use by future students.

Full name ______________________________

Year of study
and course ______________________________

Date ____________________

Signature ____________________

N.B. REMEMBER TO HAND THIS FORM BACK TO YOUR COLLEGE CONTACT PERSON AS SOON AS POSSIBLE

APPENDIX C

Department of Education

UNIVERSITY OF NATAL
PIETERMARITZBURG

STELLA AURORAE

Course Certificate

INTO SCIENCE

Phumzile Mzimela
. . . .

successfully completed the
12 week "INTO SCIENCE" course

Ken Harley

Head of Department **1 October 1997**

Appendix D

INTO SCIENCE

BACKGROUND

The Education Department, University of Natal, Pietermaritzburg, is hoping to offer a new Further Diploma in Education programme from January 1998 to help science teachers to improve upon their understanding of science and how to teach it.

Part of the diploma is a preparatory course called 'Into Science', which introduces students to some basic ideas and principles involved in scientific study, the basic mathematical skills required for that study and the study and reading skills required for independent distance learning.

THIS IS WHERE YOU COME IN

Before offering the diploma, it is necessary to trial part of the material to help answer important questions regarding its usage. This trial is the 'Into Science' course and your taking of the course will help us to answer these questions since as you proceed through the course your progress will be carefully monitored by the University.

WHAT DO YOU GET FROM THIS COURSE ?

Should you pass the course, you will receive :-

* more confidence with regards to your future teaching of General Science / Biology / Physical Science.
* an idea as to what good distance materials are like and the type of working strategy you will need to employ for successful distance education.
* a certificate from the University, which will be a useful asset when you eventually apply for a post.
* credits towards your F.D.E. in Science Education should you ever decide to pursue it.

LENGTH OF THE COURSE

The course stretches over a period of 10 weeks and consists of 12 modules. The 'standard student' is expected to put in 12 study hours per week, although this will differ from individual to individual. Tutorials will be held weekly in order to assist students in possible problem areas. You are assessed by means of 4 short assignments done during the course.

MATERIALS REQUIRED

Copies of the 'Into Science' material will be provided by the University, although you will need to provide a basic scientific calculator, a hard covered exercise book, a protractor and a compass. For those of you who decide to attempt this course, a more detailed list of the materials required from week to week (most of which will be provided by the college) will be given to you at a later date.

Before you receive the 'Into Science' materials you will need to pay a R50 deposit per person. This money will be fully refunded to you at the end of the course when you hand the materials back in a good condition.

WHAT NOW ?

If you are interested in this course please collect a registration form from your contact person at the College. Read through the form very carefully, complete it and then hand it back to your contact person as soon as possible. You will then be informed in due course as to what the future arrangements will be.

Appendix E

Initially planned commencement dates and finishing dates for each college

	College A	College B	College C
Visit 1	13 February 1997	29 January 1997	
Visit 2	25 February 1997	25 February 1997	20 February 1997
Module 1 (Tutorial)	11 March 1997	3 March 1997	27 February 1997
Module 2 (Tutorial)	18 March 1997	10 March 1997	6 March 1997
Module 3 (Tutorial)	25 March 1997	17 March 1997	13 March 1997
Module 4 (Tutorial)	1 April 1997	24 March 1997	20 March 1997
Module 5 (Tutorial)	8 April 1997	31 March 1997	27 March 1997
Module 6 (Tutorial)	15 April 1997	7 April 1997	3 April 1997
Module 7 (Tutorial)	22 April 1997	14 April 1997	10 April 1997
Module 8 (Tutorial)	29 April 1997	21 April 1997	17 April 1997
Module 9 (Tutorial)	6 May 1997	28 April 1997	24 April 1997
Module 10 (Tutorial)	13 May 1997	5 May 1997	1 May 1997
Module 11 (Tutorial)	20 May 1997	12 May 1997	8 May 1997
Module 12 (Tutorial)	27 May 1997	19 May 1997	15 May 1997

Appendix F

To : All Students

'Into Science' Material Evaluation Students Instructions.

1. We are asking you to fill this questionnaire which will give us some information about the 'Into Science' material.

2. The purpose of this exercise is to check whether the material is suitable to be used here in South Africa as it is, or we need to make some modifications so that it will be relevant to our context.

3. The completion of this exercise will help you to learn something about evaluating instructional material. You will learn this by doing some evaluation yourself, following structured instructions and guidelines.

4. We would like to have your true perceptions and reasons why you think or feel the way that you do. However we would like you to take this exercise seriously.

5. Please note that there are no right or wrong responses: Different people will have different views.

6. There is no hurry in filling the questionnaire. You can fill it as you go along reading the material.

7. If you feel that the given spaces are not enough, please insert a page and indicate the question which you are referring to by writing its number.
   e.g Q1 (continued)---------------------

8. Write your name and your College on top of your questionnaire before you submit it.

9. Please hand over your completed questionnaire on or before the last tutorial session, to any of the project team members (Dave, Kitty, David)

10. Please note that the completion of this exercise is strictly confidential i.e the College staff members will not have access to the information you will be giving, it will be seen by the research team members only.

11. We will appreciate if you can complete this exercise before the end of the 'Into Science' course.

12. Please do not hesitate to ask any of us if anything is unclear, or you think we are missing something important.

THANK YOU.

General Material Evaluation by the students

Name:——————————————

College:——————————————

Initial reaction.

1. What did you expect this course to be like?

   Before you heard the explanationby the project team:

   After you heard the explanation by the project team:

   ----

2. Some people say that the way they learn in this course is different from ways they learnt before. Have you found any ways of learning the course content, that were new to you? Explain.

   ----

3. Is this type of learning good or bad? Why?

Study Guidance.

4.(a) What do you think about the study guidance that is given in the material?

Is it appropriate?

Is the guidance sufficient?

Is it useful?

Is the study guidance realistic or does it expect too much from you? Elaborate.

4.(b) What kinds of students is this material suitable for?

Design and appearance of the material.

5. Is the material attractive and easy to handle or could it be improved?

Some suggestions:

---

6. Each booklet contains two modules. Do you think this is a good idea? Explain.

---

7. Comment on the covers of the booklets (colour, paper texture, picture, binding, etc.)

---

8. How do you feel about the size of print used?

----

9. Are the sub-sections marked out clearly with headings?

----

10. 'Into Science' has wide margins on the sides of each page, the words are not packed, which can be a waste of paper and costly. How do you feel about this? Explain.

Language used.

11. Is the writing style user-frienly ("you" and "I" or "We"?) i.e First person.

How do you feel about this style of writing?

12. Is the material easy to read and understand? Please consider words, sentence complexity, Idioms, etc.

Introductions, Summaries and Objectives.

13. Each module has objectives or goals stated at its beginning (Study Guide Section). What do you think about this?

~~Are they stated clearly and simple?~~

14. What are your views on the introductions and summaries?

Are they appropriate?

Are they explicit enough?

Examples.

15. How do you feel about the examples used in the text?

Are they relevant or appropriate to our situation?

Are they enough to give you practice before the next section?

16. Is there any information and examples that are unnecessary? Quote from the text.

17. Are local examples and experiences used?

What local examples would you use if you were rewriting the texts specially for use in South Africa?

Prerequisite Skills.

18. Are skills and information gained in the earlier Modules required for the later Modules? Give examples.

---

19. Did you find yourself lacking some information or skills at some point? Explain.

---

20. Comment on the sequencing or order of the Modules.

Tutorials.

21. What did you expect from the Tutorials before they started?

---

22. What did you find most useful aspects about the tutorials?

---

23. What were the least useful aspects about the tutorials?

----

24. What points were clarified during the tutorials and what were not clarified?

----

25. What are the advantages and disadvantages of group discussions during tutorial sessions?

----

26. What experiences did you gain when your group was preparing to lead tutorial session?

How did you feel about these experiences?

27. How did you feel about other groups' presentations?

28. (If applicable) What did you learn, as a result of your group leading a tutorial, that you would not have learnt otherwise?

Practicals.

29. Comment on the activities and practicals suggested in the materials.

Did you do all of them? Explain.

Are they easy to follow and stated on a step-by-step basis?

How do you compare these practicals with those done at your College and in schools?

Assessment.

30. Did you answer all the Self-Assessment Questions (SAQ's)? Why?

What did you do when you came across difficult questions?

The questions in the Workbook are provided to give you more practice. Did you use any of them? Explain.

----

31. Did you have a group discussion and group answers for the assignments?

When you were answering the assignment questions did you consult other people e.g. already qualified teachers, Maths and Science students, etc ? What kinds of people (if any) did you talk to?

----

32. How do you feel about having four assignments for assessment purposes in the 'Into Science' couse?

Comment on the style of the assignments.

How did you answer your assignments (module per module or after all relevant modules / writing after each module or wait until you had finished)?

----

33. Did the assignments influence the way you learnt the material?

How?

Knowledge and Skills gained.

34. Are the explanations, in the materials sufficiently clear and simple?

----

35. Is the material split into manageable chunks?

----

36. Have you been introduced to new scientific and mathematical ideas: e.g. 'facts', terms and concepts? List the main ones that struck you. Use a seperate sheet if you need more space.

Scientific ideas	Mathematical ideas
----------------------	--------------------
----------------------	--------------------
----------------------	--------------------
----------------------	--------------------

37. Comment on the diagrams and tables drawn.

Are they given where needed?

Are they clearly stated or not? Give two to three examples.

----

38. Do you think this 'Into Science' study package should be accompanied by other learning activities apart from SAQ's, tutorials, practicals and assignments? Why? Give examples of activities that could be used and for which sections.

----

39. What thinking skills have you gained?

----

40. What learning skills have you gained?

Comparison with classroom and College.

41. What features does this 'Into Science' course have which normal College courses are not able to provide?

----

42. What features does this 'Into Science' course does <u>not</u> have which normal College courses are able to provide?

---

43. What teaching ideas are available in this 'Into Science' material that could be transferred to mainstream classroom situation?

---

44. What useful teaching ideas / approaches could be used in a mainstream classroom situation which are not available in the 'Into Science' material?

---

45. Comment on the advantages of using this type of material compared to books like school textbooks.

---

46. Comment on the disavantages of using this type of material, also compare it with books like school textbooks.

Learners.

47. What type of learners are these 'Into Science' materials best suitable for (age, geographic area, gender, anything else you think is important)?

----

48. How intelligent do they have to be?

----

49. What reasons for learning do you think they should have?

----

50. Why do you they would choose this type of learning and this 'Into Science' Course?

----

51. What past experiences do you think they should have?

----

52. What might be their main learning problems? Why?

53. Where would they do most of their learning and why?

54. How do the students who are doing 'Into Science' at your College compare with these 'Ideal learners'?

55. How do students who are not doing 'Into Science' at your College compare with these 'Ideal learners'?

"About Yourself".

56. What do you read per week other than 'Into Science' material? How many pages / books per week?

57. Where do you study, and What are the conditions like e.g home, quiet area, electricity, etc?

58. Why are you a student at your College (Appelsbosch, Edgewood or Madadeni)?

59. What do you hope to do afterwards?

60. Why did you choose 'Into Science' or 'Science Support programe' (for Edgewood students)?

THANK YOU.

Appendix G 'INTO SCIENCE' FEEDBACK QUESTIONNAIRE ON MATERIAL AND COURSE MODIFICATION.

This questionnaire has been designed to investigate the approaches to learning and studying adopted by 'Into Science' students. Please respond to the statement by circling the relevant answer or number. All students must be aware that all the responses are confidential and will not be made known to your, However we ask for your name as we need to link the responses with your overall performance.

Please fill in the details, or circle the appropriate number:

Name and Surname: --

Gender: Male 1

Female 2

Age:--------- years

Which year are you in at your College? 1 2 3 4

Programme (e.g. JP, SP, etc): --------------------------------

Major subjects at the College? --------------------------------

----

SECTION A REASONS FOR ENTERING THIS COURSE

You decided early in the year to take 'Into Science' course. We would like to know why you have decided to take the course? Circle the appropriate code number to indicate how strongly each of these reasons applied.

5=Strongly Agree 4=Agree 3=No Particular View 2=Disagree 1=Strongly Disagree

1. I wanted to be able to retrain as a teacher of Science subjects.	5	4	3	2	1
2. Because it was an extra course and free of charge.	5	4	3	2	1
3. Because all of my friends were doing it and they influenced me.	5	4	3	2	1
4. It sounded interesting.	5	4	3	2	1
5. I thought the course would give me useful skills.	5	4	3	2	1
6. It will enable me to study Science in depth after leaving College.	5	4	3	2	1
7. I wanted a certificate with the University name on it.	5	4	3	2	1
8. To fill in the time while the classes were suspended.	5	4	3	2	1

9. Any other reasons(Please be specific)--

SECTION B

APPROACHES TO STUDY AND EXPERIENCE TO 'INTO SCIENCE'

We want to know whether you find this course has influenced the way you study. For each of the statements below please indicate how true it was/is for you:

(a) Before starting 'Into Science'.
(b) Now while doing 'Into Science'.
(c) Now while doing other courses.

Circle the appropriate response.

5=Strongly Agree 4=Agree 3=Not Sure 2=Disagree 1=Strongly Disagree

	Before doing "Into Science"					Now when doing "Into Science"					Now when doing other college courses				
1. I used to organise my study time to make best use of it.	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1
2. In most cases I have to do the work without having a chance really to understand it.	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1
3. When I am tackling a new topic. I try to see how it fits with what I know already.	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1
4. I can understand and remember ideas from the material, but find it difficult to fit it to the overall picture.	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1
5. I am aware of the methods I am using to try to understand.	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1
6. In vacations, I make sure that I keep several days for studying.	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1
7. I always set aside particular times of the day and weekends to work on particular subjects.	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1
8. I usually work on whatever assignment is due next .	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1
9. When dealing with a new topic, I need to work out the ideas for myself	5	4	3	2	1	5	4	3	2	1	5	4	3	2	1

10.	This course has helped me to develop good reading and studying habits.	5	4	3	2	1
11.	Up to now, I seem to have a good grasp of the 'Into Science' subject matter.	5	4	3	2	1
12.	I to memorise much of what is dealt with in 'Into Science', because I could not understand.	5	4	3	2	1
13.	I don't have much of a problem in picking up important points in the 'Into Science' material.	5	4	3	2	1
14.	Much of what I am studying in 'Into Science' seems to consist of unrelated bits and pieces.	5	4	3	2	1
15.	I feel sure that I will not be able to do the work as well as other people in the 'Into Science' course.	5	4	3	2	1
16.	It is not possible to do all the work in 'Into Science' in the time available.	5	4	3	2	1
17.	Sometimes I worry about having to be able to cope with this 'Into Science' course.	5	4	3	2	1
18.	I have now realised that it is possible to do much more work than I used to doing before.	5	4	3	2	1
19.	Group discussion in the tutorials are helpful to understanding.	5	4	3	2	1
20.	The fact that 'Into Science' material does not use South African examples does not hinder my understanding.	5	4	3	2	1
21.	Weekly tutorials are extremely helpful top understand and I think all students should attend.	5	4	3	2	1
22.	I t is not necessary to have a time consuming tutorial for every module.	5	4	3	2	1
23.	The 'Into Science' material will work best in conjunction with lectures i.e College situation as opposed to self study situation.	5	4	3	2	1

SECTION C

DIFFERENT TYPE OF TEACHING AND COURSES

Here we would like to know your preferences for different writing style of learning material, exam and assignment types, and course types. Please circle the relevant number as before.

5= Strongly agree 4=Agree 3=Not sure 2=Disagree 1=Strongly disagree.

I generally prefer study material which:

1.	Show me how what I am learning relates to the outside world.	5	4	3	2	1
2.	Tells me exactly what to put down in my notes and structured.	5	4	3	2	1

I generally prefer exams and assignments which :

1.	Give me the opportunity to show that I have thought about the course for myself.	5	4	3	2	1
2.	Can be answered directly from the material itself.	5	4	3	2	1
3.	Make it clear how much effort I am expected to put in each part of the question by mark allocation.	5	4	3	2	1
4.	Have general questions which allow me to show my own ideas on the subject.	5	4	3	2	1
5.	Have very specific questions to make me realise whether I have understood or not.	5	4	3	2	1

How important do you think the following types of assessments are in a Science course?

5=Very important
4=Just important
3= No particular View
2= Low Value
1= Almost irrelevant

1.	Written examinations at the end of the course. Why?-- ---	5	4	3	2	1
2.	Individual assignments during the course. Why?-- ---	5	4	3	2	1
3.	Tests during the course. Why?-- ---	5	4	3	2	1
4.	Participating in group-work. Why?-- ---	5	4	3	2	1
5.	Compiling a file of my own work. Why?-- ---	5	4	3	2	1

6.	Performance in oral work. Why?-- --	5	4	3	2	1
7.	Performance in practicals. Why?-- --	5	4	3	2	1

SECTION D GENERAL

1. Most of the course textbooks have one book per course. 'Into Science' uses several smaller booklets. Which of them do you prefer and why?

   ----

2. Each module should take how many weeks to study?

   ----

3. When do you think each module booklets be handed out to students(all at the beginning of the course, or at the beginning of each module) if the booklets are separate?

   ----

4. The 'Into Science' course writers say that you can do the course without having studied any Science at school. How true do you think this is? Explain.

   ----

5. Which Modules were:

a.	Challenging	1	2	3	4	5	6	7	8	9	10	11	12
b.	Interesting	1	2	3	4	5	6	7	8	9	10	11	12
c.	Boring	1	2	3	4	5	6	7	8	9	10	11	12
d.	Easy	1	2	3	4	5	6	7	8	9	10	11	12
e.	Difficult	1	2	3	4	5	6	7	8	9	10	11	12

6. If you had to explain to your fellow student who what to know about this 'Into Science', what would you say the 'Into Science' is all about?

Is there anything you want to say about the 'Into Science' program and materials?

THANK YOU, FOR YOUR PARTICIPATION!

Appendix H

Study Time Form

Module	Study Session	Duration(hr/min)	Page Numbers	
			Started at	Ended at
One	1			
	2			
	3			
	4			
	5			
		Total:		
Two	1			
	2			
	3			
	4			
	5			
		Total:		
Three	1			
	2			
	3			
	4			
	5			
		Total:		
Four	1			
	2			
	3			
	4			
	5			
		Total:		
Five	1			
	2			
	3			
	4			

	5			
		Total:		
Six	1			
	2			
	3			
	4			
	5			
		Total:		
Seven	1			
	2			
	3			
	4			
	5			
		Total:		
Eight	1			
	2			
	3			
	4			
	5			
		Total:		
Nine	1			
	2			
	3			
	4			
	5			
		Total:		
Ten	1			
	2			
	3			
	4			
	5			
		Total:		
Eleven	1			

	2			
	3			
	4			
	5			
		Total:		
Twelve	1			
	2			
	3			
	4			
	5			
		Total:		

What arrangements of getting the material have you made with your partner(s)?

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What difficulties and strengths you have made in managing your study time? Why?

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General comments:

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Appendix I 'Into Science' Focus Group Session Questions

1. What did you expect this course to be like:
    - Before the research teams' explanation?
    - After the research teams' explanation?
2. How would you explain to your fellow student what 'Into Science' is all about?
3. Why did you do this course?
4. Where(venue) did you usually study for the 'Into Science' course?
5. How did you study for this course?
    - Is the approach you were using before different from the way you have been studying in the 'Into Science'? How?
    - Is this good or bad? Why?
6. What study arrangements did you make with your partner(s) , with regards to the sharing of study materials?
7. What constitute a good learning environment for you?
8. Comment on the study guidance provided in the materials. Is it appropriate, useful or sufficient? In what way?
9. How do you feel about one booklet containing two modules as opposed to one thick booklet as normal school textbooks?
10. Comment on the following :
    - Conversational style of writing e.g. 'We' , 'You', etc.
    - Booklets colours.
    - Cover pictures.
    - Paper texture.
    - Print size.
    - Large margins.
    - Are subsections clearly marked.
    - Diagrams and tables used.
    - SAQ's and In-Text questions.
    - Questions and answers on each module in the Workbook?
    - Complexity of the English used.
    - Efficiency of introductions and summaries.
    - Weekly tutorials.

11. Comment on the examples used in the materials, i.e.

    - Local examples compared to British examples?

12. What did you expect the tutorials to be like before they started?

13 Were the tutorials useful? How?

14. Comment on the activities and practicals suggested in the materials.

    - Did you do all of them? why?

15. How do you feel about the use of the 2 Multiple-choice assignments and 2 short answer assignments as a final assessment technique?

16. How do you feel about being given assignment questions together with the rest of the materials long before they are due?

17. Do you think this 'Into Science' study package should be accompanied by other learning activities besides SAQ's, 4 assignments, tutorials, etc?

18. What new knowledge and skills you have gained from using the 'Into Science' materials?

19. What features does the 'Into Science' material have and the normal classroom and or College does not have?

20. What features does the normal classroom or College situation have that are found in these materials?

21. What are the advantages and disadvantages that these type of learning materials have?

22. What type of learners are these material best suitable for?

    - How intelligent do they have to be?
    - What might be their reasons for doing this course?

23. Which modules did you find:

    - Challenging?
    - Easy?
    - Boring?
    - Difficult?
    - Interesting?

Do you have anything you want to say about the course?

THANK YOU VERY MUCH FOR YOUR PARTICIPATION.

Appendix J

To : All Tutors

'Into Science' Material Evaluation Tutors Instructions.

1. We are asking you to fill this questionnaire which will give us some information about the 'Into Science' material. One of the reasons of trialing this material is that they were designed for distance mass Education, so it will be interesting to find out what modifications if any will be necessary to provide this type of Education to a mass scale here in South Africa.

2. We would like to have your true perceptions and reasons why you think or feel the way that you do. However, we would like you to take this exercise seriously.

3. Please note that there are no right or wrong responses: Different people will have different views.

4. There is no hurry in filling the questionnaire, however we will appreciate if you can complete this exercise before the end of the 'Into Science' course.

5. Please do not hesitate to ask any of us if anything is unclear, or you think we are missing something importantly.

6. If you feel that the given spaces are not enough, please insert a page and indicate the question which you are referring to by writing its number. E.g. Q 1 (continued)----------------------

7. Please write your name and your College on top of your questionnaire before you submit it.

8. Please hand over your completed questionnaire on or before the last tutorial session, to any of the project team members (Dave, Kitty, David)

9. Please note that the completion of this exercise is strictly confidential the information you will be giving, it will be seen by the research team members only.

THANK YOU.
From: Project Team Members.

Tutor's Questionnaire

1. What did you think of the 'Into Science' materials when you first saw them?

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2. How did you find students actually got on?

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3. If students did worse or better than you expected, why do you think this was so?

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4. What three main ideas or skills that you think students were introduced to by the materials? Please indicate how many students do you think were able to grasp these successfully by ticking into the appropriate box.

MODULE	Almost all	Most	About half	Some	Very few	None
One 1 ____________ 2 ____________ 3 ____________						

Two 1 __________ 2__________ 3__________						
Three 1 __________ 2__________ 3__________						
Four 1 __________ 2__________ 3__________						
Five 1 __________ 2__________ 3__________						
Six 1 __________ 2__________ 3__________						

Seven 1 ______ 2______ 3______						
Eight 1 ______ 2______ 3______						
Nine 1 ______ 2______ 3______						
Ten 1 ______ 2______ 3______						
Eleven 1 ______ 2______ 3______						

Twelve 1 ____________________ 2____________________ 3____________________						

5. Did the following affect students approaches to learning? How?

(a) Understanding rather than memorising.

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(b) Using skills.

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(c) Reviewing own learning progress.

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(d) Awareness of own learning styles?

(e) Any others you have noticed?

6. 'Into Science' relies on the written materials. Please comment on the following aspects.

(a) Conversational style of writing using 'we' and 'you'.

(b) Sentence length and complexity.

(c) Vocabulary.

(d) Glossary at the end of each Module.

(e) Idioms.

(f) Pictures and diagrams.

(g) General appearance of booklets.

(h) Use of topics and sub-topics.

(l) Use of introductions and summaries.

7. Many people have commented that the 'Into Science' booklets took very long to finish in the time available. The following aspects of the style contribute to this greater length.

(a) Conversational style of writing mentioned above.

(b) Text leads reader step by through a reasoning sequence instead of presenting a condensed summary of ' facts to be learned'.

If a local version of 'Into Science' is to be produced, what features do you think it should have?

Any other comments on appearance and style?

9. Do the examples and analogies seem relevant to the students' interests and are they sufficiently illuminating?

10. What difficulties would you expect with the following activities and practicals? How many students do you think did each one? Fill in the spaces and tick the appropriate box.

ACTIVITIES	Almost All	Most	About Half	Some	Very Few	None1
1. Measuring the dimensions of leaves. (Module 2)						
2. Measuring the size or area of a room. (Module 3)						
3. Measuring the size of water droplets (Module 4)						
4. A plastic comb or ruler and small pieces of tissue paper i.e characteristics of Atoms. (Module 5/6)						
5. Dried yeast with cold, luke warm and hot water. (Module 7)						

6. Heating a saucepan of water and measuring its temperature using a Thermometer. (Module 8)						
7. Measuring angles using a protractor and drawing circles using a pair of compasses. (Module 9)						
8. Describing the characteristics of sedimentary rocks in the United Kingdom 100-150 words (Module 11)						
9. Plotting a graph to show increase of CO_2 From 1950-1990 AD using data from a given table. (Module 12)						

11. What problems did you find students actually had when they did it? (If you know).

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12. Any other comments you would like to make about the activities and practicals in 'Into Science'?

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13. What functions if any do you think the weekly tutorial served? Explain.

14. Do you think any of the Modules need to be strengthened further? If so please state for each Module, how you think it should be strengthened, and why?

15. Should any of the present content be omitted? Please specify what and why do you say so?

16. Would you change the order of any of the topics? Which ones? Explain.

17. In the 'Into Science' programme the students are given all the assignment questions at the outset. What effects, if any, do you think this has?

18. The programme contains two multiple choice and two short answer assignments. Do you think these will give an accurate reflection of students progress? Comment as necessary.

19. The material includes (a) SAQ's and the In-Text questions (b) a supplementary workbook with extra practice questions. Do you think students actually do either of these since they are not compulsory? Do you think they find them helpful?

20. One function of assignment questions is to guide students learning. What kinds of learning do you think the assignments provide?

Any other comments?

21. Some people think that the teaching and learning approaches used in 'Into Science' are useful models that could also be used in classrooms. What particular aspects of the 'Into Science' approach do you think could be used in College classrooms?

22. These books were written for use of students outside the classroom. What do you see as useful teaching ideas that are available in a classroom situation but not found in the 'Into Science' materials?

23. 'Into Science' materials is written to introduce students to science thinking skills needed for entry to University studies in science. Do you think any of the skills in the course are not important for future teachers? Explain.

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24. Some people have suggested for the 'Into Science' course to be done by students entering University / Technikon courses. What modifications in the materials do you think will be required and be helpful if they are to be used in 'Higher Education'?

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Appendix K

'Into Science' Tutors' Interview Questionnaire

1. Before the 'Into Science' started what type of students did you think will successfully complete the course?
   How many?
   Why?
2. Now the course has been running for 12 weeks, how many do you think will successfully complete the course?
   Why?
3. Some people say that we need to have such courses to be implemented at a large scale. What advice will you give?
4. One of the reasons why we have a shortage of science teachers now in our schools is because some students (particularly Blacks) drop it at some stage. Some people are suggesting this course could enable such students to start them successfully on Science studies. What do you think about this?
5. Sometimes College Lectures are not sure How too design an in-depth Science course; one example can be they use pre-designed self-study course Materials like the 'Into Science'. This would remove the burden of trying to guess what are the acceptable standards and leave a lecturer free to concentrate on adaptations to the Local environment and discussing in a classroom. What do you think of this idea?
6. What can you say about the examples and analogies used in the Material?
7. Do you think the Students did all the experiments in the Material? Why?
   Do you think they manage to do the experiment (those who have done it) Why?
8. What functions do you think the weekly tutorial served? Explain.
9. In the 'Into Science' programme, students are given all the assignment questions at the outset. What effects , if any, do you think this has?
10. The programme contains two multiple choice and two short answer assignments. Do you think these will give an accurate reflection of students progress?
11. How do you think the students at your college will prefer to be assessed ? Why?

12. The Material includes (a) S.A.Q's and the In-Text Questions, (b) A supplementary workbook with extra practice questions. Do you think students actually do either of these since they are not compulsory? Do you think they find them helpful?

13. One function of assignment questions is to guide students' learning. What kinds of learning do you think the assignments provide.

14. What do you think are the reasons that made students to do this course? (Not applicable in College C)

15. What Ideas and Skills that you think the students have gained from using this material; that they would not have gained otherwise?

16. Most of the course textbooks have one book per course. 'Into Science' uses several smaller booklets. Which one do you prefer? Why? Which one do you think students would prefer? Why?

17. Each Module takes one week to study according to the programme. Is this reasonable for South African Students? Why? How long do you think each Module should take? Why?

18. When do you think each Module Booklet should be handed out to students (all at the beginning of the course; or at the beginning of each Module) if the Booklets are separate?

19. The 'Into Science' course writers say that you can do the course without having studied any Science in School. How true do you think this is? Explain.

20. Which Modules would you say were:-

    (1) Challenging

    (2) Interesting

    (3) Boring

    (4) Easy

    (5) Difficult

21. 'Into Science' programme relies heavily on the written text.

    Comment on the following:-

    (a) Conversational style of writing, e.g. "We", "You" etc.

    (b) Booklet colours

    (c) Cover Pictures

(d) Paper Texture

(e) Print Size

(f) Large Margins

(g) Are sections clearly marked

(h) Diagrams and tables used

(i) Complexity of English used

(j) Efficiency of Introductions and Summaries

22. Do you think the 'Into Science' study package should be accompanied by other learning Materials long before they are due.

23. What features does the 'Into Science' Material have and the normal classroom or college does not have?

24. What features does the 'Into Science' Material not have and the normal classroom have?

25. What advantages and disadvantages that these types of learning materials have? Do you have anything you want to say about the course?

THANK YOU FOR YOUR PARTICIPATION!