Information communication technologies to enhance teaching and learning in higher education: A survey of teaching staff at Rhodes University

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Samevatting

Informasie kommunikasie tegnologie om onderrig en leer in hoër onderwys te verryk: 'n Opname van akademiese personeel aan Rhodes Universiteit

'n Opstel deur

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Die astronomiese ontwikkeling van informasie kommunikasie tegnologie (IKT) hou verreikende gevolge in vir elke lewensfeer in die twintigste eeu. Spesifiek op die terrein van produksie en oordrag van kennis, twee kernfunksies van hoër onderwys, hou IKT nie net 'n bedreiging in vir die tradisionele wyse waarop hierdie kernfunksies vervul word nie, maar bied ook moontlik die enigste oplossing vir die uitdagings van toegang, koste, buigsaamheid en kwalitiet waarmee universiteite gekonfronteer word.

Waar die toepassing van tegnologie in afstandsonderrig reeds help om bogenoemde uitdagings aan te spreek, is dieselfde resultate meer ontwykend in tradisionele residensiële universiteite soos Rhodes Universiteit. Verder is universiteite meer geneë om IKT in navorsing en administratiewe prosesse te gebruik, as in onderrig en leer. Hierdie opstel fokus dus op die behoeftes en verwagtings van onderrigpersoneel aan Rhodes Universiteit om IKT te gebruik om die onderig-en-leerproses te verryk.

Die rasionaal vir die gebruik van IKT fokus op die veranderende omgewing waarin hoër onderwys fungeer, die veranderende konsepte van kennis en kennisproduksie, en die oënskynlike potensiaal van IKT om onderwys te verbeter. Daarteenoor word die wyse waarop IKT gebruik word bespreek teen die agtergrond van voorvereistes vir suksesvolle integrasie en praktiese toepassings van tegnologie in onderrig en leer.

Key Words

Computer-assisted education

Computer-based education

Educational technology

Higher education

Information communication technology

Information technology

Instructional technology

Strategic technology planning

Technology-enhanced learning

Telematics

Brief Contents

Detailed Table of Contents

List of Tables

List of Figures

List of Abbreviations

ADC	Academic Development Centre
CAA	Computer-Aided Assessment / Computer-Assisted Assessment
CAI	Computer-Aided Instruction / Computer-Assisted Instruction
CAL	Computer-Aided Learning / Computer-Assisted Learning
CAMESE	Computer-Aided Multimedia Editing Skills in English
CBE	Computer-Based Education
CD-ROM	Compact Disc Read-Only Memory
CMC	Computer-Mediated Communication
CMI	Computer-Managed Instruction
CTI	Computers in Teaching Initiative
DMI	Desktop Management Interface
ELAP	English Language for Academic Purposes
FTP	File Transfer Protocol
GIS	Geographical Information System
GPPIS	Global Plant and Pest Information System
HTML	Hypertext Mark-up Language
ICT	Information Communication Technology
ICTs	Information Communication Technologies
ISDN	Integrated Services Digital Network
IT	Information technology
LCD	Liquid Crystal Display
NGO's	Non-Governmental Organisations
UK	United Kingdom
VRS	Voice Recognition System
WWW	World Wide Web

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Chapter 1 Context

1.1 Rationale

Information communication technologies (ICTs) have transformed many aspects of 20th century society. As Farrington (1999:73) comments, "it would be hard to find any industry whose vision for the future has not been changed radically by the dawn of the Internet Age". In trade and knowledge production particularly, the convergence of computers and telecommunications has revolutionised communications and has led to the globalisation of relationships between people in most spheres of society. "Information technology is providing rapid access to the world's knowledge resources and this is having a major impact on all aspects of social, economic, and political life" (Department of Education, 1996:vii).

Since the core functions of higher education include the production of knowledge through research, and the dissemination of knowledge through teaching, it is inevitable that ICTs will have a major impact on tertiary institutions. While the increasing invasiveness of ICTs therefore presents a threat to the conventional way in which universities conduct their business, ICTs also hold the promise of potential solutions to the pressures experienced by higher education globally. Thus, universities worldwide are under pressure to reform. Major elements in the drive for transformation include access, cost, flexibility and quality.

While universities are often at the leading edge in their use of technology for research and the application of technology to streamline administrative processes seems to be regarded as desirable, academics have been much slower to adopt technology to enhance their teaching and learning (Daniel, 1996). Furthermore, while the application of information communication technologies to deliver distance education has already proved invaluable in addressing the challenges of access, cost, flexibility and quality (*ibid.*), the potential advantages of ICTs for the traditional residential university seem less obvious.

Many South African higher education institutions have embraced distance education as an additional strategy in the drive for competitive advantage, thereby also contributing to the blurring of the boundaries between contact and distance education (Department of Education, 1999). This is not true of Rhodes University, however. Although the East London campus of Rhodes University caters for full-time as well as part-time students,

the Grahamstown campus is an established, residential campus and, as the University's strategic planning documents show, the use of distance education is not planned in the future:

> *Rhodes University is not involved in any 'distance education' such as UNISA or Technikon SA and prides itself on being able to offer students relatively small classes and easy access to teaching staff. The University will concentrate on maintaining and improving quality in its offerings rather than embracing distance education (Rhodes University, 1999a:2.3).*

In the light of the fact that most benefits of technology-use are more easily attained in distance education and resource-based learning settings (Butcher, 1999), and that Rhodes University has made a strategic decision not to embark on distance education, the challenge for the institution is to find ways to accrue the advantages of technology in teaching and learning while remaining true to its chosen objectives and strategies.

A first step in exploring the opportunities presented by the new media would therefore be to compile a comprehensive overview of the current state of affairs regarding the application of technology to enhance teaching and learning. While the input of all stakeholders in the teaching-learning process (i.e. administrators, managers, lecturers and students) is equally important for developing a comprehensive profile of the application of technology to teaching and learning, this study focuses on the views of the lecturers as the primary end-users and deliverers of the core function of teaching.

1.2 Aim

The major research question to be answered by this research project is:

How are information communication technologies currently being used to enhance teaching and learning at Rhodes University and what are the needs and expectations of lecturing staff in this regard?

The following sub-questions arise:

- Why are ICTs being used to enhance teaching and learning in higher education?
- How are ICTs being used to enhance teaching and learning in higher education?
- How are ICTs being used to enhance teaching and learning at Rhodes University?

- What are the needs and expectations of teaching staff with regard to the application of ICTs to teaching and learning at Rhodes University?
- What recommendations can be made regarding the use of ICTs to enhance teaching and learning at Rhodes University?

1.2.1 Definition of terms

computer-assisted education computer-aided education computer-supported education	Somewhat akin to computer-based education (see below), but acknowledging the fact that a computer does not form part of the entire educational process.
computer-based education computer-assisted instruction computer-assisted learning	Lippert (1993) proposes *computer-based education* (CBE) to be a generally acceptable umbrella term for describing the field of computers in education, although the term does not intend to suggest that education in any specific context is ***entirely*** based on computers. While computer-assisted instruction (CAI) focuses on the instructional aspect of education, computer-assisted learning (CAL) highlights the learning aspect of education.
computer-managed education	The application of computers to teaching and learning where the computer provides administrative support and manages the process by assessing student progress and prescribes appropriate pathways (Knoetze, 1993).
educational technology	The application of any technology (from a pencil to a personal computer) to teaching and learning.
information communication technology	The convergence of information and telecommunication technologies.
information technology	Electronic, digital technologies based on microprocessors containing integrated circuits (Laudon, Traver & Laudon, 1996).
instructional technology	The use of educational technology and/or information communication technology in an educational setting.
Knowledge Media	A specific term coined by Eisenstadt (cited in Daniel, 1996) to denote the convergence of computing, telecommunications and the cognitive sciences.
technology	The application of scientific and other organised knowledge to practical tasks by organisations consisting of people and machines (Daniel, 1996:10).
technology-enhanced learning	Learning that makes use of technology to help achieve its aims (Department of Education, 1996).
Telematics	Synonymous with information communication technologies

1.2.2 Related research in South Africa

Van Harmelen, T. (1997). The Development of a Technology-Enhanced Strategy for the University of Pretoria. M.Ed.(CAE) dissertation, University van Pretoria.

1.3 Research design

1.3.1 Data collection methods

1.3.1.1 Literature review

In order to contextualise the research problem the review of the literature focuses on the application of information communication technology to teaching and learning in higher education, drawing on international, national and local perspectives. Specific search terms include *higher education, computers, technology, information technology, information communication technology, instructional technology, technology planning, strategic technology planning and technology management.*

1.3.1.2 Survey

Cohen and Manion (1985:94) describe the survey as "perhaps the most commonly used descriptive method in educational research" that typically "gather[s] data at a particular point in time with the intention of (a) describing the nature of existing conditions, or (b) identifying standards against which existing conditions can be compared, or (c) determining the relationships that exist between specific events".

This study is primarily concerned with describing the existing conditions regarding the use of ICTs to enhance teaching and learning at Rhodes University. Similarly, the current needs and expectations of teaching staff are also investigated.

1.3.2 Description of instruments

1.3.2.1 Unstructured pilot interview schedule

An ethnographic or unstructured interview schedule is used to extract and formulate specific information requirements that are to be used to develop the survey questionnaire.

1.3.2.2 Self-completion questionnaire

The survey questionnaire primarily elicits quantitative data by way of frequency counts, but respondents are given the opportunity to add qualitative data in the margins or on separate pages. Although not the primary function of the questionnaire, this qualitative data provides details of lecturers' attitudes.

Table 1.1 uses a matrix to plot the research methods and instruments against the research approaches.

Approaches	Methods	Instruments
Quantitative	Survey	Unstructured pilot interview schedule Self-completion questionnaire
Qualitative	Survey	Self-completion questionnaire

Table 1.1 Research methods and instruments related to research approaches

1.3.3 Data collection matrix

In Table 1.2 a matrix is used to relate the subsidiary questions to the research instruments as well as the specific chapter in which the results are reported.

Sub-question ⇩ / Instrument ⇨	Literature Review	Unstructured Pilot Interview	Questionnaire	Reporting Chapter
1. Why are ICTs being used to enhance teaching and learning in higher education?	√			**2**
2. How are ICTs being used to enhance teaching and learning in higher education?	√			**2**
3. How are ICTs being used to enhance teaching and learning at Rhodes University?		√	√	**4**
4. What are the needs and expectations of lecturing staff with regard to the application of ICTs to teaching and learning at Rhodes University?		√	√	**4**
5. What recommendations can be made regarding the use of ICTs to enhance teaching and learning at Rhodes University?	√	√	√	**5**

Table 1.2 Subsidiary research questions matched with information sources and reporting chapter

1.3.4 Subjects

This study draws on the experiences and ideas of 95 members of the academic staff who are involved in some form of lecturing, teaching or tutoring at Rhodes University.

1.3.5 Limitations of this study

At universities information communication technologies are used for research, administration, marketing (recruitment), communication, recreation and teaching-and-learning. This study focuses on the use of technology to enhance teaching and learning.

To be able to reap the benefits of technology integration into the core business functions of an organisation, it is important to take cognisance of the inter-relatedness of all the activities and functions within the organisation. At a university, this requires the development of a strategic plan that will address all of the above-mentioned functions. Furthermore, developing a strategic plan should to be a collective effort engaging all stakeholders in the university community (Daniel, 1996).

Since this research project focuses only on teaching and learning, and surveys only the opinions and attitudes of lecturing staff, it cannot present a final technology strategy for Rhodes University. The aim is rather to create a framework for thinking about the role of information communication technologies in teaching and learning at Rhodes University.

1.4 Value of research

It is hoped that this study will lay the foundation for further research that will focus on the views, needs and expectations of administrators, managers and students, input from whom is required to develop a strategic plan for the application of information communication technologies to teaching and learning. Similarly, it is hoped that the research findings will open up a dialogue to discuss the role of information communication technologies in teaching and learning at Rhodes University.

Also, this research project will provide valuable data for the management of technology resources at both institutional, faculty and departmental level, as well as for strategic planning purposes. Specifically, the Academic Development Centre, which at Rhodes University has a staff development focus, will be able to draw on the research data for establishing a suitable charter for the Computer-based Education Unit, together with

appropriate strategies for supporting teaching staff and developing their skills to use information communication technology to enhance their teaching.

Finally, this study might provide a benchmark for relating the efforts at Rhodes University to work being done at other institutions of higher education in South Africa with regard to the application of information communication technology to teaching and learning.

1.5 Overview of the research report

The ensuing chapters contribute to an exploration of the above-mentioned research problem by describing various aspects of this research report.

Chapter 2: Literature Review

The literature review contextualises this study within the broader field of the application of information communication technology to teaching and learning in higher education. This is done by exploring the rationales behind technology use in higher education as well as the various ways in which technologies are used to enhance teaching and learning.

Chapter 3: Research Methodology

This chapter provides an overview of the research methodology by describing the research problem, research questions, target population, research design, research instruments, data collection procedure and data analysis.

Chapter 4: Research Findings

Having established the representivity of the respondents across faculties, ranks of teaching staff, administrative management positions and campuses, Chapter 4 presents the research findings. This is accomplished by focusing on the provision of information communication technologies, the application thereof to teaching and learning, and needs and expectations of lecturing staff.

Chapter 5: Conclusion and Recommendations

This chapter draws the threads from previous chapters together by summarising the research findings, describing the limitations of the study, and suggesting areas for further investigation. Furthermore, recommendations from Chapter 4 are summarised and expanded.

Chapter 2

Literature Review

The forces generated by the information technology revolution are centripetal and interpenetrative. There is a benign convergence of technologies, which expands the potential reward of IT while making its management more difficult.

- Duncan Greaves, 1998b

Chapter 2 Literature Review

2.1 Introduction

Despite the absence of conclusive research data on the value of computers in teaching and learning (Noble, 1998; Russell, 1997; Oppenheimer, 1997) information communication technologies (ICTs) are increasingly being introduced into higher education curricula (Gilbert, 1997; Green, 1996b).

This chapter addresses the reasons why educators continue to use ICTs in their teaching, despite the lack of convincing data. It then proceeds to investigate how institutions of higher learning are using ICTs in an attempt to enhance teaching and learning in higher education.

2.2 Why are ICTs being used in an attempt to enhance teaching and learning in higher education?

A wide variety of educational, technological, social, political and financial drivers for the use of technology in education have been identified by various authors (see for example, Plomp, 1999; Eisenstadt & Vincent, 1998; Van Harmelen, 1997; Daniel, 1996; Department of Education, 1996; Hawkridge, Jaworski & McMahon, 1990). This discussion, however, focuses on three catalysts driving the adoption of ICTs in higher education:

- the changing environment of higher education (Section 2.2.1);
- the changing concept of knowledge and knowledge production (Section 2.2.2); and
- the perceived potential of ICTs to enhance teaching and learning (Section 2.2.3).

2.2.1 The changing environment of higher education

Universities worldwide are increasingly under pressure to reform (Greaves, 1997a; Daniel, 1996; Laurillard, 1993). At the heart of the critique directed at universities, is the accusation that universities are unable to respond to a changing environment and therefore no longer serve the needs of present-day society (Plomp, 1999). Indeed, many

commentators have argued that the traditional university risks irrelevance in the information society (Greaves, 1998a; Drucker cited in Lenzner & Johnson, 1997), which requires students to become professionals capable of contributing to their country's knowledge industry (Plomp, 1999).

Even though universities have adapted to major shifts in society through the centuries (Wulf, 1998), they have always appeared to be models of constancy, unaffected by most of the scientific, technological and social changes to which they themselves have contributed (Gibbons, 1998; Daniel, 1996). Furthermore, characterisations of the core cultural and epistemological functions of the university have always involved the idea of something that was intrinsically valuable, such as the pursuit of knowledge for its own sake, irrespective of its connection to economic needs (Greaves, 1997a). Although universities have accepted an implied responsibility for economic prosperity since the end of World War II (Wulf, 1998), the past two decades have experienced intensified demands by governments, clients and patrons for transformation, accountability and transparency (Stahlke & Nyce, 1996; Gibbons, 1998). These pressures have been brought about by significant changes in the social, economic and political environments in which universities operate (Lemmer, 1998; Greaves, 1997a).

The kinds of pressures exerted on universities at the end of the twentieth century are remarkably similar all over the globe (Plomp, 1999; Lemmer, 1998; Daniel, 1996). As protectors of public interests, governments require universities to become instruments of economic development. Governments have also become concerned about quality while expecting increased access and equity (Lemmer, 1998). Students, as primary customers, expect their university qualifications to ensure them guaranteed access to occupations in a market-driven economy (Department of Education, 1997b; Stahlke & Nyce, 1996).

In addition, the ability of information technology to transcend both time and distance has added intensified competition amongst academic institutions, which have started to encroach on one another's traditional markets in the drive to gain a competitive advantage. "If there is new competition, the one thing we can predict with certainty is that there will be winners and losers" (Oberlin, 1996:29).

The result of these pressures on higher education is a model of the university functioning as a commercial enterprise, required to evaluate its processes in order to achieve maximum efficiency, customer satisfaction, productivity and ultimately profitability. While the application of common business procedures to administrative processes in higher education seems to be accepted as desirable, ongoing debate characterises the viability

of imposing business procedures on academic processes (Stahlke & Nyce, 1996; Massy & Zemsky, 1995; Porter, 1993).

Higher education in South Africa has not escaped these pressures which perhaps were made more acute by their coinciding with a changeover to a truly democratic government. Added to the pressure of transformation experienced by higher education globally, the South African government feels that it is responsible for balancing the inequalities created by the previous education system through redress programmes (Department of Education, 1997b).

Being an integral part of the international and national environment, Rhodes University cannot but be influenced by changing conditions and perceptions within higher education. Even though Rhodes University considers itself primarily a residential university, the institution recognises the diminishing gap between contact and distance education (Rhodes University, 1999a) and the need to increase its distance education offerings, especially at postgraduate level (Woods, 1998). Primary drivers for "exploring the possibilities of making use of new technologies" are the need to "facilitate teaching between the two campuses" and the need to "limit costs associated with very small classes" and individual attention on which Rhodes University prides itself (Rhodes University, 1999a:2.4).

The external environment in which universities function – governments, customers and competitors - is but one driving force behind the transformation of higher education. At the very core of universities' existence however, the changing concept of knowledge and the implications thereof for knowledge production present further demands for change.

2.2.2 The changing concepts of knowledge and knowledge production

A second compelling reason for universities to use information communication technologies to enhance teaching and learning is the fact that the concept of knowledge and the way in which knowledge is produced have changed. While the astronomic developments of ICTs have certainly contributed to the changing nature of knowledge and knowledge production, higher education has little choice but to exploit ICTs to respond to the challenges resulting from these changes.

> *Certainly knowledge, its creation, storage and communication, is part of the essence of a university. The ability to process information, the raw stuff of knowledge, thus sits at the heart of the university mission. A technology that will alter that ability by orders of magnitude cannot avoid having an*

> *impact on at least how we fulfil our mission and possibly on the mission itself (Wulf, 1998:3).*

The notion that knowledge is shaped by media is not new. Through the centuries the different media - from oral cultures through writing, printing, broadcasting to global hypermedia cultures - have transformed our concept of knowledge (Daniel, 1996). Since ICTs offer superior ways of collecting and analysing raw data to produce, present and communicate information (Laudon, Traver & Laudon, 1996), these media have contributed to moulding the concept of knowledge by altering the way that knowledge is produced. The major change is the emergence of a distributed knowledge production system as contrasted to knowledge production in relative institutional isolation (Gibbons, 1998). Eisenstadt coined the term *Knowledge Media* to denote the convergence of computing, telecommunications and the cognitive (or learning) sciences, claiming that the *Knowledge Media* "can change the relationship between people and knowledge in a qualitative fashion" (cited in Daniel, 1996:101).

> *Knowledge Media is about the process of generating, understanding and sharing knowledge using several different media, as well as understanding how the use of different media shape these processes (Eisenstadt & Vincent, 1998:4).*

2.2.2.1 The concept of knowledge

While the term *data* refers to raw, unprocessed facts, the term *information* denotes data that has been processed into a form that is meaningful and useful to humans (Laudon *et al.,* 1996). However, ongoing debate characterises the question of what *knowledge* is (Eisenstadt & Vincent, 1998).

> *Conceptions of knowledge are changing. We now believe that knowledge is intimately linked to the historical and personal perspective of the knower and are less confident that we can accurately and objectively represent or mirror reality (Daniel, 1996:25).*

Laurillard (1993) contrasts information with knowledge by depicting information as elementary and atomistic and knowledge as unitary and holistic. Eisenstadt and Vincent (1998) define knowledge as "a dynamic process, a vibrant, living thing, resting on shared assumptions, beliefs, complex perceptions, sophisticated yet sometimes crazy logic, and the ability to *go beyond the information given*" (p. 5).

> *'Knowledge' is the correct abstraction for describing what people communicate to one another. 'Information' and 'content' are not.*

Knowledge is an emergent property which transcends the fixed-size-and-space concepts of media and information (Eisenstadt & Vincent, 1998:5).

2.2.2.2 Knowledge production

Gibbons (1998) contrasts traditional knowledge production found in universities all over the globe with a new mode of knowledge production that results from technological developments. While conventional knowledge production takes place in a disciplinary structure, the new mode of knowledge production is transdisciplinary and requires knowledge to be produced in the context of application.

One of the consequences of globalisation is that knowledge creation is no longer limited to universities and colleges, and that all knowledge producers, including non-university institutions and industrial laboratories, are linked in various ways (Gibbons, 1998). Furthermore, the bulk of knowledge is produced at a different location from where it is required. Consequently, the major challenge is to find and access knowledge that may have been produced anywhere in the world and to bring it to the place where it can be used effectively in a particular problem-solving context (*ibid.*). To satisfy the demands of burgeoning knowledge industries, universities have to shift from training specialists of various kinds to creating more knowledge workers. They have to create a cadre of problem solvers and problem brokers, who are skilled at re-configuring knowledge and information that has been generated by others throughout an increasingly globalised system (*ibid.*).

However, "universities have been far more adept at producing knowledge than at drawing creatively (re-configuring) knowledge that is being produced in the distributed knowledge production system" (Gibbons, 1998:i). One way to respond to this challenge is to make more use of the potentialities of the new information and communication technologies to connect to other knowledge producers globally (Gibbons, 1998). This challenge goes beyond the provision of teaching via CD-ROMs or the Internet to taking the lead in generating a cadre of knowledge workers.

On the level of the individual, Eisenstadt and Vincent (1998) support this argument by differentiating between a learner who has memorised a formula (for example), but cannot reconstruct or re-derive it, and a learner who can re-derive the formula and apply it to a different problem-solving context. While it is possible to tediously list what the memoriser knows, it is virtually impossible to capture the applications of the facts by the re-deriver, let alone to impart that knowledge to others (*ibid.*).

2.2.2.3 From industrial to information and knowledge society

In the transition from the industrial society to an information society, universities' "critical function as 'guard of science' has been displaced in favour of a more pragmatic role in terms of provision of qualified manpower and the production of knowledge" (Gibbons, 1998:1).

At the end of the twentieth century, the global economy is therefore described as knowledge-based, with industrial capitalism being replaced by informational capitalism (Greaves, 1997a). Organisations now typically employ information workers alongside managers and production or service workers. Information workers include knowledge workers, who create information, and data workers, whose work it is to manipulate or disseminate information (Laudon *et al.,* 1996).

Eisenstadt and Vincent (1998) characterise the knowledge society by four key changes for educators and trainers:

- Knowing what will be less important than knowing how.
- What you physically possess in your storeroom will be less important than what you and your employees know.
- People will prefer to select for themselves ideas and materials that can be delivered on demand, in other words quickly and at a time appropriate to the learning.
- Presentations and expository articles may start taking the form of what could be thought of as a shared experience.

In the emerging knowledge society, "both students and staff realise that their personal success lies in being able to find a niche" (Gibbons, 1998:ii). Still in the minority, but in rapidly growing numbers, academic staff "believe that their students must integrate the use of technology into their lives as preparation for careers, or risk being (further) disadvantaged in the competition for jobs in industry, academia, and other sectors" (Gilbert, 1997:2).

> *Today, business, law, engineering, science, art, journalism, academics, as well as a whole host of other professions and occupations all require a basic understanding of, as well as the ability to work with, information technology... Regardless of students' major in college, or intended occupations in the future, information technology will play an integral role in their success (Laudon et al., 1996:xvi).*

2.2.2.4 The implications for teaching and learning

Throughout the century, changes in the concept of knowledge were reflected in theories that attempted to describe the nature of learning.

Saettler (1990) provides an impressive account of the history of technology use in education, which "can be traced back to the time when tribal priests systematised bodies of knowledge and early cultures invented pictographs or sign writing to record and transmit information" (p. 4). He provides a framework for understanding different educational applications of technology by describing four distinct paradigms of educational technology that emerged in the 20th century. The physical science or media approach tends to focus on the hardware in the presentation of materials or programs, thereby neglecting individual learning differences or the selection or design of instructional content. In contrast, the communications approach to educational technology shifts the focus to the entire process of communicating information from a source (a teacher), to a receiver (the learner). The behavioural sciences' approach (psychology, anthropology and sociology) to educational technology presents two contrasting theoretical orientations: behaviourism and cognitivism.

> *When applied to human learning, the behaviourist concept of educational technology tends to be focused on the lower cognitive processes with motives being controlled through conditioning [i.e. reinforcement through stimulus-response bonds]. Thus, the behaviourist orientation leads to a curriculum that is programmed step by step in small units, focused on immediately observable and measurable learning products (ibid.:14).*

By the early 1980s the behaviourist model was being replaced by the cognitive approach that attempts to understand the internal processes of behaviour and emphasises knowing rather than responding.

> *The cognitive approach to educational technology views the learner not as passive, but as active, constructive, and playful (ibid.:14).*

Saettler concludes his discussion by proposing that educational technology is in a "preparadigmatic state of development with respect to an adequate and generally acceptable paradigm" (*ibid.*:15).

Cronjé (1997) draws these themes together by juxtaposing the primary features of behaviourist mastery learning with those of cognitive constructivist learning. The behaviourist mastery learning theory is based on the objectivist principle that knowledge exists outside the learner and that the task of the teacher is therefore to train the learner

until the learner's comprehension of that knowledge is as close as possible to the actual object (knowledge) itself. On the other end of the continuum, cognitive constructivist learning does not acknowledge a shared reality, but assumes that knowledge is constructed and acquired by active mental processing and collaborative interpretation (*ibid.*). Taking a wider perspective on learning than constructivism, the acknowledgement of the role of the context in which learning is set, has lead to the development of a social constructivist view of learning. Social constructivism has brought with it attention to social aspects in the learning context and the influence thereof in what is learned and how it is learned (Kuiper, 1999).

In an attempt to define the character of academic learning, Laurillard (1993) critiques the notion of academic learning as imparted knowledge with its emphasis on decontextualising knowledge (i.e. knowledge has to be abstracted from the physical and social context in order to be generalisable and therefore useful). In reaction to this classical tradition of *imparting knowledge*, Dewey, Vygotsky, Piaget and Bruner (cited in Laurillard, 1993) argued for the active engagement of the learner instead of the passive reception of given knowledge. This gave rise to the Vygotskyan theory of the social character of learning and the notion of *situated learning* (*ibid.*).

However, Laurillard also expresses dissatisfaction with situated cognition as a theory to explain the character of academic learning stating that "academic learning should occupy the middle position [i.e. between teaching abstractions on the one hand and enabling students to learn abstractions from multiple contexts on the other] of an activity that develops abstractions from multiple contexts" (*ibid.*:19). Although multiple contexts may be necessary to develop abstractions, Laurillard continues by arguing that students can easily fail to engage actively with the teacher's way of thinking, since it does not clarify if and how the process of abstraction is done by the student. Laurillard concludes that teaching is *mediated learning*, which allows students to acquire knowledge of someone else's way of experiencing the world.

> *Whereas natural environments afford learning of percepts through situated cognition [i.e. in everyday life], teaching must create artificial environments which afford the learning of 'precepts', i.e. descriptions of the world (ibid.:29).*

Flowing from this discussion is the growing recognition that knowledge cannot be transferred from one individual to another. It is not possible to "fill up" students from the teacher's "vessel" of knowledge, a practice which seems to characterise the transmission-model of teaching in lecture-based settings at many higher education institutions all over

the world. The implications of this realisation for the roles of lecturers and students will be outlined in Section 2.3.1.2 on page 29.

At the core of universities' mission, knowledge production processes have been altered by ICTs in such a fashion that ICTs have become the only viable option with the potential to enable higher education to adapt to these changed processes. Another internal driving force that dictates the use of ICTs in higher education is the perception that ICTs have the potential to enhance teaching and learning.

2.2.3 The perceived potential of ICTs to enhance teaching and learning

A third powerful driver for the increasing introduction of information communication technology into higher education is the perception amongst administrators and academics that computers have the potential to enhance teaching and learning. Daniel (1996) believes that technology, "which has already made a dramatic impact in most areas of human endeavour, is a key to the renewal of higher education" (p. 1).

> *The potential of information technology to do good is unarguable and contributes to a pervasive mythos that captures the imagination of individuals from every walk of life (Oberlin, 1996:2).*

The history of personal computers has witnessed an evolutionary development from stand-alone computers to computers connected to a local area network, to wide area networks and eventually to the Internet. The significance of the network as a tool to enhance computing cannot be underestimated because "everything will revolve around network connectivity" (Greaves, 1998a:4). Similarly, it is equally difficult to quantify the impact of the Internet on society in general and specifically on education. "Next to the development of the personal computer, the single most important digital innovation of the last twenty years is the Internet" (Laudon *et al.,* 1996:199). The concept *information [and] communication technology* (ICT) is used to refer to recent revolutionary developments like the Internet and World Wide Web, which not only transcend the application of computers as stand-alone devices but also provide access to, and sharing of, huge amounts of information (Plomp, 1999). According to Daniel (1996), the potential of the Internet is linked to two phenomena.

> *First, Moore's Law, ... which says that computing power and capacity double every 18 months. Second, Metcalfe's Law, ... also known as the law of the telecosm, which says that the utility of a network to a population is roughly proportional to the number of users squared. The Internet harnesses both laws at the same time ... (p. 117).*

This line of argument is supported by Oberlin (1996) who states:

> *The total value of information technology is greater than the sum of its parts. To the extent that enterprise-wide systems function in aggregate-like ecosystems, much of IT's value grows exponentially as its supporting infrastructure and interconnections grow richer (p. 4).*

Eisenstadt's term *Knowledge Media* (see definition on page 12) develops this notion further by adding the cognitive or learning sciences to the convergence of computing and telecommunications, claiming that the *Knowledge Media* "can change the relationship between people and knowledge in a qualitative fashion" (Daniel, 1996:101). *Knowledge Media* have the potential to enable higher education to rise to the challenges of ***access***, ***cost*** and ***flexibility*** (*ibid.*). ICTs theoretically offer economies of scale, mass customisation and freedom from traditional limits of time and space (Massy & Zemsky, 1995).

2.2.3.1 Access, academic community and lifelong learning

One of the primary accusations made against universities is that national university systems are not accommodating the volume and variety of access that students demand. It is also frequently noted that the sense of the university as an academic community is being eroded (Daniel, 1996). The essence of higher education is connecting people into learning communities. New technologies, notably the Internet and the World Wide Web, may provide superior ways of creating academic communities.

> *It may now be possible for a wider variety of academics – including students – to participate more actively, fully and equally in some of the these scholarly communities. The idea of 'learning communities' may become a more attainable vision (Gilbert, 1997:6).*

The potential of ICT in education therefore has to be discussed in the context of the development of a 'culture' that allows for lifelong learning (Plomp, 1999). All over the world, governments want to see higher education become less expensive so that policies to encourage lifelong learning can be affordable. In order to remain employable, people need to become lifelong learners. While mature and part-time students are often not well served by campus instruction, growing numbers of young students, who wish to combine work and study, are looking for more flexible ways of obtaining a degree (Daniel, 1996).

2.2.3.2 Cost, effectiveness, efficiency, productivity

Furthermore, higher education is often criticised for being too costly and for the fact that the quality of higher education is not assured.

> *The costs of campus universities are too high for the majority of those around the world who will aspire to university training in the future (Daniel, 1996:16).*

Many governments believe that universities will become more efficient if they take advantage of the information communication technologies.

> *If planned carefully and costed thoroughly, the use of Internet technologies can create possibilities for achieving cost-efficiencies in educational provision (Butcher, 1999:21).*

Just as information technology has been a key factor in process re-engineering in industry (Daniel, 1996), educational organisations seek to replicate the benefits of enhanced effectiveness, efficiency and productivity within their own operations. However, according to Gilbert (1997):

> *So far most improvements to the quality of and access to education via information technology have increased costs... For the next few years, it is more realistic to strive for better quality and accessibility of education and for ways to meet 'reasonable' increases in expenses (p. 7).*

While justifications for investments in technology will least likely occur through lowering costs (e.g. fewer faculty) or higher revenues (e.g. more students), the business case for investing in information technology for teaching and learning will therefore rest primarily on the value of better learning (Oberlin, 1996). One strategy to increase learning productivity is to use information communication technologies to raise the success rate of students in targeted courses – those courses which account for the highest enrolments (Twigg, 1995).

2.2.3.3 Flexibility and individualisation

A key critique aimed at universities is that teaching methods are too inflexible to answer the needs of a diversifying student body (Daniel, 1996). As the habit of lifelong learning spreads, students will become increasingly diverse, often combining study and employment.

> *Students, who will have a wide variety of academic backgrounds, will expect to choose from an extensive curriculum delivered in a convenient and affordable manner (Daniel, 1996:103).*

Internet technologies and online learning create new possibilities for introducing flexibility for learners in terms of time, place and pacing of independent study (Butcher, 1999). People will expect their education to be personalised (Daniel, 1996). By using ICTs, educators will also be able to individualise learning experiences for learners so as to enable them to progress in their own time and at their own pace. Learners will gain more control over their learning environment, which will raise their level of motivation (Malone, 1981). If individual differences in learning styles of students are acknowledged, technology has the potential to facilitate learning for some students, but will probably inhibit learning for others, while the remainder experience no significant difference (Russell, 1997). The challenge for educators is to accommodate different students by identifying their individual learning styles and match these with appropriate technologies (*ibid.*).

By changing the relationship between people and knowledge in a fundamental way, *Knowledge Media* provide the opportunity to switch focus from group teaching to individual learning (Daniel, 1997).

> *Universities are discovering, to their amazement, that with good learning materials, effective networks, and proper support, students can learn better at home than in class (ibid.:16).*

Key driving forces behind the increasing use of information communication technologies in teaching and learning are changes in the higher education environment, shifting perspectives on knowledge and knowledge production and perceptions that ICTs have the potential to enhance teaching and learning. While it is important to understand the rationale behind the growing interest in using ICTs to enhance teaching and learning, the complex nature of both universities and technology calls for a discussion on the prerequisites for successful integration.

2.3 How are ICTs being used in an attempt to enhance teaching and learning in higher education?

This question is addressed by first focusing on an enabling framework and fostering environment as prerequisites for the successful use of information communication technologies to enhance teaching and learning (Section 2.3.1). This is followed by a brief description of some practical applications of ICTs in lecturers' teaching and their students' learning (Section 2.3.2 on page 32).

2.3.1 Prerequisites for successful use of ICTs

Despite the perceived potential of ICTs for teaching and learning, the history of educational technology is replete with exaggerated claims that subsequently proved untenable or where the use of technology did not make a significant difference in terms learning gains (Butcher, 1998; Russell, 1997; Daniel, 1996; Oberlin, 1996). Creating an environment conducive to the successful implementation of instructional technology is probably one of the most challenging exercises in any tertiary institution.

> *Hardly any organisation in South African education and training have yet devised strategies for harnessing these trends [in the development of ICTs] effectively to the general benefit of education and social development, indicating clearly that their real potential is not yet well understood (Butcher, 1999:22).*

This section focuses on some elements within an organisational structure that could drive the appropriate use of instructional technology. However, before detailing some prerequisites for successful use of technology, it is necessary to:

- qualify 'successful' by describing some of the outcomes of what seem to be regarded as successful uses of ICTs;
- highlight important principles to guide successful implementation; and
- provide a framework to organise and illuminate the discussion.

Criteria for success

Generally speaking, the successful implementation and use of ICT can be interpreted as taking advantage of technology to improve higher education (Van Harmelen, 1997). In essence, "the aim of teaching is simple: it is to make student learning possible"

(Ramsden, cited in Laurillard, 1993:13). Focusing on teaching and learning, some expectations are that the use of educational technology will:

- enhance educational effectiveness, which can be defined as acceptability and impact of educational outputs (graduates) in the relevant sectors of the task environment or market (Van Harmelen, 1997);
- increase teaching effectiveness (Daniel, 1996);
- increase teaching efficiency, i.e. "reaching more people, more cost-effectively" (Van Harmelen, 1997:18);
- increase learning productivity (Daniel, 1996) by making it more effective, i.e. "higher retention recorded in a shorter timeframe" (Van Harmelen, 1997:18) or increasing the throughput rate (Twigg, 1995).

Principles to guide implementation of ICT

Since the range and complexity of technologies available to support teaching and learning expand so rapidly, it is imperative that the implementation of technology into education should be guided and evaluated by research activity.

> *Because the use of new technology in teaching is innovative and exploratory, we cannot approach it as we do traditional teaching, with the assumption that we know how to do it. A more appropriate model would be research activity (Daniel, 1996:157).*

Due to a growing consensus that technological solutions do not work (Butcher, 1998), another important principle that should underlie all decisions regarding the use of ICT is that technology should be applied within a clear view of the nature of education (Plomp, 1999; Department of Education, 1996). This should be accomplished by focusing first on teaching and learning and then on technological options and administrative processes (Gilbert, 1997; Stahlke & Nyce, 1996).

> *Educational decisions should be based on a deepening understanding of the ways in which face-to-face communications, telecommunications and independent work can fit together for the best learning and teaching (Gilbert, 1997:3).*

Consequently, any re-engineering of teaching and learning should originate with the academic staff as the expert content-providers (Greaves, 1997a).

Framework for discussion on prerequisites

The model to depict the learning process as a result of activities and conditions for learning used by Plomp (1999) in his article, *Higher Education for the 21st Century and the Potential of ICT*, appropriately focuses on the learning process (instead of a technological perspective). It therefore provides a suitable organising principle to situate the discussion on the prerequisites for successful use of ICT to enhance teaching and learning.

In Figure 2.1 the outer circle represents the level of institutional organisation and management which provides the environment for the learning process. Two dimensions, each with two forces, identify the driving forces behind the learning process (*ibid.*). The horizontal dimension portrays the relation between the actors in the learning process: the teacher and the learner, while the vertical dimension represents the learning infrastructure, consisting of content as the first force, and teaching and learning materials and technical infrastructure as the second. The learning process happens at the intersection of these two dimensions, as a result of the interplay among the four forces: teacher, learner, content and media. The figure illustrates the view that the learning process is the result of the structural conditions derived from the learning infrastructure, the personal characteristics of the actors involved and the integration between the two (*ibid.*).

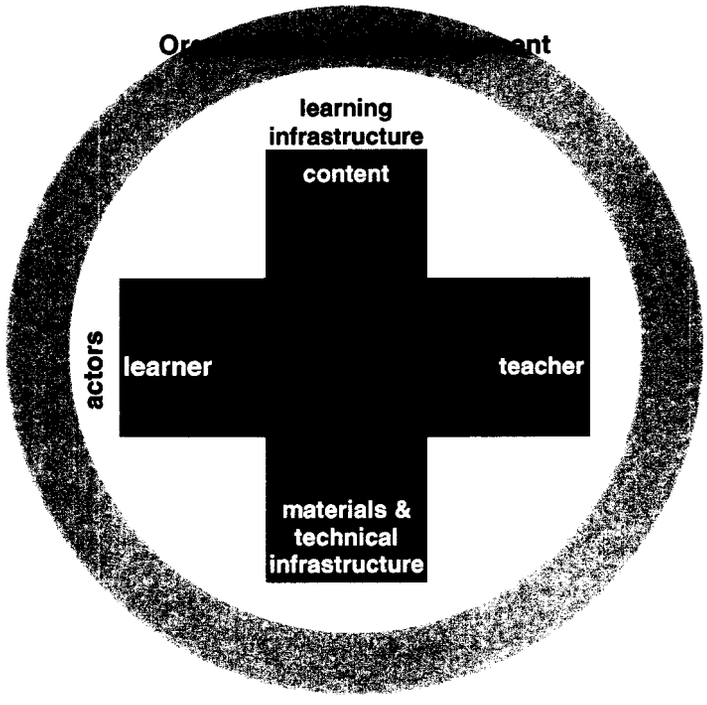

Figure 2.1 The learning process depicted as a result of activities and conditions for learning (Plomp, 1999:17)

Substantial change and improvement in the learning process as a whole will not result from changing one of the driving forces. For example, while the provision of computers, software and network facilities is an obvious improvement in terms of the availability of materials and technical infrastructure, it will have no impact on content or the roles of the actors in the process. Only an effort that combines changes in the roles of the teacher and the student, the content and organisation of the curricula, and corresponding curriculum materials has the potential to enhance and renew the learning process contained in a new technical infrastructure (*ibid.*).

While a discussion of content as a part of the learning infrastructure falls beyond the scope of this investigation, the ensuing discussion on the prerequisites of successful integration of ICTs into teaching and learning focuses on:

- organisation and management - the environment (Section 2.3.1.1);
- the teachers and learners - the actors (Section 2.3.1.2); and
- the materials and technical infrastructure – part of the learning infrastructure (Section 2.3.1.3).

2.3.1.1 The environment: organisation and management

Contradicting integration strategies

There seems to be a continuum of change strategies that are used to introduce technology into curricula (Jurow, 1999). Echoing the sentiment of the model used by Plomp (1999), some commentators at the one end of the continuum argue that, in order to receive the full benefits of technology, the teaching and learning process needs to be re-engineered, ultimately requiring "a new organisational infrastructure" (Laurillard, 1993:4).

> *The tough challenge for campus universities is that to derive most benefit from technology they must recast their teaching/learning experience. Put another way, the forms of technology-based education that appear to pose the least threat to current teaching practices also hold out the least promise for reducing costs or yielding valuable differentiation (Daniel, 1996:148).*

From an opposite point of view, other observers argue that the most effective use of technology in teaching and learning involves a combination of approaches using technology to enhance face-to-face classes. Colleges and universities should find a middle ground between "high touch and high tech" in classrooms, using information technology to supplement, but not replace, traditional lectures (Green, 1999:2). Oberlin

(1996) proposes strategies that support continuous or incremental change in lieu of revolution. Focusing on business organisations, Kotter (1999) believes that planning for transformation is the wrong goal. Planning for incremental change not only produces better results, but can also help avoid the most expensive disruptions in organisational effectiveness.

Gilbert advises institutions to "develop a 'portfolio' of specific change strategies that includes a combination of a few 'narrow/deep' and a few 'wide/shallow' change strategies" (1996:21-22). While the dimension of 'narrow' versus 'wide' refers to the proportion of teaching staff and students who will be involved in a particular use of new technology, the dimension of 'shallow' versus 'deep' applies to the level of impact on those whose teaching and learning experiences are affected. The ultimate goal is to work towards a combination of strategies with both a 'deep' and 'wide' effect.

Strategic technology planning

There seems to be a growing consensus that a primary prerequisite for the successful integration of information communication technologies into teaching and learning is the continuous development of a strategic technology plan (Jurow, 1999; Gilbert, 1997; Daniel, 1996). Such an institution-wide process should include wide representation of all stakeholders not only to secure ownership, but also to provide a resource of practitioners, with relevant experience, knowledge and skills, who would create new capabilities when combined to work together in different ways.

> *There seems to be some correlation ... between institutional success and the level of participation of staff in governance (Daniel, 1996:128).*

The process of strategic planning can also overcome the dysfunctional separation of people, functions and purposes across professional/functional and hierarchical boundaries within one organisation (Gilbert, 1997).

A key element of the strategic planning process is to reach agreement that change is in fact required (Jurow, 1999) by developing an overarching institutional strategy (Gilbert, 1996). Such an overall institutional strategy should basically determine whether the institution prefers to be a leader, follower or resister. While leader institutions will want to invest heavily in new opportunities thereby accepting a high failure risk, followers need to watch peer institutions carefully and only adopt those technologies that seem to be working. "Resisters try to avoid engaging in new activities until it becomes embarrassing not to do so" (*ibid.*:20). A primary task of representatives undertaking the planning process would be to collaboratively create a common vision to focus their effort and guide

difficult decision-making, especially in the light of many conflicting interests that are likely to appear (Gilbert, 1997; Kotter, 1999).

An important aspect of a strategy should be the recognition that the required changes are complex, costly and time-consuming. The strategy should therefore reflect the structural nature of the changes (Plomp, 1999). Due to many complex factors and continuous change, the primary outcome of such a strategic technology planning process should be relatively flexible guidelines which provide direction for students and staff, rather than fixed policies (Gilbert, 1996).

To ensure sustainability of strategic technology planning, the technology strategy should be linked to the priorities of the institutional strategic plan. "Such an approach helps to ensure a review of the implications of technology for all significant activities in the institution's value chain" (Daniel, 1996:152). Developing an institutional strategy for the financing of technology is another major component of the strategic planning process that would give substance to a strategic technology plan (Green & Jenkins, 1998).

Financial planning

Financing the replacement of ageing hardware and software is the third major challenge in post-secondary education in the United States (Green, 1999). Economic factors complicating the financial management of information technology include its steadily increasing value, the accelerating rate of technical sophistication, intensifying demand for IT services and computing power, continually changing IT standards and architectures, falling per-unit prices and the growing total cost of ownership (Oberlin, 1996).

To maximise the potential benefit of information communication technologies for universities, an unprecedented focus on financial management is imperative (Oberlin, 1996). Due to the complexity of IT financial management, single-focused perspectives of technologists, administrators or financial planners alone will not succeed in providing appropriate financial models. Instead, these solutions "will come from the strategic plans and business analyses of pan-university planners, senior business officers, college presidents, trustees, and legislators" (*ibid.*:22). The legacy-based fiscal thinking of both technologists and financial officers seems to prevent institutions from realising the full potential of technology. This is due to an unwillingness and/or inability to quantify academic processes and an unwillingness to substitute capital for labour (Daniel, 1996; Oberlin, 1996).

Financial management of information technology should also be informed by the following principles:

- Asset management of information technology is crucial to effective financing strategies (Green & Jenkins, 1998) and is distinctly different from asset management of other capital equipment due to rapid technology advancements resulting in obsolete machines being replaced by machines with superior performance (Oberlin, 1996).
- Each new generation of information technology has an economic life cycle that is independent of its functional life cycle (Oberlin, 1996) and various types of technology costs should be annualised into portfolios of longer-term perpetuities (Green & Jenkins, 1998).
- "Funding for an institution's central IT support organisation should be placed on a recurring life-cycle basis to the extent possible, and should not overly rely on one-time sources or depreciation schedules not attuned to the rapid pace of technological change" (Graves, 1999:3).
- Mechanisms and reliable benchmarks for measuring institutions' financial return on technology investments and demonstrating higher value for its primary product should be developed (Green & Jenkins, 1998; Oberlin, 1996).
- If the business case for investing in information technology for teaching and learning relies on valuing better learning, institutions will have to grow their technology budgets by either raising the price of education or reallocating current budgets to eliminate inefficient and redundant programmes (Greaves, 1998b; Oberlin, 1996; Graff & Berube, 1995).
- "When implementing a technology strategy it is important to have a special source of funds on which individuals and units can call" (Daniel, 1996:140).
- "Technology should be treated as an operating expense, not a capital expense. Inappropriate accounting hinders a technology strategy by focusing too much on large equipment decisions" (*ibid.*:140).
- Various types of annualised technology costs should be matched with appropriate funding mechanisms (Green & Jenkins, 1998).

Support, incentives, recognition and reward

According to the 1999 National Survey of Information Technology in Higher Education (Green, 1999) providing adequate **user support** is the second biggest issue in American

colleges and universities. The number of support staff should correlate with the number of users and machines. For their corporate clients, the Gartner Group's guidelines regarding user support generally recommend one IT support person for every 50 to 75 users (*ibid.*).

Traditionally, the mission of central IT organisations was operations: creating and sustaining centralised IT services. At institutions that wish to maximise their return on investment in technology by integrating ICTs into teaching and learning, central IT organisations will have to become co-responsible for the integration process. The relationship of the central IT organisation to academic staff should change from "service provider" to "partner and enabler" (Greaves, 1998a:5). An ongoing collaborative effort, particularly applicable to instructional technology, of evaluating new technologies for operations and supporting selected decentralised experiments should become part of a central IT organisation's mission that keeps the institution current (Graves, 1999).

Furthermore, a distinction should be made between technical support staff, responsible for hardware and software maintenance, and instructional support staff, who should assist academic staff and students with integrating technology into teaching, learning and research. This type of instructional support should ideally be distributed across campus so that it is available in the departments in close proximity to the end-users.

Students are a major resource for support. Students should receive training to be able to assist fellow students with technological problems. Furthermore, technology competent students should be paired up with less-competent academic staff with the aim of enhancing technology infusion (Norman, 1999).

Universities should have an institutional program to **recognise and reward** the use of information technology as part of the faculty review process (Green, 1999). Due to major obstacles such as a lack of adequate support, lack of equipment and facilities and an unreliable technical infrastructure, academic staff in some institutions are currently being penalised rather than being rewarded for their efforts to use technology in their teaching.

> *Failing to recognise and promote faculty who invest in technology in their scholarly and instructional activities sends a chilling message about the real departmental and institutional commitment to the integration of technology in instruction and scholarship (Green, 1999:6).*

Educational institutions should ensure that lecturers have adequate time, resources and support to advance their instructional skills as new options for doing so become available (Gilbert, 1997).

Regardless of the technologies used to support communication or resource provision, education fundamentally remains a process of engagement between two groups of people: teachers and learners, i.e. the actors represented in Figure 2.1.

> *To succeed, educational projects seeking to harness the potential of ICTs will have to focus clearly on ensuring that both educators and learners are equipped to engage effectively in the teaching and learning that takes place (Butcher, 1998:33).*

2.3.1.2 The actors: learners and teachers

While many challenges face universities who wish to increase their return on investment in information communication technologies, the major challenge involves human factors: "assisting students and faculty to make effective use of new technologies in ways that support teaching, learning, instruction and scholarship" (Green, 1999:2).

New roles for academic staff

Since the use of ICTs can become the basis of new ways of organising, representing and communicating knowledge, the use of ICTs becomes essential for the work being done in disciplines across the spectrum (Gilbert, 1997). Academic staff need to learn new educational approaches and how information technology can be used to enhance work in their disciplines (*ibid.*). If the task of teaching staff evolves from lecturing to facilitating, they will need training to enable them to make the shift from lecturing to students, to mediating between students and the learning materials (Daniel, 1996).

> *Lecturers will become facilitators and designers of students' learning environments, and they may take on a variety of roles such as resource person, coordinator and often also co-learner and co-problem solver. This demands a special approach to staff development which goes beyond the training of basic ICT skills (Plomp, 1999:26).*

Furthermore, academic staff are used to a craft approach to teaching that involves them in planning the curriculum, organising the resources, instructing the content to the students and assessing the students' attainment (Van Harmelen, 1997; Daniel, 1996). New approaches will require more development work, introduce greater division of labour and put more responsibility on the student (Daniel, 1996).

New roles for students

Cognitive science and social educational research shifted pedagogical perspectives from a "transmission" model - the idea that learning is essentially the assimilation of information - to a more "constructivist" model - the idea that learning is an active process

in which individual learners construct their own meaning to knowledge (Rodenburg, 1998). (See Section 2.2.2.4 on page 15).

In the transmission model learning has become too much a matter of *reproduction* with little attention to the *production* of knowledge and skills. The knowledge society needs people who are competent at dealing with a wide variety of often unforeseeable situations. Therefore students need to learn to produce knowledge in order to solve problems (Plomp, 1999).

> *This requires not only a solid basis of 'objective' knowledge and skills (such as reading, writing, and arithmetic), but also problem-solving abilities, such as analysis and design skills, and the capacity to cooperate, communicate and find relevant information (ibid.:18).*

For learners to acquire productive skills and the skills required for problem-solving, independent learning and lifelong learning, they will have to be enabled to become more active and more responsible for their own learning process (*ibid.*). Students will also need to "learn in collaborative groups both to increase their ability to work on teams and to learn more effectively through social interaction" (Gilbert, 1997:4). However, learning will continue to be a process in which the learner needs support in terms of well-adapted subject matter, the organisation of learning activities by a teacher, as well as technical infrastructure and adequate materials (Plomp, 1999).

2.3.1.3 The learning environment: materials and technical infrastructure

> *High quality courses and learning resources are crucial to the success of technology-enhanced learning initiatives (Butcher, 1999:14).*

The **development of courseware** is a time-consuming and expensive process which should ideally be undertaken by a team of specialists consisting of programmers or authors, teaching-and-learning consultants and subject or content experts (Department of Education, 1996). However, different institutions respond differently to the challenge of developing courseware.

> *There is, after all, a danger that unless universities become generators of technology-based courses their faculty will gradually become buyers' guides and librarians for materials produced outside the academy (Daniel, 1996:138).*

In response to this challenge, some South African universities have designated groups of varying numbers of staff members to develop courseware. Examples include the Universities of the Western Cape, Rhodes, Cape Town and Pretoria (Lippert, 1993).

While the development of Computer-aided learning (CAL) courseware was either scaled down or terminated over time, some universities continue to offer this service, e.g. the University of Cape Town's Multimedia Education Group, which develops courseware for selected Humanities departments (University of Cape Town, 1999).

On the other hand, effective courseware is often developed by individual lecturers without the support of a course team. At the University of Natal, Rodrik Wade and Nicole Geslin's *CAMESE* (Computer-Aided Multimedia Editing Skills in English) (Wade, 1998) and Alan Amory's *Zadarh*, are examples (Amory, 1999).

In this regard, the British model of establishing Computers in Teaching Initiative (CTI) Centres seems to be an ideal solution to the challenges of both cost and time. With the aim of promoting and evaluating the use of computers for teaching and learning, different centres, each focusing on different disciplines, were set up at several UK universities (Laurillard, 1993). This kind of infrastructure preferably needs to be initiated by a body higher than an individual institution. (The UK CTI Centres were set up by the Universities Funding Council.) Unfortunately the model is not explicitly recommended in the proposed policies and strategies of either the discussion document, *Technology Enhanced Learning Investigation in South Africa* (Department of Education, 1996) or in the *Technology Enhanced Learning Initiative in South Africa: A Strategic Plan* (Department of Education, 1997a).

However, focusing on distance education and resource-based learning, the South African Ministry of Education, "supports the development of a national network of centres of innovation in course design and development, as this would enable the development and franchising of well-designed, quality and cost-effective learning resources and courses, building on the expertise and experience of top quality scholars and educators in different parts of the country" (Department of Education, 1997b:18).

Green (1996c) emphasises the importance of technical **infrastructure** as "critical catalysts for innovation and for the integration of technology in instruction" (p.26). The integrity of the technical infrastructure should be beyond suspicion or distrust so as not to frustrate academic staff and students by jeopardising their efforts to use ICTs to enhance their teaching and learning (Greaves, 1998a). Furthermore, the stability and reliability of the physical infrastructure should encourage staff to experiment and take risks (Ehrmann, 1995). An institution's total IT investment should be administrated "with enough flexibility to encourage and support innovation and entrepreneurship in the departments" (Graves, 1999:96).

Universal student access to technology should be part of a technology infrastructure which is a prerequisite for re-engineering the learning environment (Daniel, 1996).

> *All of an institution's students and employees should have convenient and affordable access to a personal computer, with a basic collection of productivity software, that can be connected to the institution's network at any time and from almost any place they are working – the office, a library, a home or residence hall, a field location, or another remote location (Graves, 1999:100).*

2.3.1.4 Prerequisites: Summary

The discussion on the prerequisites for successful integration of ICTs into teaching and learning focused on three primary driving forces behind teaching and learning with technology: (1) an enabling environment, (2) the actors and (3) the materials and technical infrastructure. The final section in this chapter draws these themes together by exploring various practical applications of technology to education.

2.3.2 Practical applications of ICTs in teaching and learning

A wide variety of terminology and acronyms used to describe the application of technology to education denote the many ways in which computers can be used, since different terms or acronyms often indicate a specific focus (Lippert, 1993). Due to continual technological advancements new possibilities and applications for education continue to emerge. In order to conceptualise the vast number of possibilities of educational uses of computers various authors offer a number of classification and categorisations systems (see for example, Collis, 1996; Bogle, Nicol & Heath, 1997; Laurillard, 1993 and Knoetze, 1993).

Collis (1996) distinguishes between learner and teacher-oriented uses of ICT. Learner-oriented uses include:

- structured and predetermined learning tasks such as drill and practising exercises, testing, tutorials, games;
- ICT enhancing flexibility of use which can be applied in many student-centred learning approaches, such as simulations, CD-ROMs, the World Wide Web, etc.; and
- tools or content-free ICT for educational purposes, such as word processing, spreadsheets and calculations.

Teacher-oriented uses include all of the above learner-oriented uses, together with ICT used as a tool for typical teacher activities:

- teacher productivity, such as student record keeping, development of course materials, tests, information for parents, and so forth;
- resource acquisition, like CD-ROM on stand-alone computers or on-line libraries; and
- communication.

Another categorisation of the potential functions of ICT in education by Collis (1996) uses a number of dimensions to classify the use of computers in education:

- stand-alone versus distributed use;
- teacher/learner as producer versus consumer; and
- locus of control: teacher controlled versus learner controlled use.

According to Knoetze (1993) the use of computers in education can be classified into three distinctive categories: (1) educational research, (2) administration and (3) teaching and learning. Although this study focuses on the use of computers in teaching and learning, the inter-relatedness of these applications should be acknowledged, as well as the degree to which research and administration support teaching and learning (Daniel, 1996). With regard to the use of computers for teaching and learning, Knoetze (1993) further distinguishes between Computer-Assisted Education which focuses on teaching or mastery of subject content, and Computer-Managed Education which could be associated with the added function of controlling and managing the teaching/learning situation.

2.3.2.1 Computer-assisted education / Computer-based education

The ensuing discussion investigates computer-assisted education from two different angles: firstly, the types of software or courseware (i.e. the computer programs that are available) and secondly, the different functions of the various software or courseware programs.

Figure 2.2 provides a conceptual overview of the use of information communication technologies in education by focusing on the various types of software or courseware that can be used in teaching and learning and matching these programs with corresponding functions. (In this figure, blue-coloured text and lines are used to emphasise the focus of this discussion. Coloured boxes are also used to match corresponding functions across

categories, e.g. red boxes indicate that spreadsheets, databases, GIS and statistical programs are used for data analyses).

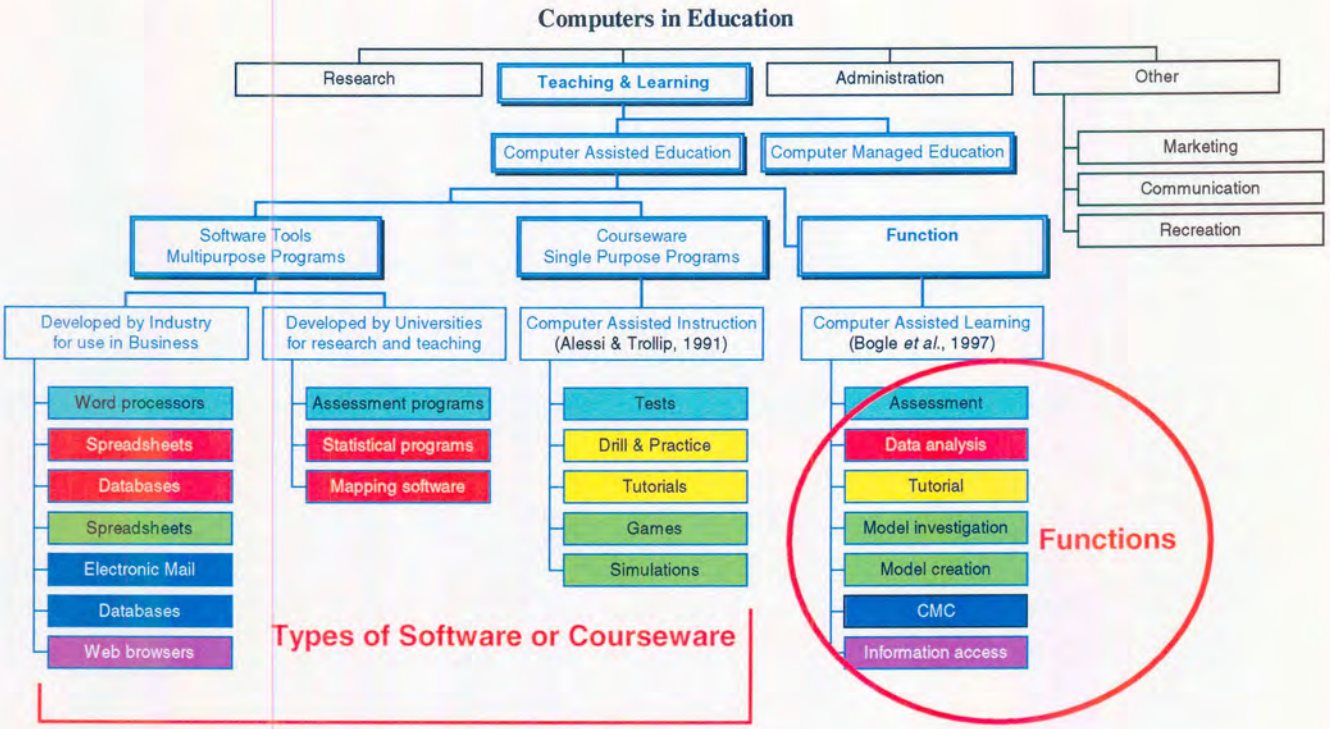

Figure 2.2 The use of computers in education

Types of software or courseware

The discussion on the types of software first focuses on tools (multi-purpose programs) and then on courseware (single-purpose programs).

Software tools or multipurpose programs

Software tools or multipurpose programs can be used in various disciplines to realise teaching and learning aims (Knoetze, 1993). Also called *content-free software tools* (Collis, 1996; Knoetze, 1993), these programs are used to fulfil generic functions. Ehrmann (1995) uses the term *worldware* to describe those software application programs that are developed for purposes other than instruction, but are also "educationally valuable because they enable several important facets of instructional improvement" (p. 25). Worldware includes *personal productivity tools* or *office automation tools* originally designed to increase productivity in business, service and manufacturing organisations by automating time-consuming and repetitive tasks and making information more readily available at all levels of management and workers. Personal productivity tools are usually marketed as software suites, which are bundled versions of a manufacturer's line of office automation software, all containing a consistent user interface and the ability to share data among the different applications: word processors,

spreadsheets, database management systems, electronic mail, etc. (Laudon *et al.,* 1996). Ehrmann (1995) provides some reasons why worldware has proved to have great educational potential (value) and wide use for a long period of time (viability):

> *they are in demand for students know they need to learn to use them and to think with them; faculty already are familiar with them from their own work; vendors have a large enough market to earn the money for continual upgrades and relatively good product support; and new versions of worldware are usually compatible with old files, thus, faculty can gradually update and transform their courses year after year without last year's assignment becoming obsolete (p. 25).*

Bogle *et al.* (1997) expand this list by noting that students need to acquire general computer skills and experience for commercial products commonly used in their subject and often for their future employment. Also, the use of this software improves presentation skills through the use of graphics and word processing packages.

Software tools or multipurpose programs can further be subdivided into two categories: commercial products designed by industry for use in business organisations and those developed by universities for research or educational purposes (Bogle *et al.*, 1997).

Software tools developed by industry for use in Business

The use of **word processors** for the writing of assignments and project-based learning can be categorised as formative assessment of student learning. While word processing software can be used productively in almost any discipline for writing assignments, at school level it is usually associated with language teaching where its editing features can by used maximally (Knoetze, 1993). In language teaching, the benefits of word processing are particularly evident in the development of writing through the "process" or holistic approach, as opposed to the product-focused approach (Hodgkinson, 1993). However, the advantages of word processing extend beyond language teaching. In projects-based learning, the ease of editing allowed by word processors enhances students' capacity to rethink and revise. Using a strategy that Ehrmann (1995) calls "DIATing" – "Doing it Again – Thoughtfully" (p. 26) word processing is ideally suited for the developmental stages of project-based learning: plan, draft, conversation, another draft, conversation, final version – a process which provides opportunity for reflection (*ibid.*). The “comments” feature of word processing packages is, for example, a very useful tool in teaching writing skills as well as in postgraduate supervision.

Furthermore, extrapolating from the proposition that writing represents a unique mode of learning (Emig, 1983), the added value that word processing brings to writing should be

acknowledged. The capacity of writing to enhance learning is summarised by Boughey (1997:126-127):

- "By externalising and giving permanence to one's thoughts, the act of writing allows writers to consider, clarify, and revise those thoughts more readily than if they had not been written down".
- "The need to pay attention to the audience of the text prompts writers into anticipating and considering viewpoints other than their own".
- Since writing is produced and received in a context that lacks support for the communication of meaning (e.g. facial expressions or tone of voice), meanings in writing must be made explicit. "Understanding of the need to be explicit forces writers to engage with the prepositions contained in their text more than in speaking".
- While speaking allows participants to construct meaning through interaction, "writing is a lonely process requiring writers to explore, oppose, and make connections between propositions for themselves, a process which is conducive to learning".
- "The linear form of a finished piece of writing requires that thoughts be ordered and organised. The process of organising and ordering these thoughts means that the writer has to examine and manipulate those thoughts thoroughly".

Spreadsheets have the obvious advantage of automating calculations in numeric disciplines like Mathematics, Accounting, et cetera. However, their ability to graphically represent variables enhances their value for all disciplines with a mathematical structure, e.g. Natural and Physical Sciences (Knoetze, 1993). Spreadsheets are a particularly appropriate way to develop computer-assisted courseware based on simulation models (Cuttle, Young & Heath, s.a.). The opportunity to investigate models of real life systems can greatly enhance students' learning. Models of biological, chemical, physical and socio-economic systems can actively involve students in problem solving (*ibid.*). The advantage of this approach of developing courseware with spreadsheets (referred to as *LoCAL*) is that lecturers can build on and enhance their existing spreadsheet skills to develop educationally effective courseware from their existing spreadsheet data and databases (Tidball, s.a.).

The superior capabilities of **databases** to store, categorise and retrieve data can be used by students to create databases in collaborative project-based learning (Knoetze, 1993). The types of data that databases are able to store range from simple text to sophisticated environments of images and sound. Students can interrogate existing reference

databases which can direct them to suitable texts. As learning tools, image databases can be used to develop identification skills (Bogle *et al.,* 1997).

The rapid growth in functionality of ICTs opens possibilities for developing and exploiting information bases in ways that were simply not possible before (*ibid.*). Key drivers of this trend include:

- the possibility to digitise any kind of information, whether it be text, graphical, audio or video;
- growing functionality of electronic databases which allows storage of various digital formats and permit sophisticated data queries by also using Web browsers across an Intranet or the Internet;
- exponential growth in the processing power and storage capacity of personal computers which allows for huge databases to be created and extremely fast manipulation of data; and
- rapid developments in electronic communication which includes the convergence of information and communication technologies (Butcher, 1999).

One example of such a group project is GPPIS, a multimedia database for global plant and pest information using a decentralised interactive learning system (Laing, Lee, Nowell, Marsell & Putter, 1999). GPPIS uses a set of inter-related databases and several standard methods and protocols that enable participants to contribute, share and maintain data.

Software tools developed by universities for research

Examples of software tools that were originally developed by universities for research or teaching purposes include geographical information systems (GIS), assessment packages, authoring, graphics and modelling tools. For example, "the wide range of applications of geographical information systems in all areas of land used and environmental science has resulted in the development of teaching versions and data sets suitable for educational purposes" (Bogle *et al.,* 1997:5).

The learner-oriented applications of software tools described above are obviously not subject specific and can be used across many disciplines. On the other hand, courseware used with structured and predetermined learning tasks is in essence substituting activities and methods aimed at acquisition of reproductive knowledge and skills, well known in 'traditional' education (Collis, 1996).

Courseware or single purpose programs

In contrast to multipurpose programs, single purpose programs refer to those computer-based instruction programs which are developed for use in a specific course or discipline (Knoetze, 1993). This does not imply that single purpose programs can be used in only one way, however.

Alessi and Trollip (1991) describe an expository model of instruction that requires effective instruction to include four phases:

- the instructor presenting the information to the students,
- the instructor guiding the students' first interaction with the material,
- the students practising the material to enhance fluency and retention, and
- assessment of student learning to determine if they have learned the material and what they should do next.

Computer-based education constitutes the use of a computer to fulfil one or more of these phases (Knoetze, 1993; Alessi & Trollip, 1991). Applying their expository model to computer-based instruction, Alessi and Trollip (1991) distinguish five major types of courseware: *tutorials, drills, simulations, games* and *tests*, each of which fulfils one or more of the phases in the instructional process as outlined above. While tutorials are used to present information and guide the student through the initial acquisition, drills and games typically allow the student to practice for fluency and retention. Tests are used to assess the level of learning. Simulations may be used to present information, and to guide, drill and/or test the learner. Specific examples of educational software programs, which may also contain combinations of these types, include *History of the World* and *Nature 2.0* of Dorling-Kindersley and *Simcity* of Maxis.

Functions of software or courseware

Focusing on computer-assisted learning, Bogle *et al.* (1997) present another classification, based on the primary function of educational software packages. Courseware is designed to assist in the following seven activities, which are not mutually exclusive:

- assessment – what does the student know about ... ?
- information access – what is ... ?
- computer-mediated communication – let's share ideas ...
- model investigation – what if ... ?

- data analysis - what is the meaning of ... ?
- model creation - what is the relationship between ... ? and
- tutorial – teach about ...

Using this classification of Bogle *et al.* (1997), Table 2.1 uses a matrix to plot different types of software against various functions.

	Assessment	Data analysis	Tutorial	Model investigation	Model creation	CMC	Information access
Word processors	✓						
Spreadsheets		✓		✓	✓		
Databases		✓					✓
Electronic mail						✓	
Computer conferencing						✓	
Web browsers						✓	✓
Assessment programs	✓						
Statistical software		✓					
Mapping software		✓					
Drill & Practice			✓				
Tutorials			✓				
Simulations				✓			
Games				✓			
Programming languages / software				✓	✓		

Table 2.1 Classification of software according to their function

Assessment

The primary objective of computer-assisted assessment (CAA) is to promote reliability by counteracting declining levels of objectivity usually linked with assessment of increasing numbers of scripts, especially by more than one assessor (Kleeman, 1998; Bogle *et al.*, 1997). Also, computer-assisted assessment provides a wide variety of question types that may be more valid, reliable or efficient than the multiple-choice questions normally associated with objective assessment (Alessi & Trollip, 1991). CAA programs can also be used for formative assessment by developing and delivering self-evaluation quizzes with immediate or postponed feedback, in contrast to using them only to assess learning (Bogle, *et al.*, 1997).

Information access

Access to databases has been enhanced by the advent of the CD-ROM and the Internet. "Publication of large research databases on the World Wide Web (WWW) means that

they are no longer tied to their site of study" (Bogel *et al.*, 1997:6). Various Internet technologies (email, WWW, File Transfer Protocol) have the capacity to provide resources that combine one or more media (text, graphics, audio, video) relatively quickly and cheaply. Changes to resources are inexpensive and available almost immediately (Butcher, 1999).

Computer-mediated communication (CMC)

Asynchronous communication technologies like electronic mail, bulletin boards and listservs can facilitate discussion between teachers and experts, teachers and learners, and learners amongst one another. The major advantage of email is the capacity to facilitate ongoing communication at times that are convenient for the participants. "It is human nature to find ways to convert synchronous communications into asynchronous forms" (Gates, 1995:66). In addition, other technologies like chat rooms as well as audio and video conferencing can support real-time conversation.

Although computer-mediated communications have obvious advantages in distance education settings, it can also be used productively for on-campus students. Email and computer conferencing can offer high levels of synchronous and asynchronous interaction between lecturers and students, as well as amongst students, beyond the contact made in the traditional lecture and tutorial.

> *On a keyboard, the thoughtful have time to think and the shy have courage to speak, and the tedious can be deleted by the merciful stroke of a key or two (Farrington, 1999:85).*

The significance of computer-mediated communication becomes especially apparent in the light of Laurillard's (1993) *conversational framework* describing the process of academic learning. Particularly, asynchronous communication allows students to "consciously stand back from [their] experience and then, having reflected upon it, argue about it" (Laurillard, 1996:103).

> *Students are also given time to reflect on the problems posed and compose a more considered answer at their own pace, improving critical [thinking] and communication skills (Bogle et al., 1997:6).*

Computer-mediated communications will enable many universities to enhance intellectual interaction by re-creating a sense of academic community, which may have been eroded by growth and diversification (Daniel, 1996).

Model investigation

The investigation of simulation models are useful for representing complex relations (Laurillard, 1993) and presents one of the most effective ways to promote deep conceptual understanding of real world phenomena (Bogle *et al.*, 1997). By allowing easy manipulation of input values and immediate and effective presentation of results, simulations provide highly effective learning environments. Alessi and Trollip (1991) distinguish between simulations that teach *about* something (*physical* and *process* simulations) and those that teach *how to do* something (*procedural* and *situational* simulations). Some advantages of using simulations instead of real world experiences include the safety and availability of simulations, the ability to control the time frame and complexity of a simulation, as well as cost benefits. Compared to conventional tutorials, drills and tests, simulations enhance motivation, transfer of learning and efficiency (Alessi & Trollip, 1991).

Data analysis

While spreadsheets can be used for data analysis, an increasing number of dedicated packages are specifically designed for students and non-statisticians, featuring only the appropriate statistical functions, help on statistical theory and tips on the best test to use with specific data sets (Bogle *et al.*, 1997). Similarly, databases and geographical information systems (GIS) are used for data analysis.

Model creation

Building models from scratch requires the discipline of explicitly defining the relationships in a program and forces the student to think logically and very clearly about a problem. Such assignments develop skills in problem analysis, synthesis and validation (Bogle *et al.*, 1997). Although spreadsheets provide a particularly appropriate and easy way to develop computer-assisted courseware based on simulation models (Tidball, s.a.), models can also be built using programming languages or dedicated simulation languages such as *ModelMaker* (Bogle *et al.*, 1997).

Tutorials

Although Alessi and Trollip (1991) describe the functions of tutorials as presenting information and guiding the student through the initial use of the information, this original version of a tutorial has mutated to include practice exercises and (self) assessment.

> *The computer can provide illustration, animation, interaction and feedback to assist and enrich learning. Remedial help, self-assessment and supporting material can be made accessible within a 'secure', self-directed learning environment (Bogle et al., 1997:8).*

2.3.2.2 Computer-managed education

According to Alessi and Trollip (1991) Computer-managed instruction (CMI) systems were designed to provide instructors with administrative support for managing instructional material and activities. As an alternative to traditional group-based instruction, these programs were developed to deal with the data processing needs of individualised instruction and mastery learning programs, which require more frequent testing, record-keeping of individual students' progress and reporting of this information. The program also provides a prescription of activities that teach the objectives not yet mastered by an individual student.

2.3.2.3 Practical applications: Summary

This review of the application of ICT to teaching and learning reveals two important trends that should inform any initiatives to integrate technology into higher education curricula.

Firstly, similar to the combination of various functions in specific examples of CAL courseware (e.g. tutorials that also include drill and testing), the boundaries between computer-based education and computer-managed education have became less distinct over time. Contemporary courseware is developed and distributed with built-in management features. The University of Natal's *CAMESE*, for example, "makes use of Authorware's performance tracking functions as well as its ability to link to a database ... to provide the program with a management system" (Wade, 1998:3). Such a management system usually controls student access to the program through authentication and records students' progress through the content.

Secondly, developments in the field of computers in education have seen a gradual shift from focusing on computer-assisted learning (CAL) to focusing on computer-mediated communication (CMC). While computer-assisted learning emphasises the transfer of knowledge from a teacher (or computer program) to a learner in a transmission model of teaching, computer-mediated communications are associated with the construction of knowledge through social interaction, which fits in comfortably with Laurillard's (1993) *conversational* model of learning. In addition, CMC facilitates access to information resources, allowing users to be both consumers and publishers of information (Farrington, 1999).

> *The new information technologies make it possible to disseminate information faster than ever before, but their truly revolutionary aspect is that they allow each user to be a publisher of information as well as a*

> *consumer and to interact with vast numbers of people around the globe, simply, quickly, and inexpensively (ibid.:73).*

Undergraduate education should combine the teaching of a "solid basis of 'objective' knowledge and skills" (Plomp, 1999:18) that introduces students to a specific discipline with the development of "problem-solving abilities such as analysis and design skills" (*ibid.*). Similarly, the key challenge for the use of technology in teaching and learning is to find appropriate balances between the use of CAL courseware on the one end of the continuum and computer-mediated communications at the other end.

> *Educational decisions should be based on a deepening understanding of the ways in which face-to-face communications, telecommunications and independent work can fit together for the best learning and teaching (Gilbert, 1997:3).*

2.4 Conclusion

In an attempt to contextualise the enquiry into the needs and expectations of lecturing staff regarding the use of ICTs to enhance teaching and learning at Rhodes University, this literature study investigated the reasons why educators all over the globe are increasingly introducing ICTs into teaching and learning, notwithstanding the perception that research has yet to establish beyond doubt the value of technology-use in education. To develop a comprehensive profile of the current use of ICTs in higher education, this chapter also described some organisational prerequisites for successful integration of ICTs into teaching and learning before outlining specific applications of various technologies in different teaching and learning activities.

In this interpretation the rationale for the use of information communication technologies in teaching and learning had a triple focus. Firstly, higher education is increasingly being pressured to adapt to a changing environment. Secondly, the concept of knowledge, the very essence of universities, seems to have changed. Finally, while both the changing environment and the changing conception of knowledge dictate change in education, one of the core functions of the university, ICTs seem to hold the biggest promise for potential solutions (Greaves, 1998b; Daniel, 1996).

The investigation into the rationale for the increased integration of ICTs in teaching and learning has traced the evolutionary developments in:

- society and economy - from an industrial through an informational to a knowledge-based society and economy;
- concepts of knowledge - from abstract knowledge through individually constructed knowledge to socially constructed knowledge;
- perceptions of academic learning - from learning as imparted knowledge through constructivism, social constructivism and situated cognition; and finally in
- technologies - from stand-alone computers and multimedia, through local area networks, the Internet and WWW, and to *Knowledge Media*,

all of which suggest that information communication technology has an authentic role to play in higher education and specifically in the quest to enhance teaching effectiveness and learning productivity (Daniel, 1996).

However, any attempts to realise the vast potential of ICTs for teaching and learning in higher education should take cognisance of the equally complex natures of both university systems and information communication technology systems. "By the standards of most businesses universities ... are complex operations" (Daniel, 1996:133). While technological innovation has obviously contributed to this drive for transformation, it nevertheless holds the promise of potential solutions to problems faced by tertiary education (Gilbert, 1997; Greaves, 1997a; Daniel, 1996). "There seems to be rapidly growing acceptance that the ways in which information technology is used for teaching and learning will be a significant part of this transformation" (Gilbert, 1996:13). Some observers, such as Oberlin (1996) and Greaves (cited in University of Zululand, 1998), believe that information communication technologies present the only viable option for addressing these challenges:

> *Information technology will represent the single biggest opportunity to either enhance or damage an institution's competitive standing (Oberlin, 1996:22).*
>
> *An institution must commit itself seriously and in practice by diverting resources [to information technology] or its future will be under threat (Greaves, cited in University of Zululand, 1998:4).*

Chapter 3

Research Methodology

Using new technologies will have a visible impact on the university and so, in a changing world, will maintaining the status quo.

- John Daniel, 1996

Chapter 3 Research Methodology

3.1 Introduction

The purpose of this study is to describe the current use of information communication technologies to enhance teaching and learning at Rhodes University as well as the needs and expectations of lecturing staff in this regard. A survey was used as a descriptive method while an unstructured pilot interview and a self-completion questionnaire were used as data-gathering instruments.

3.2 Research problem

The major research question investigated in this research is:

How are information communication technologies currently being used to enhance teaching and learning at Rhodes University and what are the needs and expectations of lecturing staff in this regard?

3.3 Research questions

Table 3.1 uses a matrix to plot the subsidiary questions against the research instruments used. The matrix also indicates how answers to the sub-questions were collected as well as the section in Chapter 4 where each question is reported.

3.4 Research population

The population upon which the survey is focused is those members of the academic staff of Rhodes University who are involved with some form of lecturing, teaching or tuition. Rank descriptions of the target population include *Professor, Associate Professor, Senior Lecturer, Lecturer* and *Junior Lecturer*. Since the population was readily identifiable and it was possible to contact every member of this designated group, sampling decisions did not arise (Cohen & Manion, 1985). At Rhodes University some members of the research

How are ICTs currently being used to enhance teaching and learning at Rhodes University?				
Sub-question ⇩	**Instrument ⇨**	**Unstructured Pilot Interview**	**Questionnaire**	**Reporting section**
How well are teaching staff equipped with ICTs to enhance their teaching?		Researcher	1.1 a – 1.43 a	4.3.1 – 4.3.5
Which ICTs are currently being used by teaching staff for which purposes?		Researcher	2.1 a – 2.57 a 8.1 a – 8.2 a	4.4.1 – 4.4.7
What are the educational problems experienced by teaching staff?			12	4.5.1
How are departments involved in the development of materials and technical infrastructure?		Researcher	8.3 a – 8.7 a	4.5.2
What are the needs and expectations of teaching staff with regard to the application of ICTs to teaching and learning at Rhodes University?				
Which ICTs are required by teaching staff to enhance their teaching?		Researcher	1.1 b – 1.43 b	4.3.1 – 4.3.5
Which ICTs would teaching staff like to use for which teaching purposes?		Researcher	2.1 b – 2.57 b 8.1 b – 8.2 b	4.4.1 – 4.4.7
What educational problems could be addressed by using ICTs?			12	4.5.1
What are the computer skills training needs of teaching staff that will enable them to use ICTs in their teaching?			2.1 c – 2.57 c	4.4.1 – 4.4.7
What are the needs of teaching staff in terms of incentives, support and assistance to use ICTs in teaching?			9.1 – 9.9	4.5.3
What are departments' plans regarding development of materials and technical infrastructure?			8.3 b – 8.7 b	4.5.2

Table 3.1 Subsidiary research questions

staff also lecture. Since it was not possible to identify those research personnel who are also currently teaching, questionnaires were sent out to all 48 members of the research staff. Once the questionnaires were returned and it was possible to determine which researchers were also teaching, the returns from the researcher-lecturers were included in the total population of teaching staff.

3.5 Research design

Since the purpose of this study is to describe the nature of existing conditions, a small-scale survey was used to gather data from lecturing staff at Rhodes University. Having decided on the general purpose and primary objective of the survey, the main research question was subdivided into subsidiary questions.

3.6 Research instruments

Both qualitative and quantitative techniques were used in the study. While unstructured (ethnographic) interviews were used to identify and formulate specific information requirements that were used in the development of the self-completion questionnaire, this questionnaire (Appendix A) was used to gather both quantitative and limited qualitative data.

3.6.1 Unstructured pilot interview schedule

The purpose of the unstructured pilot interviews was to identify the issues that needed addressing and to formulate specific information requirements for the survey. These pilot interviews were primarily focused on lecturing staff from the Faculty of Pharmacy at Rhodes University. While background information regarding the requirements of the researcher and the general situation in this Faculty were exchanged during a roundtable discussion, subsequent interviews with selected members of the teaching staff, representing different departments within the Faculty, were aimed at itemising specific data requirements. In addition, the Head of the Department of Computer Science, who also acted as chair of a 1996 Information Technology Review Committee, and the Dean of the Faculty of Law were interviewed.

While the interviews focused on the general features of ICT use for teaching and learning in the different academic departments, specific questions addressed in the interviews were:

- How were ICTs used in the past to enhance teaching and learning in the department?
- How are ICTs currently being used to enhance teaching and learning in the department?

- What are the needs and expectations of academic staff with regard to the use of ICTs to enhance their teaching?

3.6.2 Self-completion questionnaire

While the unstructured interviews provided the majority of the information requirements for the survey, some items were adapted from questionnaires of other similar surveys that were consulted (Greaves, 1998b; Foundation for Research Development, 1998; Greaves, 1997b; Green, 1996a).

To establish the availability of and need for ICTs to members of the teaching staff, Question 1 of the survey questionnaire (Appendix A) focuses on access to:

- hardware in lecturing staff offices (i.e. allowing daily access);
- hardware within academic departments (i.e. allowing relatively easy access);
- hardware within the University (i.e. reasonable access through booking);
- software in staff offices; and
- staff members' access to hardware and software at home.

Question 2 of the survey questionnaire investigates current staff use, aspirations to use and training needs to use ICTs for:

- preparation of study material and for lectures;
- presentation of lectures;
- communications with students and colleagues;
- practicals and tutorials;
- assessment of student learning; and
- evaluation of teaching and courses.

While Questions 3 to 7 focus on student access to ICTs and student computer literacy, Questions 8 and 9 investigate teaching of off-campus students and issues in the development of teaching materials and technical infrastructure. Questions 10, 11 and 12 respectively request respondents to describe their past use of ICTs for teaching and learning, referenced documents describing past use of ICTs and educational problems experienced by staff. Due to the limited scope of this study which focuses primarily on teaching staff, Chapter 4 does not report on Questions 3 to 7, and 10 and 11.

Cohen and Manion (1985) propose that an ideal questionnaire should be clear, unambiguous and uniformly workable as to minimise potential errors from respondents and coders. "Since people's participation in surveys are voluntary, a questionnaire has to help in engaging their interest, encouraging their cooperation, and eliciting answers as close as possible to the truth" (*ibid.*:103).

In order to enhance the clarity of the questions, six lecturers, representing different faculties, ranks and management positions, as well as staff members in the Academic Development Centre were requested to pilot draft copies of the questionnaire. These members of staff were requested to indicate any ambiguous or unclear instructions or questions and to inform the researcher of any issues that were not addressed adequately in the questionnaire, but which they felt should be included. Some of their recommendations were incorporated in the design of the questionnaire.

Strategies to encourage cooperation and increase the response rate included printing the questionnaire on a conspicuous bright blue coloured paper and binding the complete questionnaire, together with the covering letter in an easy-to-handle booklet format. Furthermore, the questionnaire was sent out under the auspices of the Academic Development Centre (ADC) with the Director of the ADC and the researcher co-signing the covering letter.

3.7 Data collection procedure

Using the Rhodes University telephone directory, a database of all academic staff was developed in *Microsoft Access 97*. Since some members of staff joined the University only after the telephone directory had been compiled, the database was updated using a list of new staff members obtained from the Personnel Division. Using address labels printed from this database, questionnaires were addressed to each member of the target population. Questionnaires were sent to respondents and returned to the researcher via internal mail.

3.8 Data analysis

A survey is perhaps the most commonly used descriptive method in educational research (Cohen & Manion, 1985). While this survey primarily provides frequency counts, the processed data is used to present relational analyses. Although the questionnaire

essentially elicited quantitative data, qualitative data was also obtained by requesting respondents to "add any other relevant information or explanations in the margins or on separate pages" (see *Instructions* on page A-2 of *Appendix A*).

While *Microsoft Access 97* was used to record all the responses of all the respondents, analysis of the data was done with *Microsoft Excel 97*, due the need to design graphs to illustrate the quantitative data.

3.9 Conclusion

In order to provide a conceptual overview of the research process, this chapter described the research problem, research questions, target population, research design, research instruments, data collection and analysis procedures in detail. Reporting on the research findings, Chapter 4 firstly addresses the representivity of the respondents as compared to the whole of the target population. Chapter 4 also interprets the results of the analysed data.

Chapter 4

Research Findings

Campus strategic plans indicate an increasing awareness of the 'critical role' of information technology as a resource for instruction and learning.

- Kenneth C Green, 1998

Chapter 4 Research Findings

4.1 Introduction

Successful implementation and use of information communication technologies (ICTs) to enhance teaching and learning share some important prerequisites with designing information systems for organisations. Foremost, an important principle for designing effective information systems in organisations is close interaction between systems analysts, who are primarily responsible for developing the system, and end-users, who will actually use the completed system (Laudon, Traver & Laudon, 1996). Secondly, two key ingredients of successful information systems implementation are the involvement of end-users in the change process and the training of end-users to enable them to change (*ibid.*). Likewise, effective implementation and use of ICTs for teaching and learning requires a collective effort (Gilbert, 1997; Daniel, 1996) which, amongst others, also acknowledges and accounts for the needs and expectations of academic staff and students – the end-users of ICTs for teaching and learning.

> *"There seems to be some correlation ... between institutional success and the level of participation of staff in governance. This should not be surprising, for knowledge-based industries work best with management processes based on teams and consensus rather than on hierarchy and authority" (Daniel, 1996:128).*

While the ICT requirements of students fall beyond the scope of this study, the perspectives, needs and requirements of the teaching staff as primary end-users of technology for teaching is investigated. Chapter 4 reports on the following two subsidiary research questions:

- How are information communication technologies being used to enhance teaching and learning at Rhodes University?
- What are the needs and expectations of lecturing staff with regard to the use of ICTs to enhance their teaching at Rhodes University?

While these two questions clearly view the area of research from different perspectives, their close inter-relatedness calls for them to be reported on in tandem. Thus, this chapter will address both these questions simultaneously under the headings and subheadings as provided by the overview of this chapter in Table 4.1.

How well are lecturers equipped with ICTs to enhance their teaching and what are their needs in this regard?	**Section 4.3**
Hardware in staff offices	4.3.1
Hardware in academic departments	4.3.2
Hardware within the University	4.3.3
Software	4.3.4
ICTs at home	4.3.5
Which ICTs are being used for which teaching purposes, what would lecturers like to use and what are their training needs in this regard?	**4.4**
Preparation	4.4.1
Presentation	4.4.2
Communication	4.4.3
Practicals and Tutorials	4.4.4
Assessment of student learning	4.4.5
Evaluation of teaching and courses	4.4.6
Teaching off-campus students	4.4.7
What are lecturers' current attempts, needs and future plans to integrate ICTs into teaching and learning?	**4.5**
Educational problems experienced by lecturing staff	4.5.1
Development of materials and technical infrastructure	4.5.2
Incentives, support and assistance	4.5.3

Table 4.1 Overview of Chapter 4

4.2 Survey results

While the complete results of the survey are available in Appendix B, the results of questions 1, 2, 8, 9 and 12 are discussed in this report.

4.2.1 The target population

The population upon which the survey was focused is those members of the academic staff of Rhodes University who are involved with some form of lecturing, teaching or tuition. A total of 392 survey questionnaires were sent out to academic staff, which included 344 lecturing staff and 48 research staff. Since the survey was exclusively aimed at teaching staff and only eight members of the research staff indicated that they were teaching, the remaining 40 (i.e. 48 minus 8) questionnaires sent out to researchers were

subtracted from the total number of questionnaires sent out. The total population was therefore calculated to be 352 (392 minus 40) lecturing staff. Figure 4.1 depicts a graphical representation of the numbers of academic staff with the target population indicated in colour.

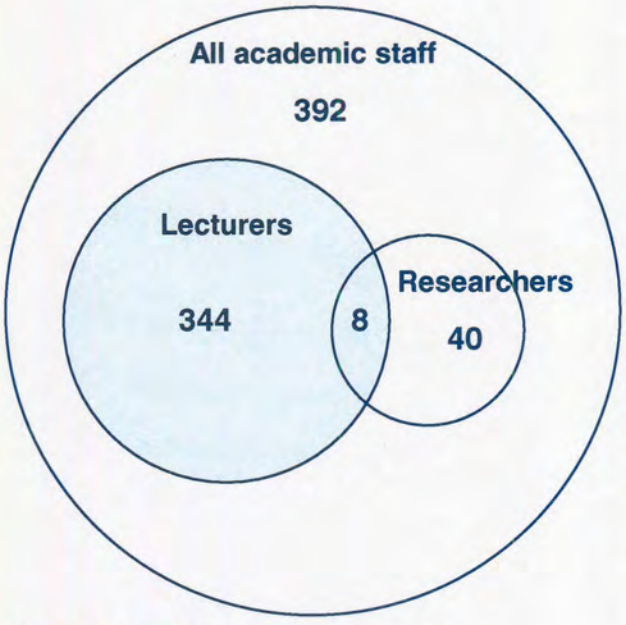

Figure 4.1 The target population

Consequently, the 95 questionnaires that were returned in time for processing represent a return rate of 27%.

4.2.2 Representivity of respondents

In order to contextualise responses, this sub-section aims firstly to establish the level of representation of faculties and post grades (or ranks) in the group of respondents, i.e. by reporting on the proportion of respondents per faculty (across post grades) as well as the proportion of respondents per post grade (across faculties).

Next, the representation of faculties and ranks in the respondent group is compared with the representation of faculties and ranks in the whole of the population of teaching staff. The aim of this exercise is to establish the representivity of the group of respondents. The degree of respondents' representivity relates directly to the level of credibility and validity of the research results: the more representative the respondents are of the population, the more credible and valid the results will be.

This data is also used to determine the level of significance attributed to the instructional use of ICTs by any subset of respondents. With acknowledgement that other factors also

influence the returning of questionnaires, in this analysis, a higher level of representation is assumed to indicate a higher level of importance attributed to instructional use of technology by any subset of respondents.

Finally, the representivity of the respondents across Rhodes University's two campuses is compared.

4.2.2.1 Faculties

Portraying the representation of faculties in the group of respondents, Figure 4.2 illustrates that the Faculties of Science and Humanities roughly contributed about one third of the responses each, while the remaining four faculties and research institutes constituted the last third. (Note: percentages are rounded to the nearest integer.)

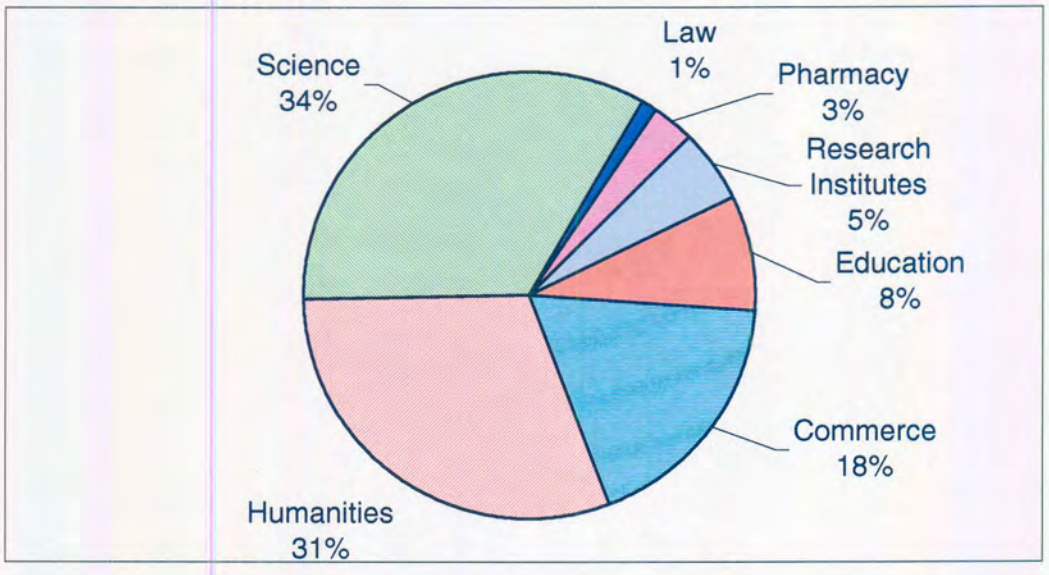

Figure 4.2 Respondent ratio per Faculty

However, since the different faculties do not have the same number of lecturers, they are not equally represented in the total population of lecturers. A comparison between the ratios of respondents per faculty and lecturers per faculty will therefore reveal more meaningful information. Figure 4.3 uses a three-dimensional column chart to portray the same data as the above pie graph (depicted in the first series in the front row of columns). This time, however, it is juxtaposed to the ratio of all lecturers per faculty (the second series represented in the back row of columns).

Taking the Faculty of Law as an example, while 1% of the respondents (i.e. 1 out of 95) teach in the Faculty of Law, 5% of all lecturers at the University (i.e. 16 out 352) teach in this Faculty.

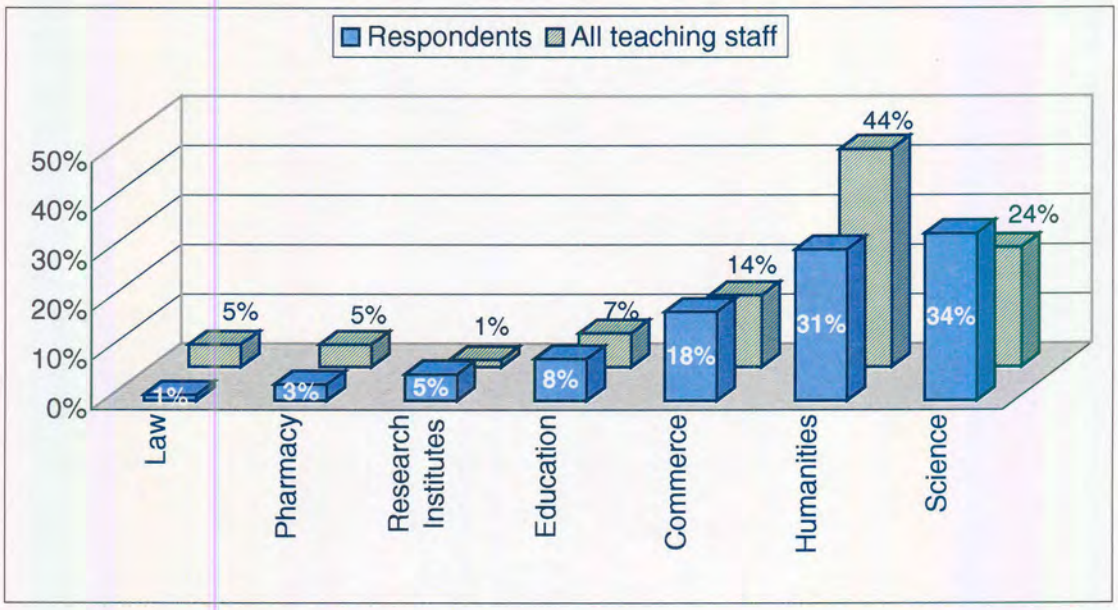

Figure 4.3 Comparison between respondent and lecturer ratios per Faculty

This figure illustrates a close correlation between the ratio of respondents per faculty and the ratio of lecturers per faculty with no more than a four percent difference in any of the faculties, excluding Humanities and Science. Furthermore, comparing the ratio of respondents to the ratio of all lecturers per faculty, three faculties have a slightly higher proportion of respondents: Education (1% higher), Commerce (4%) and Science (10%). This might indicate a higher degree of significance attributed to educational technology by staff members of these faculties than by the staff of other faculties and research institutes. In the Humanities, the gap of 13% between respondent ratio and lecturer ratio might indicate a significantly lower interest of lecturers in that Faculty in the use of technology, as compared to the other faculties.

4.2.2.2 Ranks

The ranks or post-levels of respondents provide another indication of both the respondents' level of representivity of the total population of lecturers, as well as the relative significance and value attributed to the educational uses of technology by the University's lecturers. If, for example, all the respondents were junior lecturers, the research results would obviously not bear the same weight than if staff in higher grades

were represented in the respondent group. Figure 4.4 represents a breakdown of respondents according to their designations.

In this discussion "other" refers to *Professor Emeritus, Retired Professor, Director, Senior Instructor, Instructor, Academic Development staff, English Language for Academic Purposes (ELAP) Coordinator* and *Distance Education Tutor.* Also, the eight researchers who responded to the questionnaire were added to the numbers of their equivalent teaching staff ranks. *Senior research officer* or *fellow* is equivalent to *senior lecturer*, *research officer* is equivalent to *lecturer*, and *research assistant* or *junior research officer* is equivalent to *junior lecturer* (Rhodes University, 1999b).

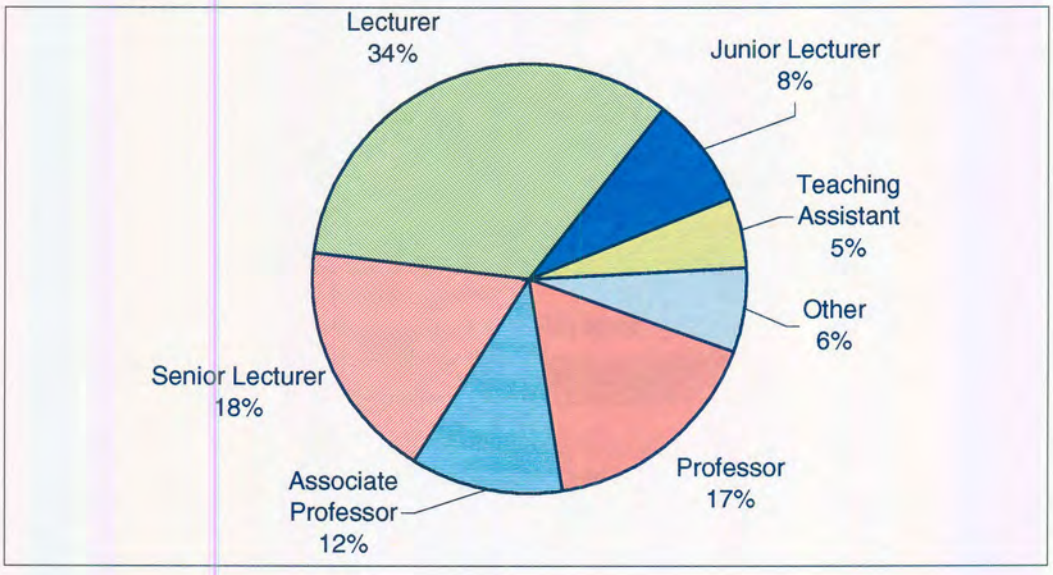

Figure 4.4 Ratio of respondents per rank

When this data is compared to the representation of all lecturing staff in the various post-levels (Figure 4.5), a close resemblance between the ratio of respondents per rank and the ratio of lecturing staff per rank is evident. Across all ranks the difference between the respondent ratio and lecturer ratio is never bigger than three percent. Focusing on administrative management positions, the last item in each series (encircled in red) further illustrates that the proportion of respondents who are either deans or heads of departments (14%), exceeds the proportion of deans and heads of departments for the whole of the target population (9%).

Both Figure 4.3 and Figure 4.5 provide evidence of the respondents' high level of representivity across academic faculties as well as ranks of teaching staff.

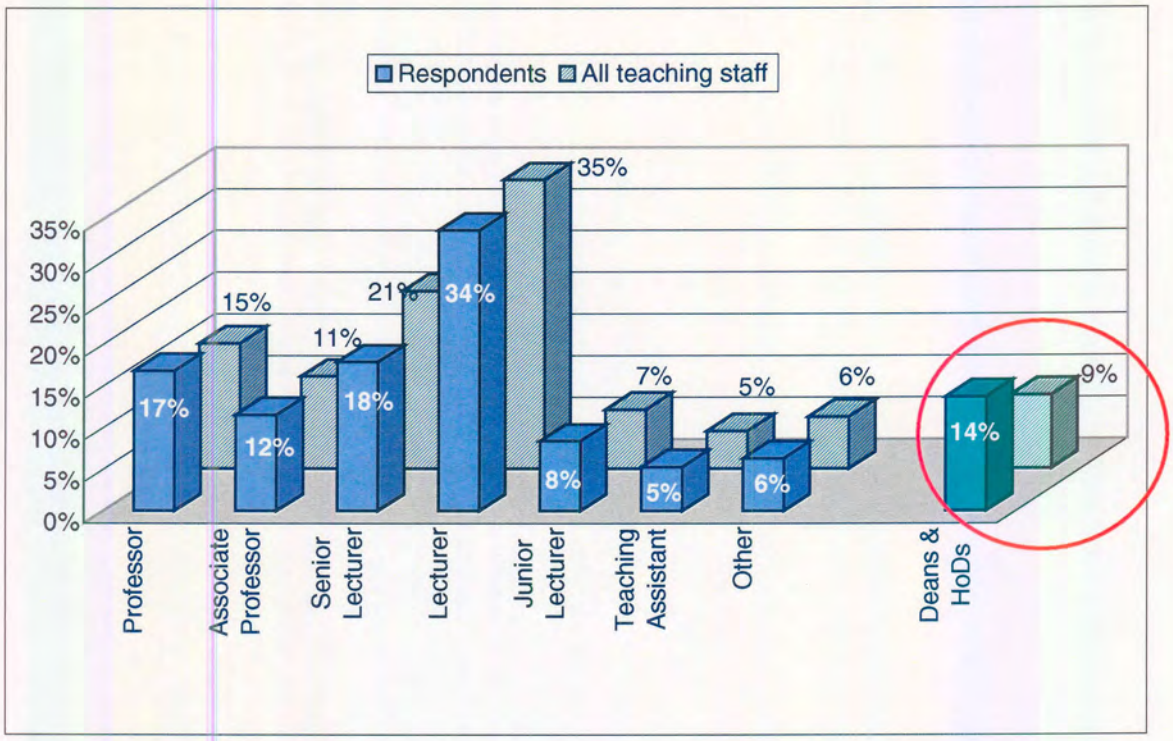

Figure 4.5 Comparison between respondent and lecturer ratios per rank

If the response rate per rank is indicative of the level of significance attributed to the instructional uses of ICTs, this data clearly indicates beyond doubt that the lecturing staff regard the use of education technology as important.

4.2.2.3 Campuses

Finally, by focusing on the representation of respondents across Rhodes University's two campuses, Figure 4.6 reveals that the ratio of respondents from the East London campus (7%) is five percent lower than the ratio of all teaching staff from the same campus (12%).

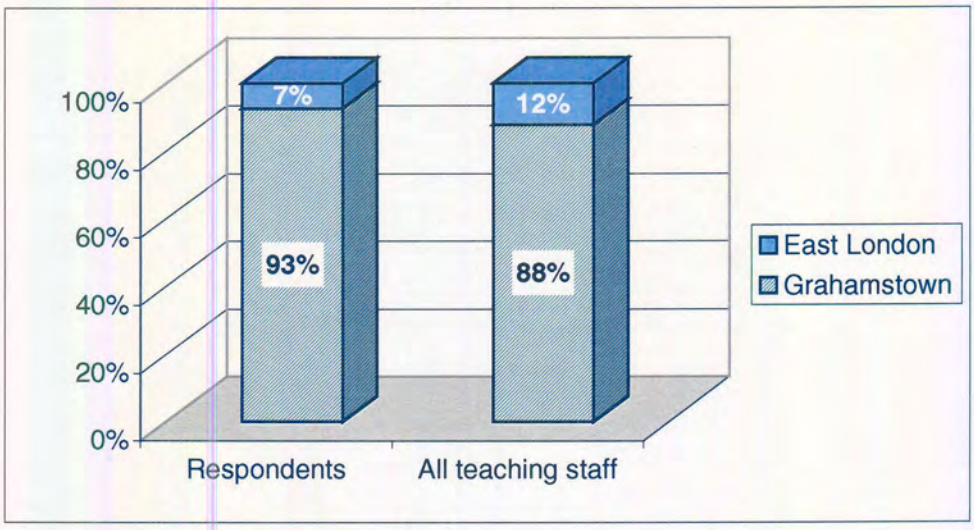

Figure 4.6 Comparison between respondent and lecturer ratios per campus

4.2.3 Survey results: Summary

The preceding analysis provides evidence that the 95 respondents (resulting in a return rate of 27%) is sufficiently representative of the total population of 352 lecturing staff to generalise the research results for all of the lecturers. This representivity was established not only across faculties, but also over grades of lecturing staff and across campuses.

4.3 How well are teaching staff equipped with ICTs to enhance their teaching and what are their needs in this regard?

The availability of ICTs to lecturers as well as their needs for ICTs are discussed under the following headings:

- hardware in lecturing staff offices (i.e. allowing daily access), Section 4.3.1;
- hardware within academic departments (i.e. allowing relatively easy access), Section 4.3.2;
- hardware within the University (i.e. reasonable access through booking), Section 4.3.3;
- software in staff offices, Section 4.3.4; and

- staff members' access to hardware and software at home, Section 4.3.5.

4.3.1 Hardware in teaching staff offices

Information about the level of sophistication of hardware in staff offices focused on different generations of the microprocessors in computers, the type of printers, the availability of multimedia, scanners and voice recognition systems (VRS).

4.3.1.1 Personal computers

Figure 4.7 illustrates that 64% of lecturing staff have access to at least one desktop computer with a Pentium microprocessor or better in their offices. In addition, (although not captured by this graph), 4% of respondents declared access to more than one computer in their offices, while 3% disclosed access to laptop computers. However commendable this provision of high-end machines is for the University as a whole, it offers little consolation for those individual members of staff (24%) who have to work with less powerful computers, or those who had to buy their own equipment (4%). Attesting to this need, 5% of respondents indicated their need for a computer in their offices while 3% commented that they required an upgrade (not depicted in this graph).

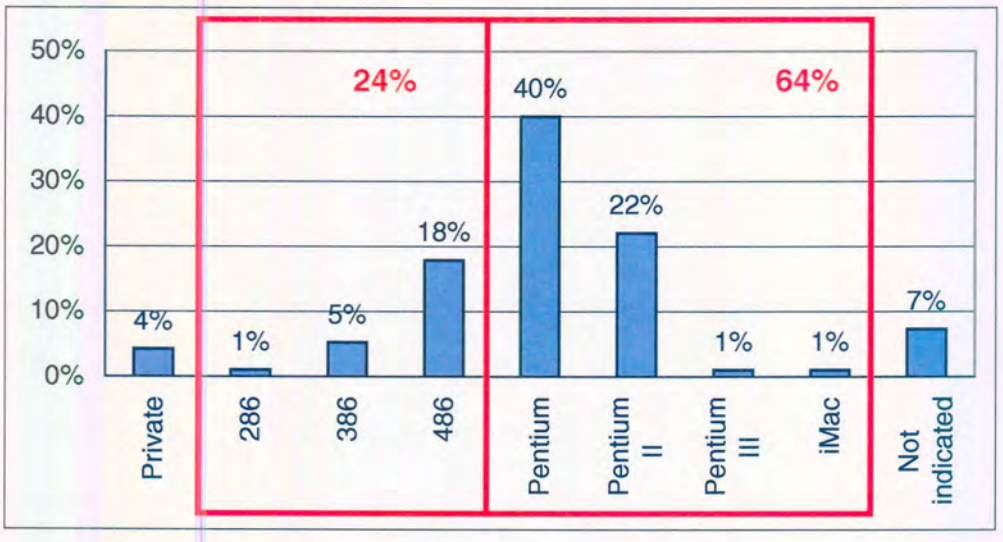

Figure 4.7 Types of microprocessors of staff computers

There are however some factors that might have influenced the validity of this data.

In the "Instructions" of the questionnaire, respondents were informed that a non-response to a specific item would be assumed to indicate "not applicable" to them or their needs.

Although 7% of the respondents have not indicated any access to computing facilities, 6% have in subsequent questions claimed that they use some of the technologies.

Moreover, it was not possible to determine whether respondents were actually knowledgeable enough to answer this question accurately. One respondent's comment on the whole of Question 1 supports this possibility:

> *"Don't know what these are. Sorry – I am hopelessly out of my depth here. Step 1 of capacity building is information on what these things are or can do. Why would I want them?"*

To accommodate for end-users' possible limited knowledge of computer configurations, it is suggested that future surveys provide respondents with a list of basic configurations, each of which should include specifications for hardware, operating system and software. Respondents could then be required to make a choice between the various configurations by indicating the one that matches their own equipment most. To prevent confusion, they should also have the option to indicate that they do not have access to a computer.

4.3.1.2 Printers in teaching staff offices

In line with networked environments at other tertiary institutions as well as business and government organisations, staff at Rhodes University are provided with access to printing facilities through the local or wide area networks by way of print servers. Supporting this principle, 24% of respondents indicated that they do not have access to a printer in their offices (see Figure 4.8) while 93% indicated that they have access to shared printing facilities within their departments (see Figure 4.9 on page 63).

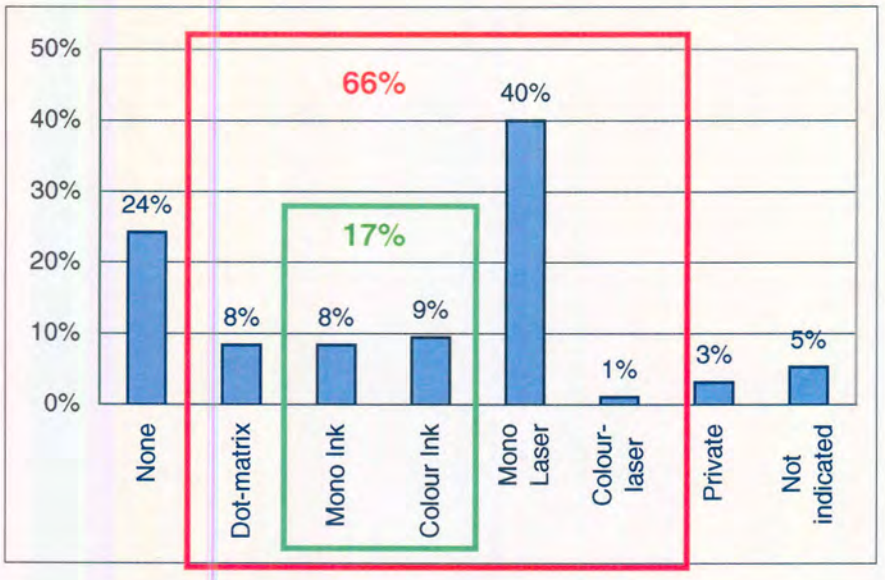

Figure 4.8 Printers in staff offices

Counteracting the intention of this principle however, in addition to shared printing facilities (to be reported on in Section 4.3.2.1 on page 62), some 40% of the respondents reported access to laser and 17% (8% + 9%) to inkjet printers in their offices. Furthermore, while 7% of the respondents remarked that they had two printers (laser and inkjet) in their offices (not reflected in this chart), 9% indicated their need for a printer in their offices and 3% would like to have access to shared printing facilities within their departments. (See Section 4.3.2.1 on page 62 for an in-depth discussion on the provision of printers).

4.3.1.3 Multimedia

Fifty nine percent of respondents have a CD-ROM drive in their computers, whilst 43% indicated the availability of a soundcard and 39% have speakers available. Although not investigated by the questionnaire, 3% of the respondents remarked that they had access to a CD-writer. However, 17% of the respondents indicated that they would like to have multimedia peripherals. In the absence of an explicit policy on the provision of multimedia this discrepancy needs further investigation, especially in the light of the growing number of multimedia programs and courseware available on CD-ROM and the Internet.

4.3.1.4 Scanners and Voice Recognition Systems

While 11% of respondents indicated access to an optical scanner available in their offices, 20% expressed their need for one. As teaching staff begin to produce digital

versions of course materials for distribution either through the Local Area Network or the Internet, the need for optical scanners will probably increase. Large-scale acquisition of optical scanners might not be the best solution. Similarly, the provision of optical scanners as a bookable facility is not viable, because a scanner has to be connected to a computer and the drivers (software) have to be installed onto the hard disk of the computer. It is therefore recommended that the current availability of scanners be publicised so as to provide lecturing staff with a choice of scanners to use. It is also recommended that a long-term strategy to supply lecturing staff with access to optical scanners within their departments, similar to the strategy to provide printers, be developed.

Only one respondent has a voice recognition system (VRS) in his/her office whereas 19% remarked that they would like to have a VRS in their offices. The application of voice recognition systems in education seems less obvious than some of the other technologies. Nevertheless, by replacing keyboards as input devices, these systems, which can be considered as personal productivity tools, will become increasingly significant especially for users without touch typing or keyboard skills.

4.3.2 Hardware available in academic departments

The purpose of this investigation is to focus on those peripherals that are needed by lecturing staff for teaching and learning purposes, but that can be shared amongst colleagues within the same department without inhibiting productivity: printers, optical scanners, digital cameras and video camcorders.

4.3.2.1 Printers in academic departments

As indicated by Figure 4.9, 82% of respondents have access to monochrome laser printers within their departments. Although not reflected in this figure, 21% of the respondents claimed that they have access to two printers (laser and inkjet) in their departments, while 4% disclosed access to four printers (laser, colour-inkjet, monochrome-inkjet, dot-matrix) in their departments.

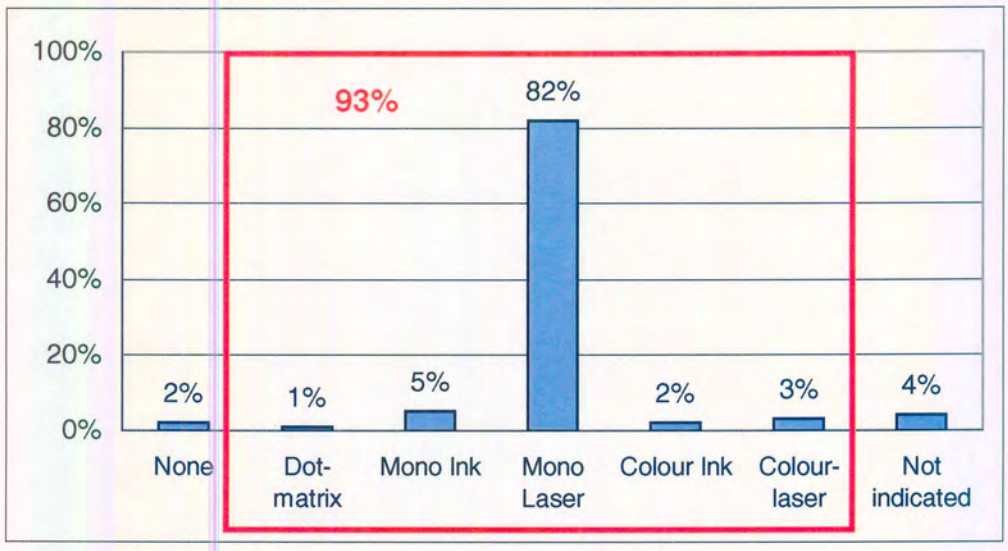

Figure 4.9 Access to printers in academic departments

Since many of the respondents belong to the same department, the respondents' access to departmental printers does not offer a true reflection of the provision of printers per department. While Figure 4.10 organises this data according to the number of printers per department, Figure 4.11 (page 64) illustrates the types of printers per department. Figure 4.10 illustrates that 26% of departments provide staff with access to three or more printers.

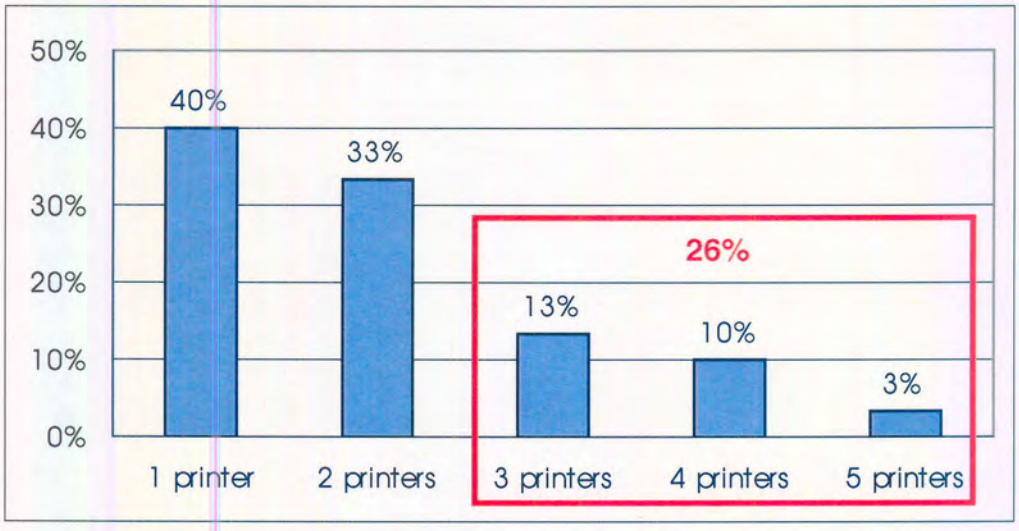

Figure 4.10 Number of printers per department

As illustrated by Figure 4.11, departments with one printer typically have a monochrome laser printer, while departments with two printers typically have access to a monochrome laser and either a colour or monochrome inkjet printer, or a dot-matrix printer. It is

possible that some respondents did not report dot-matrix printers because they are not used anymore. (Although a breakdown of hardware per department is beyond the scope of this study, such an analysis might provide valuable information for strategic technology planning purposes at Rhodes University).

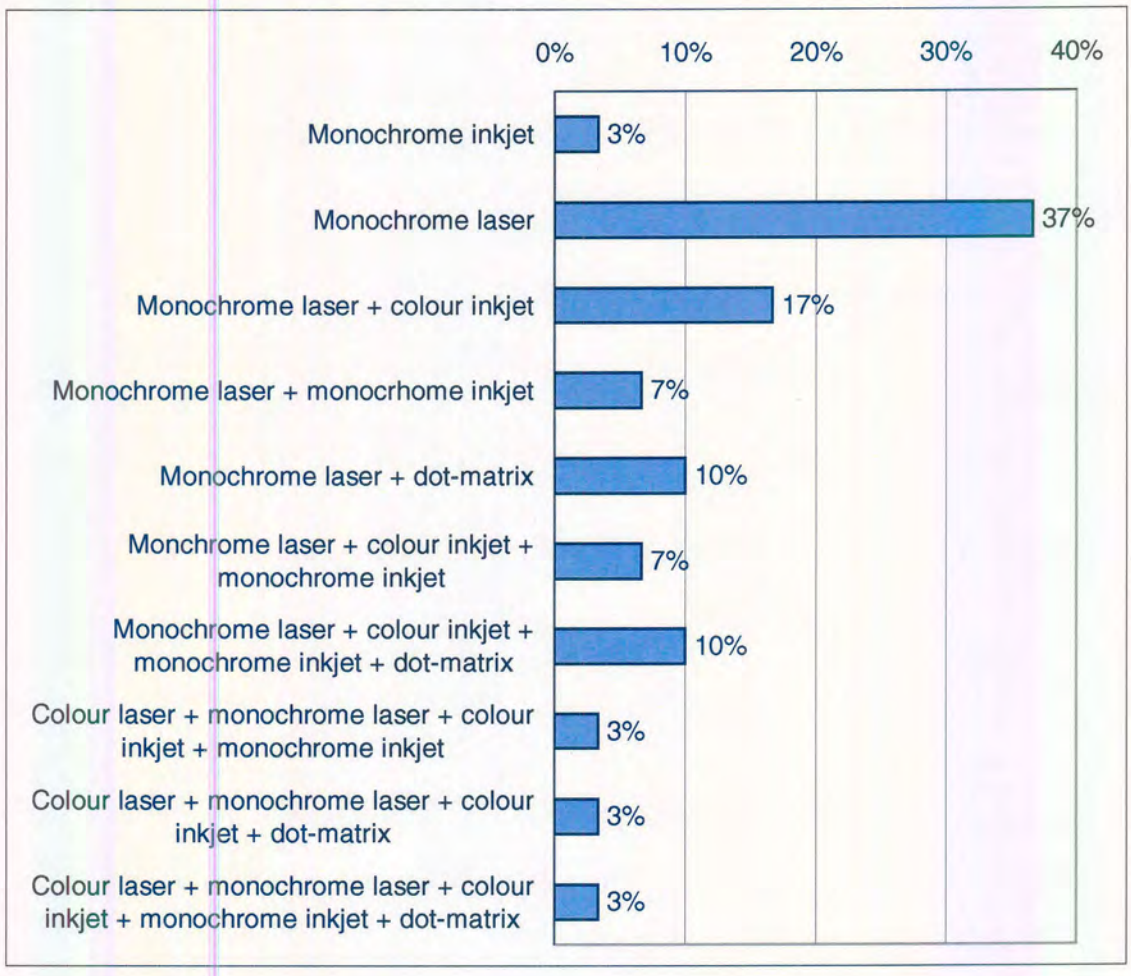

Figure 4.11 Type of printers per department

One possible explanation for staff having access to both office and shared printing facilities is that their offices might be isolated from the rest of the department's offices, e.g. located on a different floor or in a different building on the campus. Also, it is acknowledged that academic staff might need access to both monochrome and colour printers. However, the fact that 66% of the respondents indicated access to an office printer (see Figure 4.8 on page 61) and 7% declared two printers in their offices (see Section 4.3.1.2 on page 60) despite the availability of shared printing facilities, might indicate a possible oversupply of printers. Supporting this likelihood, 26% of the departments are reported to provide access to three or more printers (see Figure 4.10 on

page 63), while 2% of the respondents, on the other hand, indicated no access to shared printing facilities, and 3% expressed their need for access to shared printing facilities.

While this possible oversupply of printers, both in staff offices and in departments, could be ascribed to the increasing capacity and quality of printers over time, this could also suggest the possible absence of mechanisms or procedures to redeploy functioning equipment or dispose of obsolete equipment. The apparent abundance of printers in some departments and seemingly shortage in others may thus be attributed to a possible lack of effective asset management. The imperative for effective asset management of information technology has been highlighted in Chapter 2 (see *Financial planning*, Section 2.3.1.1 on page 24), together with a description of the essential differences between asset management of information technology as compared to other capital equipment (Oberlin, 1996). It is recommended that Rhodes University adapt its asset management of information technology to match the special requirements thereof.

4.3.2.2 Scanners, digital cameras, video camcorders and data projectors

The proportion of respondents indicating relatively easy access to scanners, digital cameras and video camcorders within their departments is 41%, 13% and 26% respectively while 14%, 21% and 20% of the respondents related their need for access to the same equipment. Two percent of the respondents disclosed access to data projectors within their departments while one respondent also indicated departmental access to an ISDN Video Conference Unit. Other equipment that were mentioned as being needed in academic departments are laptop computers, data projectors and colour laser printers.

Similar to the use of optical scanners as described in Section 4.3.1.4 (page 61), digital cameras and video camcorders will increasingly be used to create course materials in digital format. Creating a technology rich environment where these tools are available and easily accessible to teaching staff is essential if the University wants to capitalise on the advantages presented by ICTs.

4.3.3 Hardware available within the University

The aim of this inquiry into the availability of hardware within the University is to establish lecturing staff access to those perhaps more expensive facilities, that are not available within their own departments, but are provided by the University through central units and thus have to be booked in advance. Respondents indicated access to liquid crystal display slates (23%), data projectors (29%), scanners (24%), digital cameras (5%) and

video camcorders (14%). In spite of the fact that the University provides laptop computers and data projectors as bookable facilities for the purpose of electronic presentations, 15% of the respondents indicated that they would like to have access to data projectors. One respondent may have captured the general sentiment of teaching staff by commenting that they *"need more than the current holdings"*. At least 2% of the respondents commented on the unavailability and poor quality of video equipment.

Other respondents indicated their need for access to liquid crystal display panels and scanners (both 8%), digital cameras (21%), video camcorders (14%) and photo slide scanners (1%). The respondents (8%) who observed a need for access to liquid crystal display panels might not be aware of the superior quality of the display of data projectors as compared to that of liquid crystal display slates.

A comment that may indicate cause for concern states "*I don't know what is available and what I would use it for*". Such a comment seems to attest to possible ignorance on the part of some members of the teaching staff. It is therefore recommended that the availability of the equipment be more widely publicised and that their operation and functions be demonstrated in the computer literacy courses offered by the Information Technology Division.

4.3.4 Software

This section of the questionnaire attempted to establish the kinds of software lecturing staff members have available to use and which software they need as tools for teaching purposes. The focus was not on educational software or courseware, but rather on office automation or personal productivity tools, computer-mediated communication tools, authoring, programming and referencing software. It should also be noted that it was not the intention of this survey to determine which software suites of which developers were used or needed (e.g. Microsoft or Corel).

Figure 4.12 clearly indicates the high availability of word processors (91%), electronic mail (87%), Web browsers (81%) and spreadsheets (75%). In stark contrast, the limited availability of authoring (2%), desktop publishing (8%), referencing (13%) and programming software (14%) could be ascribed to the specialised applications of these programs. The highest incidences of needs were recorded for reference software (encyclopaedia) and desktop publishing software (both 15%), HTML editors (13%), graphics software (12%) and authoring software (11%).

Apart from reference material, desktop publishing, authoring and programming software, all the other types of software are available at Rhodes University under various site licence agreements with software developers and/or vendors. One possible explanation for some staff members' lack of access to these software may relate to limitations in the hardware that they have available.

Specialist software that teaching staff have available includes software for statistical analysis (*Statistica*, *Statgraphics*), geographical information systems, remote sensing software, *Scientific Word*, *Quark Xpress* (desktop publishing), *Latex* (typesetting), *Finale* (Music), *ArcInfo and Arcview*, *Photo Access* (photo manipulation), and *Pastel* (Accounting). However, the need for some of the same software was indicated by other respondents: quantitative data analysis packages (*Statistica, Statgraphics, SAS & SPSS PC*), geographical information systems and remote sensing software and Accounting packages (*Pastel*). Some of the required software packages that are apparently not at all available at Rhodes University include qualitative data analysis packages (*Nudi*st*), Project Management tools, Reference Management tools (*"for managing research papers, etc."*), and electronic meeting systems.

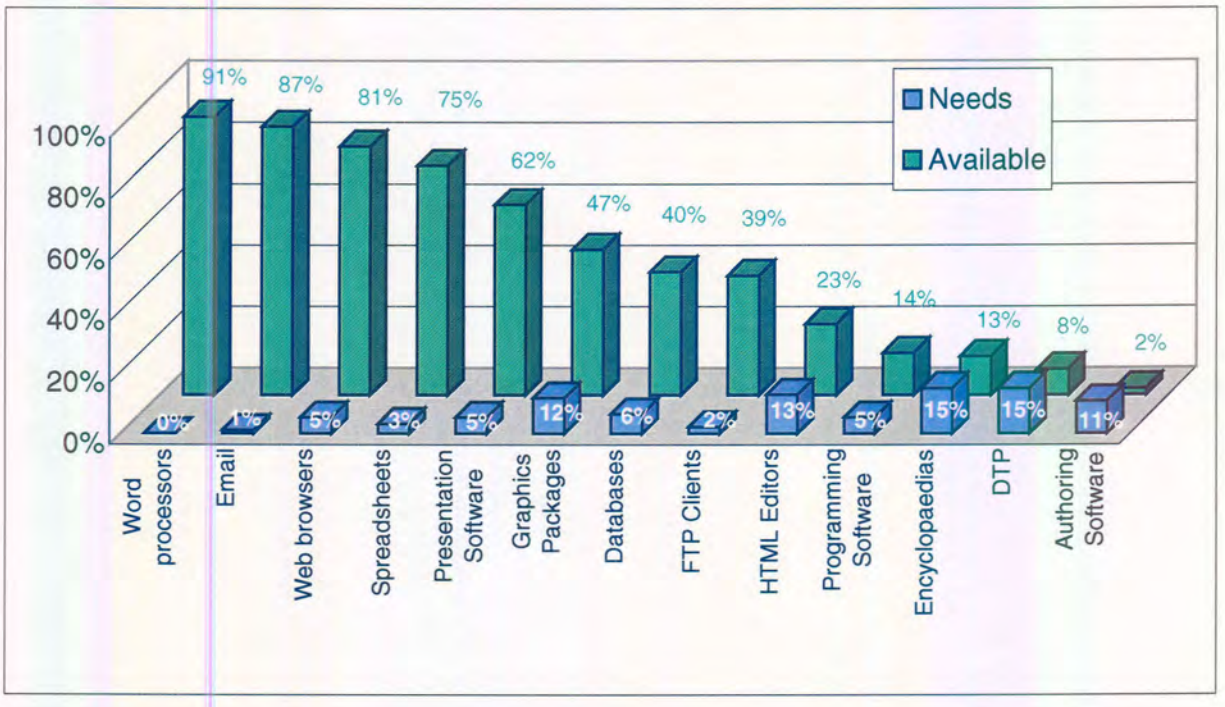

Figure 4.12 Software

It is clear that the range of software that is used is too wide for the University to provide high-level support for each type of software. The Information Technology Division does

indeed provide software support to only a specified list of standard software. Since the Information Technology Division is situated ideally to become aware of any software support needs, it is therefore recommended that the Division organise user support groups for those software packages for which they do not provide training and support.

4.3.5 Computing facilities at home

Due to the nature of the teaching profession, members of lecturing staff are continuously required to work at home, either by preparing for lectures or marking assignments. Furthermore, the academic system allows lecturers extended periods of study leave (referred to as *sabbaticals*). These factors not only necessitate the availability of computing equipment at home, but also require compatibility between office and home facilities in order to effortlessly transfer data between these two environments. In order to use the Internet and email for research, staff on sabbatical require communication lines from their home computers. Providing a summary of respondents' access to computing facilities at home, Figure 4.13 indicates that 58% of respondents have access to compatible computers, 53% to printers and 48% to compatible software. Fourteen percent of the respondents indicated access to their home directories on fileservers, while just over a quarter (26%) have access to the Internet and email from home.

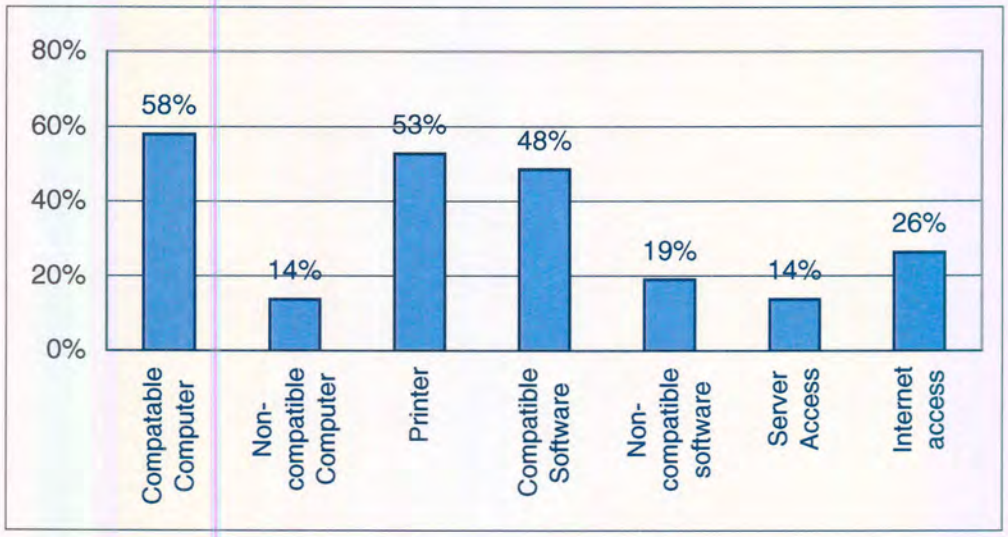

Figure 4.13 Computing facilities at home

Even though some respondents reported that they often work in their offices after hours, a quarter of the respondents indicated that they would like to have a computer system at home, which is compatible with their office machines in terms of both hardware and software (not indicated in this graph). The ratios of respondents who would like to have

access to their home directory on the network server and access to the Internet are 39% and 37% respectively.

Some respondents used this opportunity to air their dissatisfaction with the computing facilities and services provided by the University: *"I take it as a matter of course that in order to have up to date equipment I must buy my own i.e. work at home"*. Also, with regard to a data connection one respondent with an *Imaginet* email address at work, (*Imaginet* is a commercial Internet service provider), commented that his email address *"says something itself!"* while another commented: *"We have been waiting for this [i.e. a data connection] for months now. Telkom have been [at my home] and the modem has been bought. We're waiting for Rhodes".*

One of the major features of the so-called information age is the blurring of boundaries between the office and home (Laudon, Traver & Laudon, 1996). As already stated, the nature of academic work often necessitates that teaching staff work on preparation or assessment at home after hours. Thus, creating enabling conditions that will assist teaching staff to acquire computing facilities at home may hold tangible advantages for the University. It is therefore recommended that the University investigate different ways to enable lecturing staff to acquire computing equipment at home and that the use of laptop computers for academic staff be considered.

4.3.6 Provision of ITCs: Summary

This section attempted to quantify and qualify the information communication technologies teaching staff have at their disposal to fulfil their teaching function. Respondents indicated that, in their offices, 64% of the lecturing staff are provided with powerful Pentium or better machines. There are some indications of a possible oversupply of printers, both in staff offices and within their departments. Responses further indicated that access to more sophisticated technologies like voice recognition systems (1%), digital cameras (13%) and video camcorders (26%) are limited. Staff members seem to be well provided with personal productivity and communication tools in their offices. While not necessarily compatible with their office machines or connected to a fileserver or the Internet, 72% of respondents indicated access to computing facilities at home. Since 26% of the respondents indicated that they have access to the Internet and email from home, it means that 46% of the respondents (72% minus 26%) have the necessary equipment (perhaps excluding modems) at home, but are not able to use it optimally, because it is not connected to their office environment.

While it is possible to make a case that lecturing staff at Rhodes University are reasonably well provided with computing facilities, there are still staff members who feel their productivity is being constrained by the equipment available to them. For the majority of respondents the greatest need seems to slant towards computing facilities and data connections at home, with scanners and newer technologies like digital cameras and video camcorders second on the list.

Primary requirements identified in this section include:

- the need to investigate the provision of multimedia;
- the need to publicise the facilities that are available (e.g. optical scanners);
- the need to plan for the provision of some technologies in departments;
- the need for asset management better matched with the demands of information technology;
- the need to organise user support groups for specialist software packages; and
- the need to investigate mechanisms to assist lecturing staff to acquire computers for home use.

4.4 Which ICTs are teaching staff using for which teaching purposes, what would lecturers like to use and what are their training needs in this regard?

Irrespective of the extent of lecturing staff members' access to information communication technologies, a more fundamental question addresses the purposes and functions that these facilities are used for by teaching staff to enhance their teaching. This section aims to report on lecturers' utilisation of and requirements for ICTs, as well as their needs for training. The various activities associated with the teaching and learning process will serve as an organising principle in this discussion:

- preparation for lectures and of study materials;
- presentation of courses and lectures;
- communication with students and colleagues;
- practicals and tutorials;

- assessment of student learning;
- evaluation of teaching and courses; and
- teaching of off-campus students.

4.4.1 Preparation

Figure 4.14 condenses the returned responses by disclosing:

- the percentage of respondents currently using various software and hardware to prepare course materials for courses and lectures;
- the percentage of respondents who would like to use the various technologies for these purposes; and
- the training needs that will enable respondents to do so.

Due to the nature of academic work, it is not surprising that word processors are used extensively to prepare study materials (90% of respondents), while a high level of usage of various Internet tools for information access are also reported (an average of 74%). In stark contrast with this high incidence of Internet use for information access, respondents indicated a low level of usage of the same technology to distribute information and materials. For example, only 29% indicated that they use an FTP client to transfer material to a Web server for students to access and only 12 % use an HTML editor to prepare Web pages. (Since 29% use an FTP client and only 12% of the respondents mentioned that they use an HTML editor to prepare study materials for students to access on the Web, it can be assumed that some respondents use other means to construct HTML-documents and that other types of documents are being transferred as well).

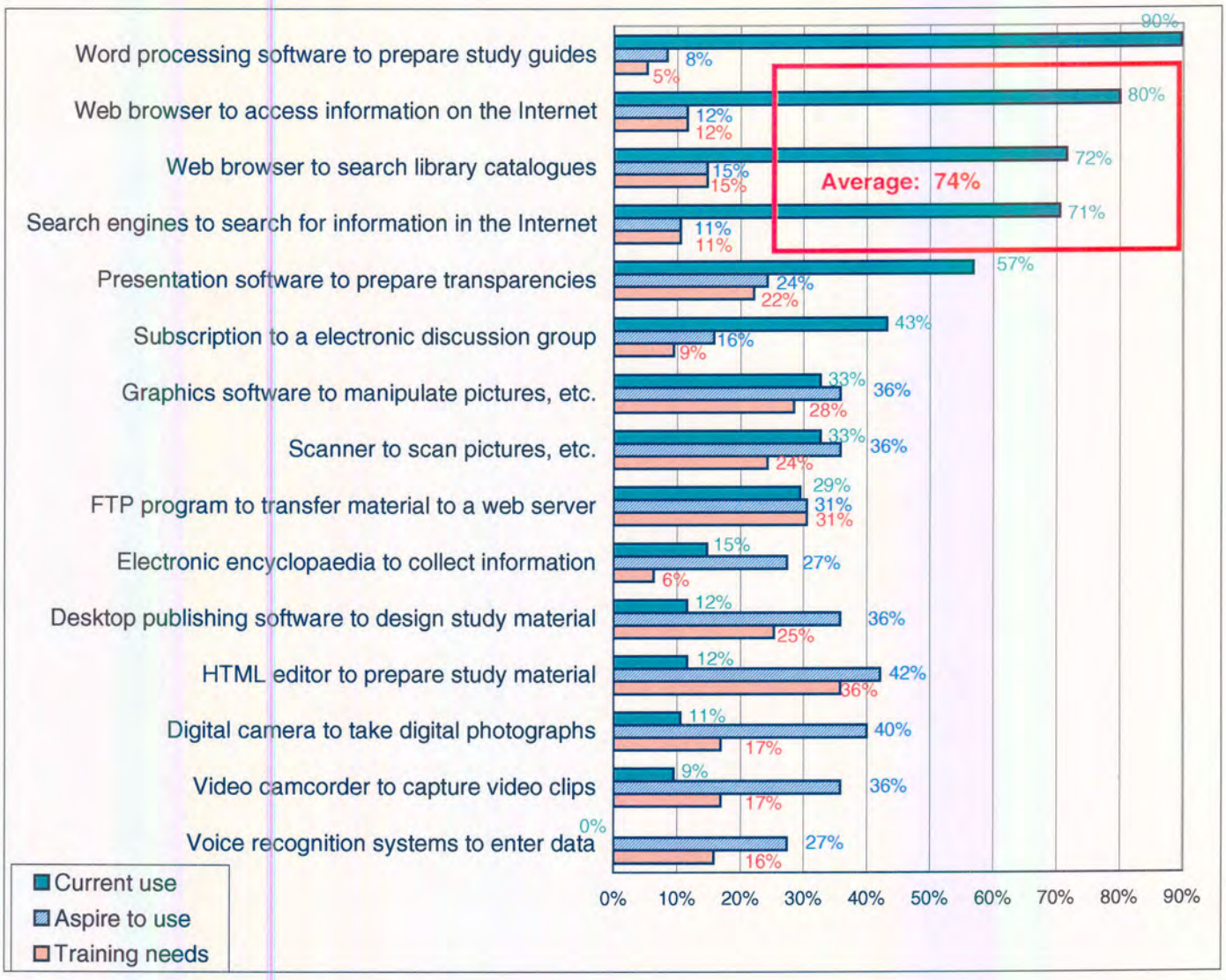

Figure 4.14 ICTs for preparation

Following the use of word processors and various Internet technologies, 57% of the respondents indicated that they use presentation software to prepare transparencies to be used on an overhead projector. While the relative high cost of transparency sheets may limit their use, a more restricting factor is the lack of flexibility that limits their usefulness. Once a transparency is printed, it cannot be updated or modified to adapt to a changed curriculum. It is therefore not surprising that there is a move towards using presentation software together with a data projector, which provides for far more flexibility in terms of content. Information in digital format, whether material for electronic presentations or Web pages, can be updated at no or little extra cost (Butcher, 1999), allowing courses to be improved steadily, "and thus grow in effectiveness and quality

each year in a way that simply does not happen in the traditional format" (Farrington, 1999:89).

The lack of use of ICTs to distribute information is further supported by the second series in Figure 4.14 that illustrates the desire of lecturing staff to use an HTML editor to prepare study material for students to access on the Web (42% of the respondents). Similarly, technologies that are used in conjunction with Web publishing, i.e. taking digital photos (40%), scanning and manipulating pictures with graphics software and capturing video clips (both 36%), are also high in demand. Equally important is the need to design study material using desktop publishing software (36%).

Not surprisingly, respondents expressed their most urgent training needs as the use of an HTML editor to prepare study material for students to access on the Web (36%), the use of an FTP client to transfer material to a Web server for students to access (31%), graphics software to manipulate pictures and diagrams (28%) and desktop publishing software to design study material (25%). The third series in Figure 4.14 depicts these and other training needs of lecturing staff regarding the use of ICTs for the preparation of lectures and study materials.

4.4.2 Presentation

While the cost of transparencies and the fact that their content cannot be updated tend to limit their value, it is also important to note that "the powerful visualisation capabilities of computers can be used to present information in ways that are often more effective than print" (Farrington, 1999:78).

At undergraduate level, teaching at Rhodes University appears to be predominantly lecture-based. The use of ICTs for presentation purposes in lectures is demonstrated in Figure 4.15. Although almost a quarter of respondents (23%) indicated that they use a computer with a data projector and presentation software to present lectures, the frequency of this practice was not researched. Similarly a high occurrence of responses indicating the use of a Web browser and Internet access (22%) for demonstrations during lectures does not denote how regularly it is used.

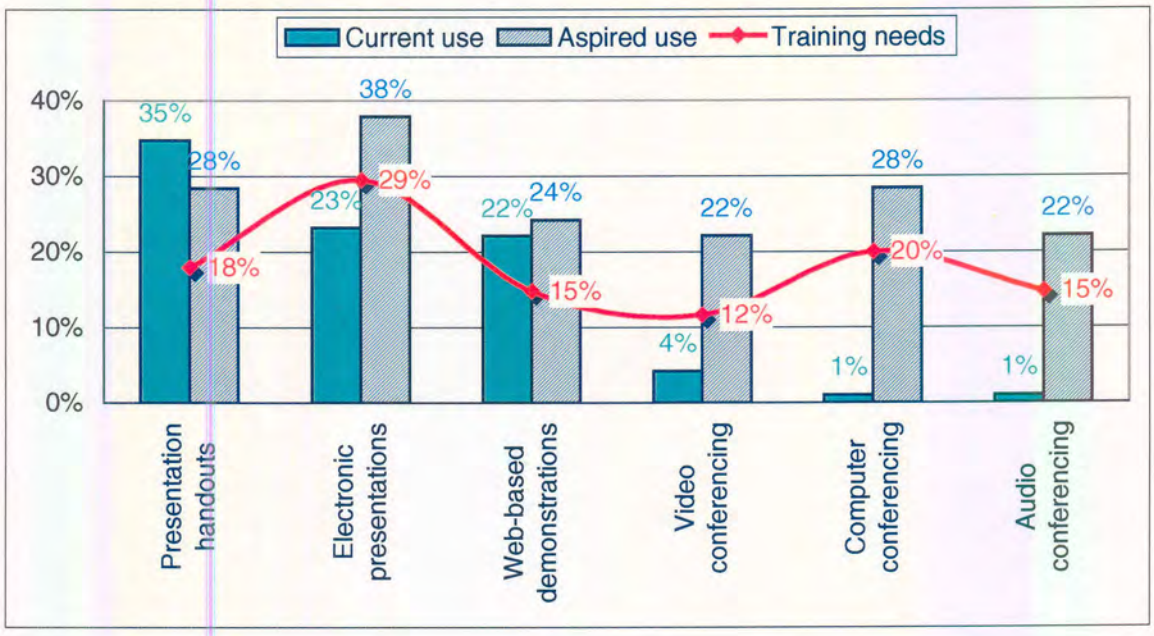

Figure 4.15 ICTs for presentations

Three comments of respondents may provide a more accurate reflection of the attitude of staff towards the use of ICTs in lectures:

> *"Some [of the ICT tools] I have but do not use because of the limitations in lecture venues and traditional structure of courses".*
>
> *"I avoid such accessories because nothing ever works in the lecture theatres – even basic videos!"*
>
> *"Heavens, who would have time to do all this – too much teaching!"*

Taking into account the primarily lecture-based teaching style at Rhodes University, it is unsurprising that the desire of staff to use ICTs to enhance their lectures focuses strongly on delivering electronic presentations (38%). Similarly, 29% of respondents indicated that they need training to deliver electronic presentations by using a computer, data projector and presentation software, which, according to one respondent, *"need to be easily accessible in lecture halls"*. It is therefore proposed that the University devise strategies to furnish lecture halls with permanent electronic presentation equipment. (See Section 5.4.1 on page 92 for a recommendation regarding the provision of laptop computers).

The limited use of more advanced technologies such as computer conferencing, audio and video conferencing (between 1 and 4 percent) is an indication of the limited

availability thereof, while the more common use of presentation handouts created with presentation software (35%) suggests that these technologies are more readily available.

4.4.3 Communication

Figure 4.16 provides an overview of the current use of ICTs for communication purposes in teaching and learning, lecturers' aspirations to use it and their training needs in this regard. While 86% of respondents revealed that they use email to interact with individual students, 61% said that they use mailing or distribution lists to communicate with groups of students. Listservs to extend classroom discussions are used by 20% of the respondents and 13% indicated that they need training to enable them to do so. One respondent explicitly expressed the desire to facilitate electronic group discussions to extend classroom discussion:

> *"[I] would like to have the facility of email addresses of students on a particular course [that can] easily be compiled (off [a] control base) to facilitate ongoing discussion of a course while it is on".*

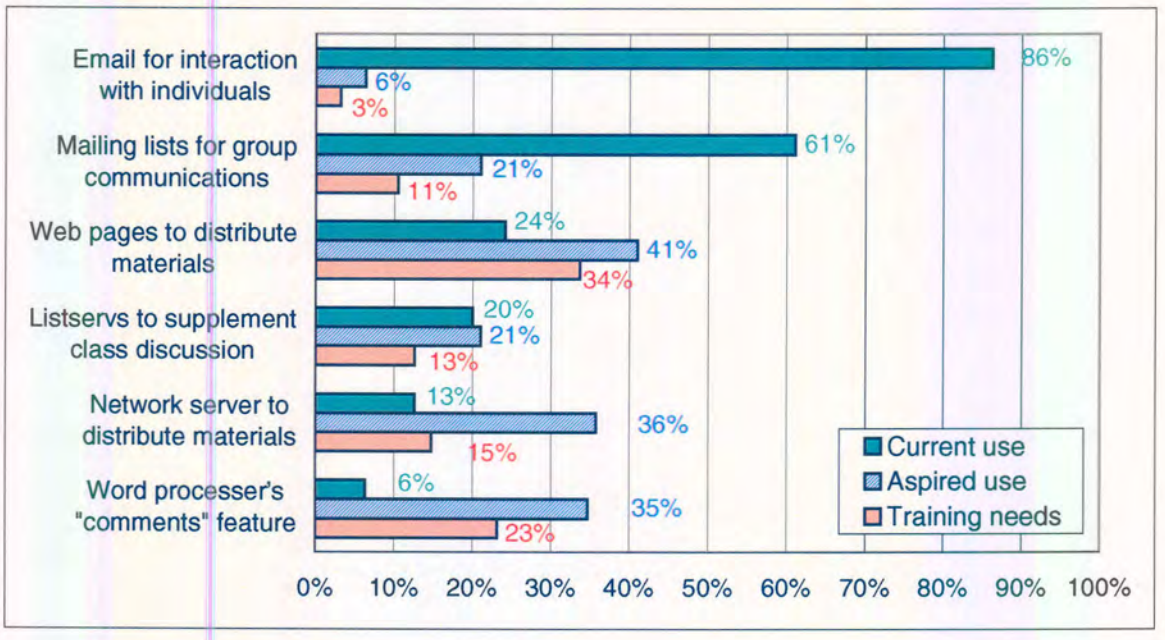

Figure 4.16 ICTs for communications

Almost a quarter of respondents (24%) use Web pages to distribute study material while only 13% use a file server on the local area network for this purpose. The need of lecturing staff to maximise their use of the existing network infrastructure becomes apparent in their desire to use Web pages (41%) and network file servers (36%) to

distribute study materials. Respondents also expressed the greatest training need to be the use of Web pages to distribute study material, announcements, etc. (34%).

A mere 6% of the respondents reported their use of the "comments" feature of word processors to furnish students with feedback on their assignments. Once again, these figures only denote the fact that the mentioned tools are used for the specified purposes, and does not quantify the frequency of its use. However, 35% of the respondents indicated that they would like to use this feature to provide feedback on students' word-processed documents while 23% indicated their need for training to do so.

In interpreting these results, it is important to take into account that respondents might be ignorant of the exact meaning and implications of using these technologies. One respondent declared such uncertainty: *"Not exactly sure what some of the above mean, but would be keen to learn and try"*.

Rhodes University boasts an extensive physical network infrastructure which, in the context of teaching and learning, appears to be used mainly for printer sharing, electronic mail and Internet access. While all of these comprise valid uses of the network infrastructure, the addition of various other functions like file sharing or distribution of study material could maximise the return on the University's investment in the physical infrastructure. An investigation into the reasons why the existing infrastructure is not used optimally would provide valuable information for staff development and training purposes. It is also recommended that the computer literacy training courses offered by the Information Technology Division be expanded to include modules on the optimal use of the local or wide area networks for teaching and learning purposes. Similarly, these courses should, apart from training basic computer literacy skills, be focused very specifically on the application of the various packages in teaching and learning. The "comments" feature of word processing packages is, for example, a very useful tool in teaching writing skills as well as in postgraduate supervision. Despite the fact that 90% of respondents indicated their use of word processors, only 6% reported that they use this feature, while 35% and 23% respectively expressed their desire to use it and their need for training to do so.

4.4.4 Practicals / Tutorials

The current use and aspired use of dedicated educational software (i.e. courseware designed for use in a specific discipline or subject area) is summarised in Figure 4.17. While a ratio of between one and thirteen percent of respondents mentioning the use of

courseware may appear suspiciously low, the very nature of dedicated educational software dictates that they can only be used in a limited number of disciplines. Similarly specialist software packages (e.g. mapping software) can only be used in specific disciplines and quantification of their use serves little purpose.

However, the apparently low usage of dedicated courseware could also be attributed to a shift away from a traditional focus on computer-assisted learning (CAL) with its emphasis on instruction and knowledge transfer to a focus on the Internet, WWW and electronic communication emphasising knowledge production and management of the educational process. (See Section 2.2.2.4 on page 15).

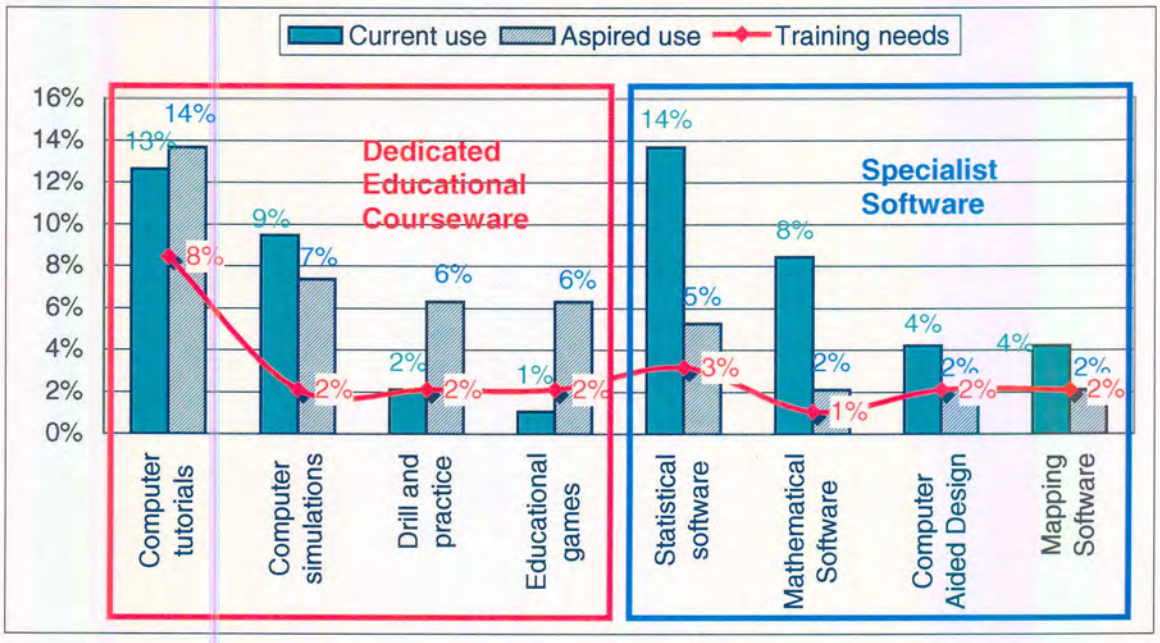

Figure 4.17 ICTs for practicals and tutorials

Of the dedicated educational courseware, respondents would like to use tutorials most (14%), followed by computer simulations (7%), drill and practice (6%) and educational games (6%). Compared to other uses of ICTs for teaching, responses consequently recorded relatively low interest in training to use either dedicated educational software or specialist software. The most prominent training need in this regard is the use of computer tutorials (8%) and statistical software (3%).

A complete list of educational software, courseware and specialist software used by various lecturing staff members is printed in Appendix B (pages B-6 to B-8).

Although not depicted in the graph, two contrasting observations are, on the one hand, respondents or departments writing their own educational software (5%), and on the other hand, respondents who indicated a degree of ignorance with regard to courseware. (See Section 2.3.1.3 on page 30 and Section 4.5.2 on page 83). Typical comments from the latter category of respondents include:

"Don't know the products";

"Don't know if this is relevant to what I teach"; and

"No idea – need to search".

Statements like these underline the need for publicising the potential and possibilities of information communication technologies as media to enhance teaching and learning at Rhodes University. However, any efforts of this nature should be encapsulated within a larger strategy for staff development on the one hand, and technology provision on the other. It is therefore recommended that an instructional development programme be developed in tandem with a technology strategy.

4.4.5 Assessment of student learning

Spreadsheets are used by 40% of the respondents to capture and calculate test and examination marks, indicating a widespread use of ICTs for administration purposes.

However, despite the fact that Rhodes University acquired a dedicated testing software package (*Question Mark for DOS*) in 1992, only 3% of respondents observed that they use computer-based testing to deliver self-assessed quizzes and only 4% use it for formal tests or examinations. Once again, this count does not quantify the frequency of utilisation. Thirty one percent of the respondents, however, indicated that they would like to use computer-based testing software to deliver both self-assessment quizzes and formal semester tests and examinations while 17% expressed their need for training to deliver self-assessed quizzes and 16% to deliver formal tests or examinations.

While it is possible to deliver lectures to large classes of students thereby increasing the efficiency of education, the labour-intensive character of assessment is one of the primary factors restricting access to education and increasing costs. As a low input, high impact form of computer-assisted education (Lippert, 1993), the Universities of Cape Town and Pretoria are using computer-based testing extensively for both formative and summative assessment of student learning. Due to the limited use of computer-based testing at

Rhodes University, this University does not equally reap the benefits thereof. The data in Figure 4.18 clearly indicate a willingness on the part of teaching staff to engage in activities that will indeed accrue the advantages of computer-based testing. In order to secure the benefits of efficiency, objectivity and reliability of computer-based testing, it is recommended that the implementation of computer-based testing be investigated at this University.

Data obtained in this question also supports an earlier finding (see Section 4.4.3 on page 75) suggesting that the network infrastructure is not used optimally: only one respondent indicated the use of either a file server on a local area network or a Web server to receive assignments from students. Furthermore, only 4% of respondents reported that they use Web pages to publish feedback on tests or assignments. Hence, 25% and 23% of respondents wish to use a network fileserver and a Web server respectively for their students to submit assignments in electronic format. Similarly, 31% of the respondents said that they would like to use Web pages to deliver feedback on tests or assignments.

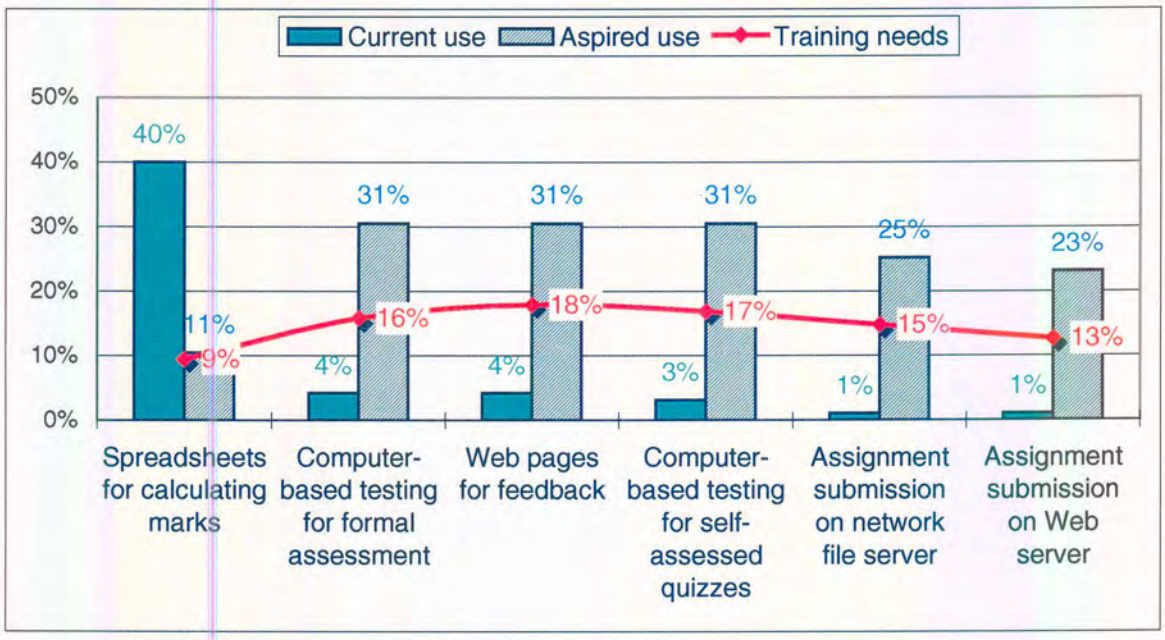

Figure 4.18 ICTs for assessment of student learning

Accordingly, respondents identified using Web pages to deliver feedback on tests or assignments (18%), and the use of either a network fileserver (15%) or a Web server (13%) as important training needs. It is therefore recommended that Rhodes University investigates the acquisition and implementation of online course delivery software

products (e.g. *WebCT, Blackboard, TopClass, Lotus Learning Space*, and others), to facilitate such activities.

4.4.6 Evaluation of teaching and courses

Since the computer-based testing package *Question Mark for DOS* was used for evaluation of teaching and courses in the past (Mallinson, 1999), this use of a dedicated testing package was also surveyed. Although 15% of respondents reported that they use computer-based testing to deliver teaching or course evaluation, within the timeframe of this study it was not possible to determine which package they use and what the frequency of that use is. The fact that the CBE-unit has provided this service in the past, but are not doing so currently, increases the possibility that the respondents referred to their past use of *Question Mark for DOS* for this purpose. On the other hand, the *Evaluation Assistant* is a Web-based program currently provided and supported by the Academic Development Centre. There is therefore no reason to doubt the 24% of respondents who indicated that they use this program. Anecdotal comments supplied by respondents indicated that they found the use of the *Evaluation Assistant* too time-consuming and the questions available in the question bank not relevant to all disciplines. Difficulties in accessing the *Evaluation Assistant* Website were also reported. At least two departments reported their use of other evaluation instruments and tools.

While 24% of the respondents reported that they would like to use a computer-based testing package to deliver teaching or course evaluations, some 11% indicated that they need training to do so. Similarly, 26% indicated their desire to use the Academic Development Centre's *Evaluation Assistant* for this purpose with 12% indicating that they need training.

It is recommended that the procedures and instructions for the *Evaluation Assistant* be simplified in order to streamline the process of questionnaire design. Furthermore, as soon as a dedicated testing program is available, the possibility of using it for evaluation of teaching and courses should be investigated in order to provide lecturers with another alternative.

4.4.7 Teaching off-campus students

In line with the diminishing gap between distance and contact education (Department of Education, 1997b), 12% of the respondents indicated that they are currently involved in teaching off-campus undergraduate students while 4% reported their intention to do so.

However, even though 22% reported teaching off-campus post-graduate students, no one indicated their intention to expand their post-graduate offerings to students at a distance, a tendency which seems to go against the spirit of lifelong learning. In order to accrue the benefits of cost, flexibility and increased access associated with distance education methods, it is recommended that Rhodes University coordinates departmental initiatives aimed at teaching off-campus students (see Section 5.4.6 on page 96).

4.4.8 Current use, intended use and training needs: Summary

This section attempted to capture the current scenario at Rhodes University with respect to the use of ICTs to enhance various activities in the teaching and learning process, together with the ICTs that teaching staff would like to use and their training needs. In this scenario ICTs are primarily used for preparation of lectures and study material while the second highest usage is reported for communication with students. ICTs are used least for assessment of student learning and presentation of lectures.

Across all categories the highest incidence of responses indicated the use of:

- word processing software to prepare course materials (90%);
- electronic mail to interact with individual students (86%);
- Web browsers to access information on the Internet (80%);
- Web browsers to search library catalogues (72%);
- search engines to search for information on the Internet (71%); and
- mailing or distribution lists to communicate with groups of students (61%).

Areas in which ICTs are used least (all less than 5% frequency counts) include:

- video camcorders to capture video clips for use in presentations;
- computer, audio and video conferencing for communication with experts, colleagues or students;
- drill and practice courseware;
- computer-based testing software to deliver self-assessed quizzes;
- computer-based testing software to deliver formal tests and examinations;
- network or Web servers with a directory allocated for submission of assignments; and
- Web pages to deliver feedback on tests or assignments.

This section also provided evidence of the growing interest amongst members of the lecturing staff to use ICTs to enhance various activities in the teaching process. The technologies that drew the highest percentage of interest are:

- the use of an HTML editor to prepare study materials (42%);
- the use of Web pages to distribute study materials (41%);
- the use of a digital camera to take digital photographs (40%); and
- the use of a computer, data projector and presentation software to deliver electronic presentations (38%).

Finally, this section provided insight into the training needs of lecturing staff. High on the agenda seem to be those technologies that will enable staff to maximise their use of the existing infrastructure: Web publishing, graphics manipulation and desktop publishing.

4.5 What are lecturers' current attempts, needs and future plans to integrate ICTs into teaching and learning?

Contributing to the data required to develop a comprehensive profile of the current state of affairs regarding the use of ICTs at Rhodes University, this section focuses on:

- educational problems experienced by teaching staff that could be addressed by using ICTs (Section 4.5.1);
- development of materials and technical infrastructure (Section 4.5.2); and
- the needs of teaching staff in terms of incentives, support and assistance to use ICTs to enhance their teaching (Section 4.5.3).

4.5.1 Educational problems experienced by teaching staff

The application of technology to education should focus first on teaching and learning, and then on technology (Gilbert, 1997; Stahlke & Nyce, 1996; Department of Education, 1996). It is therefore important first to identify an educational problem and then look for either technological or non-technological solutions to solve that problem (Department of Education, 1996).

Respondents were requested to describe specific educational problems or difficulties that they thought could be addressed by using educational technology. Only 13% of the respondents supplied such descriptions. Problems addressed by this research project are:

- electronic discussions to facilitate ongoing discussion outside formal lecture times;
- provision of supplemental reading material on the Web;
- frequent formative assessment of student learning; and
- assessment of large numbers of students (500+).

Other problems that fall beyond the scope of this research project include:

- students' lack of computer literacy;
- academic capabilities of so-called "disadvantaged" students;
- language programs focusing on pronunciation (IsiXhosa and South African English);
- attendance tracking at lectures [access and exit control]; and
- possible staffing problems.

A complete list of descriptions of these problems is available in Appendix B (page B-17).

While it will certainly be possible to address above-mentioned issues individually, the obvious extent of educational needs of lecturers and their students clearly calls for a well-structured strategy. The development of a strategy will ensure congruency between various efforts and will also match individual projects with institutional direction. (See Section 2.3.1.1 on page 24 for more detail).

4.5.2 Development of materials and technical infrastructure

At Rhodes University "in-house lesson development is not believed to be a cost-effective way of delivering this kind of service [i.e. technological solutions to teaching problems]" (Rhodes University, s.a.). However, 14% of the respondents reported current involvement with developing educational software, while 5% claimed to have entered into collaborative agreements with other institutions to develop educational software. Likewise, 13% of the respondents noted that their departments are planning to develop educational software, with only 2% of the respondents declaring the intention of their departments to enter into collaboration agreements with another institution to do so.

While 65% of the respondents indicated that a library of academic courseware should be available for review, evaluation and use by lecturing staff, some respondents expressed their reservations over such an approach:

> *"No, this is never well used unless it is explicitly bought for a task".*
>
> *"Most of the courseware I have seen is so subject specific that you will [need] a collection the size of the library if you go this route!"*

Some tension is evident between two strategies of developing courseware. On the one hand 61% of the respondents indicated their belief that technical assistance should be provided (*"but in a self-help way"*) and 49% said that development facilities should be provided in a technology resource centre. Furthermore, while 49% of the respondents voiced their opinion that teaching staff should be recognised and rewarded for developing courseware, some respondents also argued for the provision of release time for those staff. On the other hand, 36% felt that a special unit dedicated to developing instructional software for lecturing staff should be provided. However, one respondent commented that *"this would be nice, but the money spent this way in the past has not shown good returns at Rhodes"*. Perhaps unsurprisingly, 31% of the respondents indicated responses to both these strategies: provision should be made both for support for teaching staff to develop educational software and for a special unit that develops courseware for lecturing staff. Figure 4.19 summarises the views of the respondents with regard to the development of software. (Refer to Section 2.3.1.3 on page 30 for a discussion of the merits of each of these strategies).

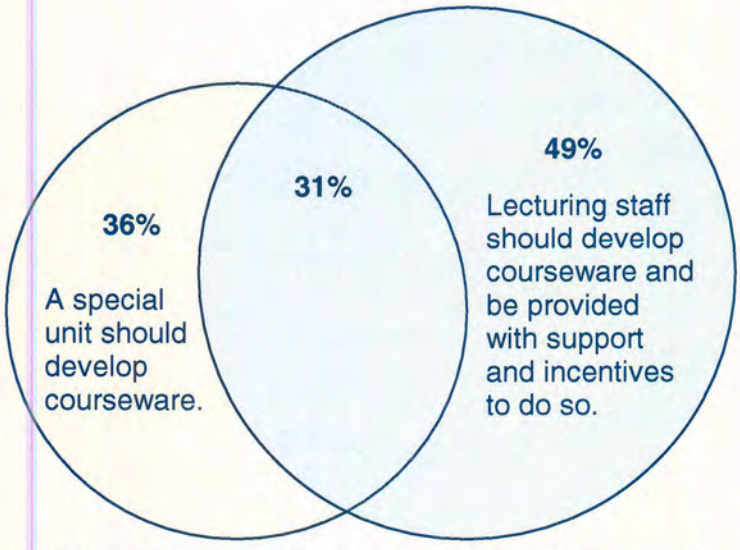

Figure 4.19 Staff opinions regarding courseware development

Some 23% of the respondents said that their departments are involved in a process to acquire a departmental computer lab while 5% related their department's intention to do so. A primary driving force for establishing departmental computer labs seems to be the lack of student access to the centralised public facilities. It is recommended however, that the University recognise the cost associated with developing and maintaining departmental labs, especially since there seems to be no coordinated approach in this regard. Furthermore, the cost and logistics of security, supervision and technical support as well as possible limited after-hours access to departmental labs need to be anticipated.

4.5.3 Incentives, support and assistance

Seventy three percent of respondents believe that lecturing staff should have access to training that will provide them with the skills needed for the instructional use of information communication technologies.

The most contentious issue was a formal programme to recognise and reward the use of ICTs as part of a routine teaching staff review and promotion process. While 36% of the respondents were of the opinion that such a programme should be provided (*"Definitely"*), one respondent noted a condition: *"... but with regard for applicability to [the] discipline."* Other respondents had reservations and indicated their scepticism:

> *"Yes, but what is the pedagogical value of ICT?*
>
> *"I don't know what the implications of these points would be? Could it disadvantage the ... courses & programmes? Possibly, I think."*

Still other comments from respondents indicated their total disapproval towards such a practice:

> *"Oh no!"*
>
> *"This is dangerous - lots of ICTs doesn't always mean good teaching."*
>
> *"This is scary - not all of us need to use technology to be good at our jobs!"*

Responses to the question of what incentives, support and assistance should be provided by the University also produced a wide range of opinions. While one respondent felt that *"none of the above"* incentives should be provided, other comments were:

"No. If it is useful, it is so because it is easier. Why then an incentive? It is my right not to use this. Why then make it a virtue through promotion & prejudice and problem?"

"Courses accredited by NQF as part of ongoing professionalism."

"Incentives to encourage staff to explore opportunities to attempt curriculum development using ICT."

"Help, training, knowing what's out there."

"Appropriate venues where it can be used."

From the above examples it is clear that a huge diversity exists in terms of lecturers' expectations and needs with regard to the educational use of information communication technology. This variety underlines the notion that not only is strategic planning imperative for successful integration, but also that the process should involve as many stakeholders as possible.

4.6 Conclusion

The results of two key questions provided the data that is required to develop a comprehensive account of the current use of information communication technologies to enhance teaching and learning at Rhodes University and the needs and expectations of teaching staff in this regard. The first question investigated current staff access to ICTs, the teaching purposes of ICTs and the development of courseware and departmental computer labs. Linked to this first question, the second question addressed the needs and expectations of lecturing staff on the same issues, but also focused on educational problems experienced by academic staff and their needs in terms of training, incentives, support and assistance.

In the absence of a national benchmark it is impossible to rate the use of ICT at any institution. While rating ICT use is not the intention of this chapter, this descriptive analysis does however leave the impression of a great deal of activity in the application of ICTs in teaching and learning. It is hoped that the exploration of the role of information communication technologies in Chapter 2 has shed some light on the authentic role of technology in teaching and learning.

Apart from raising fundamental questions regarding the use of information communication technology in education, the general comments of respondents (printed at the end of the questionnaire results in Appendix B), capture the sentiments of various groups of staff members. Some respondents openly declared their cynicism regarding the educational use of technology:

> *"I'm afraid I regard much of this questionnaire as overkill! I use this sort of stuff very cautiously and carefully. It's too easy to get swept up by hype."*

> *"I question the value of too much "glitz" for the sake of having it, or worse still, "showing off" one's personal technical wizardry."*

Others raised real issues that need to be taken into account in the development of any technology enhanced learning environment:

> *"I have never used it, but I would imagine that it involves more preparation and time rather than less. Also, some of this stuff, I believe, becomes an end in itself. Also it effaces good old-fashioned interpersonal & communication skills."*

> *"Concern: Technology will separate students from lecturer, i.e. split up the relationship on a face-to-face basis."*

> *"On-line evaluation would be easier if it didn't invoke so much organisation and so many folk – but is very valuable."*

Lamenting an uncomfortable unpreparedness to deal with the use of technology in teaching and learning, one comment may have verbalised the feeling of many academic staff members:

> *"I feel completely inadequate in this regard. Don't know what is available, and have no time to develop skills, e.g. attend workshops."*

For an institution that consists of lecturers with such a diversity of perspectives, Gilbert (1997) provides some appropriate advice:

> *"Most faculty members should be helped to master new ways of teaching. Some should not. Every effort must be made to sustain the excitement of the pioneers - those faculty members predisposed to try to improve their own teaching and their own students' learning with new applications of technology; comfortably engage the mainstream faculty—those who are not by nature especially interested in technology, but who are often concerned with improving their own teaching and their students' learning; and maintain institutional respect for the laggards—especially those who can be respected for their teaching ability and who may have important questions about new approaches" (p. 5).*

Chapter 5

Conclusion and Recommendations

One of the most powerful motivators [to integrate new technologies and new media into teaching and learning], is the growing belief that institutions unable or unwilling to move at all in this direction are unlikely to be able to compete for students, faculty, and funding in the next decade.

- Steven Gilbert, 1997

Chapter 5 Conclusion and Recommendations

5.1 Introduction

In the light of the increasing invasiveness of ICT in society and the suggestion that the advantages of technology-use are more easily attainable in distance education and resource-based settings, Chapter 1 suggested that the benefits of technology-use for Rhodes University, a campus-based university needed investigating. As a first step in developing a comprehensive profile of the current situation regarding the use of ICTs, this research project aimed to establish the current use of ICTs by lecturing staff as well as their needs in this regard.

Chapter 2 contextualised the research project by describing three primary forces driving the introduction of technology into higher education curricula:

- the changing environment of higher education;
- the changing concept of knowledge and knowledge production; and
- the perceived potential of ICTs to enhance teaching and learning.

This chapter also described organisational prerequisites for the successful integration and practical application of various information communication technologies to different stages of, and activities in, the teaching-learning-process by focusing firstly on the different software and courseware, and secondly on the functions of these software and courseware.

While Chapter 3 supplied an overview of the research methodology, Chapter 4 reported the research findings. Chapter 5 now draws these themes together by presenting a summary of the research findings, describing the limitations of the study and listing recommendations regarding the application of ICTs to teaching and learning at Rhodes University.

5.2 Summary

5.2.1 Provision of ICTs

Regarding the provision of **hardware** in staff offices and academic departments:

- 64% of lecturing staff indicated access to at least one desktop computer with a Pentium microprocessor or better in their offices;
- 40% reported access to laser and 17% to inkjet printers in their offices while 9% indicated their need for a printer in their offices;
- 93% of the respondents claimed access to shared printing facilities within their departments (82% to monochrome laser printers) and 3% would like to have access to shared printing facilities within their departments;
- 26% of the departments are reported to provide access to three or more printers;
- 59% of the respondents have a CD-ROM drive in their computers, 43% indicated the availability of a soundcard and 39% have speakers available. However, 17% of the respondents indicated that they would like to have such multimedia peripherals;
- 11% of the respondents indicated access to an optical scanner in their offices while 20% expressed their need for one;
- only one respondent has a voice recognition system (VRS) in his/her office whereas 19% remarked that they would like to have an VRS in their offices; and
- 23% of the respondents indicated access to liquid crystal display slates, 29% to data projectors, 24% to scanners, 5% to digital cameras and 14% to video camcorders within the University.

With regard to access to **software** respondents disclosed access to:

- word processors (91%);
- electronic mail (87%);
- Web browsers (81%);
- spreadsheets (75%);
- programming software (14%);
- referencing software (13%);
- desktop publishing software (8%); and

- authoring software (2%).

The highest incidences of **software needs** were recorded for:

- reference software or electronic encyclopaedia (15%);
- desktop publishing software (15%);
- HTML editors (13%);
- graphics software (12%); and
- authoring software (11%).

Regarding computing **facilities at home**:

- 58% of the respondents reported access to compatible computers;
- 53% to printers;
- 48% to compatible software;
- 14% to their home directories on fileservers (39% would like to have access); and
- 26% access to the Internet and email (37% expressed a need for access).

5.2.2 Application of ICTs to teaching and learning

Concerning the application of information communication technologies to **prepare** for lectures and study materials:

- 90% of the respondents indicated that they use word processors;
- an average of 74% reported the use of various Internet tools for information access;
- 29% indicated their use of an FTP client to transfer material to a Web server for students to access; and
- 12 % use an HTML editor to prepare Web pages.

For **communication** with students and **presentation** of lectures:

- 86% of the respondents use email to interact with individual students;
- 61% use mailing or distribution lists to communicate with groups of students;
- 24% use Web pages to distribute study material;
- 23% of the respondents use a computer with a data projector and presentation software;

- 22% use a Web browser and Internet access for demonstrations;
- 20% use Listservs to extend classroom discussions; and
- 13% use the local area network to do so.

ICTs used for **assessment** purposes include:

- spreadsheets to capture and calculate test and examination marks (40%);
- computer-based testing for formal tests or examinations (4%);
- Web pages to publish feedback on tests or assignments (4%); and
- computer-based testing to deliver self-assessed quizzes (3%).

Respondents indicated their **desire to use**:

- electronic presentations (38%);
- Web pages to deliver feedback on tests or assignments (31%);
- the Academic Development Centre's *Evaluation Assistant* to deliver course evaluations (26%);
- a network fileserver for submission of assignments in electronic format (25%);
- a computer-based testing package to deliver teaching or course evaluations (24%);
- a Web server for submission of assignments (23%); and
- Listservs to extend classroom discussions (21%).

Respondents expressed their most urgent **training needs** in respect of the use of:

- an HTML editor to prepare material for students to access on the Web (36%);
- an FTP client to transfer material to a Web server for students to access (31%);
- a computer, data projector and presentation software to deliver electronic presentations (29%);
- graphics software to manipulate pictures and diagrams (28%);
- desktop publishing software to design study material (25%);
- Listservs to extend classroom discussions (13%);
- the Academic Development Centre's *Evaluation Assistant* to deliver teaching or course evaluations (12%); and
- a computer-based testing package to deliver teaching or course evaluations (11%).

In line with the diminishing gap between distance and contact education, 12% of the respondents indicated that they are currently involved in teaching off-campus undergraduate students while 4% reported their intention to do so. However, even though 22% reported teaching off-campus post-graduate students, no one indicated their intention to expand their post-graduate offerings to students at a distance.

5.3 Limitations of study

As with most surveys, the results of this survey are dependent on the target population's level of cognisance and familiarity with the concepts under investigation. Due to the technical nature of some of the items in the questionnaire, the study may have elicited more responses from the computer literate members of staff than from those staff members that are less computer literate. Since many staff members may not have returned the questionnaire due to the fact that they may not have been able to articulate their current use, needs or expectations in the technical terms used in the questionnaire, the data may be skewed. To verify the accuracy of some of the technical type of questions (e.g. the type of computer), the survey data will have to be triangulated with the University's asset register.

Somewhat akin to the above-mentioned limitation, it should be acknowledged that the results of this survey have a limited life span in terms of relevancy. The data will become obsolete rapidly because of continuous acquisitions and upgrading of equipment and fluctuations in staff appointments. In order to obtain up-to-date data for management purposes, similar surveys will have to be conducted on a regular basis.

Finally, while respondents reported their use of various ICTs to enhance their teaching, within the limited scope and timeframe of this research project, it was not possible to investigate the frequency of the reported usage, or if the reported utilisation occurred some time in the past.

5.4 Recommendations

5.4.1 Provision of ICTs

It is recommended that the University investigates different ways to enable lecturing staff to acquire computing equipment at home. These home facilities should ideally be

compatible with and connected to their office environments. Some South African universities have provided this kind of support by making available low-interest or interest-free loans aimed at either acquiring or upgrading home computing facilities (Odendaal, 1992).

The use of laptop computers for academic staff should be investigated. While the relatively high cost of laptops and limited upgrading possibilities (as compared to desktop computers) remain major obstacles to the general adoption thereof, possible benefits of laptops might surpass the disadvantages. Instead of having two complete systems – one in the office and one at home – staff members could have one laptop computer. To counteract the inconvenience of working on a laptop staff could have only a monitor, keyboard and mouse either in their office or at home (or at both places). Although the relatively high cost of laptops may not necessarily result in huge cost savings, the added advantages of flexibility and mobility might make such an investment worthwhile. Another potential advantage that laptop ownership holds for teaching staff is the availability of a computer containing relevant data for presentation purposes both in lectures and at conferences. Also, when lecturing staff are attending conferences at remote sites, laptop ownership will enable them to stay connected to their offices and students through electronic mail.

In this regard, it is also proposed that the University devise strategies for providing lecture halls with permanent presentation equipment. If staff are provided with laptop computers, this recommendation will only require the installation of data projectors in the lecture halls.

Another possibility that needs further investigation is access to IT financial products such as *Leasing* and *Exchange Rental* through corporate partnerships with IT vendors or manufacturers. The relatively high cost of laptop ownership could for example be counteracted through such financial products, which have the added advantage of shifting the cost and risk of obsolescence from the University to the vendor or supplier. *Leasing* or *Exchange Rental* promotes life cycle budgeting and annualising of total technology costs as recommended by Graves (1999), Green & Jenkins (1998), Daniel (1996), Gilbert (1996) and Oberlin (1996).

Hewlett-Packard Technology Finance's *Exchange Rental*, for example, combines guaranteed residual values and total flexibility with the traditional financial benefits of leasing. Other key benefits include protection against obsolescence and ease of exchange, upgrading or adding on (Hewlett-Packard, 1999b).

In the absence of an explicit policy, the provision of multimedia needs investigation, especially in the light of the growing number of multimedia programs and courseware available on CD-ROM and the Internet. Furthermore, it is proposed that a long-term strategy to supply lecturing staff with access to optical scanners within their departments, similar to the strategy to provide printers, be developed.

It is also recommended that the University recognise the cost associated with developing and maintaining departmental labs, especially in the apparent absence of a coordinated approach. Possible limited after-hours access to departmental labs constrains the value of departmental labs and cognisance should be taken of the cost and logistics of security, supervision and technical support.

5.4.2 Asset management

It is further recommended that Rhodes University adapts its asset management of information technology to match the special requirements thereof (Green & Jenkins, 1998; Oberlin, 1996). To achieve effective asset management the University could investigate the possibilities of physical asset tracking and desktop management tools. Examples of such desktop management tools include Hewlett-Packard's *TopTools* and *OpenView*, Computer Associates' *Unicenter TNG*, Microsoft's *SMS*, Network Associates' *ZAG*, IBM's *TME10*, Intel's *LANDesk* (Hewlett-Packard, 1999a) and Novell's *ZEN*. Key benefits of such desktop management tools include among others:

- cross-device management (of not only PCs but also peripherals);
- maintenance of an inventory database;
- remote power on/off for after-hours software management;
- central and simultaneous driver update and PC BIOS flash;
- central management, software management and security management;
- crash and virus protection; and
- hardware diagnostics (*ibid.*).

Over and above the advantages of desktop management tools for management of the physical infrastructure, these tools excel as important instruments for strategic financial planning, an issue which is regarded as the third major challenge in higher education in the United States (Green, 1999). The relatively high cost of DMI-compliant PCs (i.e. PCs with built-in manageability features) as compared to non-DMI compliant PCs will be

counteracted by more effective asset management which in turn will counteract uncontrolled duplication of equipment.

5.4.3 Publicising of existing facilities

In the light of responses indicating that lecturers do not have access to equipment that is provided by the University (e.g. laptops, scanners and data projectors), it is recommended that the availability of existing equipment be publicised more widely.

Similarly, the potential of information communication technologies as media to enhance teaching and learning should be publicised widely. Furthermore, the operations and functions of peripheral equipment should also be demonstrated in the computer literacy courses offered by the Information Technology Division. However, any efforts of this nature should be encapsulated within a larger strategy for staff development on the one hand, and technology provision on the other. It is therefore recommended that an instructional development programme be developed in tandem with a strategic technology planning exercise.

5.4.4 Software support and training

Since the Information Technology Division is ideally situated to become aware of any software support needs, it is recommended that the Division organise user groups for the specialist software packages for which they do not provide training and support.

An investigation into the reasons why the existing infrastructure is not used optimally would provide valuable information for staff development and training purposes. However, it is recommended that the computer literacy training courses offered by the Information Technology Division be expanded to include modules on the optimal use of the local or wide area networks for teaching and learning purposes. Similarly, these courses should, apart from training basic computer literacy skills, be focused very specifically on the application of various software packages in teaching and learning. The "comments" feature of word processing packages, for example, is a very useful tool in teaching writing skills as well as in postgraduate supervision. Despite the fact that 90% of respondents indicated their use of word processors, only 6% reported that they use this feature.

It is specifically recommended that emphasis should be given to those software products that will empower teaching staff to seize the opportunities presented by on-line technologies: FTP-clients and HTML-editors. Especially in the light of the high training

need expressed for these technologies and the fact that some of these software products will soon become available for all members of staff as a result of a site licence agreement between the University and a software vendor.

5.4.5 Instructional technology

The acquisition and implementation of a Web server dedicated to teaching and learning is crucial if Rhodes University would like to secure the benefits of information communication technologies for its staff and students. Furthermore, staff and students alike should have sufficient user rights to enable them to publish Web pages.

In line with the previous recommendation, it is further recommended that Rhodes University investigates the acquisition and implementation of online course delivery software products (e.g. *WebCT, Blackboard, TopClass, Lotus Learning Space*, etc.). Also called Web-based course development tools or Internet-based training tools, these tools have revolutionised the development of online teaching and learning by facilitating the creation of sophisticated Web-based educational environments by non-technical users. Using Web-browsers as an interface for the course-building environment, these tools facilitate the organisation of course material on the Web and also provide a wide variety of features that can be added to a course. Examples of these features include conferencing systems, on-line chat, student progress tracking, group project organisation, student self-evaluation, grade maintenance and distribution, access control, navigation tools, auto-marked quizzes, electronic mail, automatic index generation, course calendar, student homepages, and course content searches.

In order to accrue the benefits of objectivity and reliability associated with computer-based testing, it is recommended that the implementation of computer-based testing be investigated at this University. As soon as a dedicated testing program is available, the possibility of using it for evaluation of teaching and courses should be investigated in order to provide lecturers with an alternative to the Academic Development Centre's *Evaluation Assistant*. It is further recommended that the procedures and instructions for the *Evaluation Assistant* be simplified in order to streamline the process of questionnaire design.

5.4.6 Teaching off-campus students

Acknowledging the distinct nature of academic disciplines as well as the relative autonomy of academic departments, it is nevertheless proposed that the introduction of

distance education courses at post-graduate level be coordinated centrally, but with input from all stakeholders. A well-planned strategy, which takes cognisance of successful distance education practices, will not only enhance the institution's reputation but also has the potential to improve the University's competitive standing. It is further recommended that some of the approaches and technologies that have been developed for distance education be adopted for residential undergraduate students. Apart from securing the benefits of distance education methods, the use of distance education technologies will ensure that postgraduate studies become a natural extension of the undergraduate experience. This might be a strong motivator for graduates, invariably employed in other centres, to continue their studies at Rhodes University. Another side benefit of using distance education technologies for post-graduate students is that these students will then become available as tutors for undergraduate students, irrespective of the geographical location of the postgraduate student. The significance of this recommendation is particularly obvious in the light of the geographical isolation of Rhodes University.

At face value, the use of "new technologies to facilitate teaching between the two campuses" (Rhodes University, 1999a:2.4) seems to be a valid application of ICTs to enhance teaching and learning. Similarly, the notion of extending the use of these services to "teach students in colleges and NGO's with which the University has collaborative agreements" (Rhodes University, 1999a) appears to be an authentic use of technology. However, care should be taken that technologies such as video-conferencing are not used to entrench a transition model of teaching where the knowledge is perceived to be 'imparted' to students by 'filling' them up from the teacher's 'vessel' (Eisenstadt & Vincent, 1998). In exploring the two dominant models of distance education, Daniel (1998) argues the advantages of an approach that targets individual learning and is based on asynchronous communication over a second approach that focuses on group teaching of students in remote classrooms, based on synchronous communication. While group teaching has a high cost, "the individual learning tradition of distance education has much more to offer: mass access, low cost and personal flexibility" (p. 26). Another important consequence is that due to its nature, group teaching can only be teacher-centred, while "under the individual learning scenario you can re-create the campus in thousands of homes and workplaces – so it has to be a student-centred approach" (p. 25).

5.4.7 Recommendations regarding similar surveys

Some lecturers do not know what configuration of computers they have. To accommodate for end-users' possible limited knowledge of computer configurations, it is suggested that future surveys provide respondents with a list of basic configurations, each of which should include specifications for hardware, operating system and software. Respondents could then be required to make a choice between the various configurations by indicating the one that best matches their own equipment.

To prevent possible confusion, respondents should also have the option of indicating that they do not have access to equipment. A "not applicable" category should also always be available to ensure that an answer is recorded for every question.

To obtain more accurate data on the use of various ICTs, it is recommended that future surveys investigate not only the current use, but also the frequency of the usage as well as the time that specific applications were used in the past.

5.4.8 Suggestions for further research

This research project focused on the use of ICTs to enhance teaching and learning by surveying lecturing staff. In order to compile a comprehensive profile of the existing conditions for management and strategic planning purposes, the perceptions of administrators and the perceptions, needs and expectations of students have yet to be investigated.

5.5 Conclusion

To contextualise this research, Chapters 1 and 2 proposed that, while the increasing invasiveness of information communication technologies have transformed society in the 20th century, higher education has not escaped these changes and therefore needs to explore the potential of ICTs to respond to various pressures exerted upon it. While the application of new media seems to hold the most promise for distance education and resource-based learning, Chapter 2 also suggested that technology has an authentic role to play in teaching and learning, also in campus settings. The challenge for Rhodes University, primarily a residential university, is to explore the ways in which information communication technologies can be used to enhance teaching and learning.

As a first step in such an investigation, this synopsis of the current state of affairs with regard to the use of ICTs for teaching and learning reveals that Rhodes University boasts an impressive technical infrastructure. Although it is difficult to assess the access of lecturing staff to computers and other peripherals in the absence of a national benchmark, it seems fair to speculate that teaching staff access to ICTs would be comparable rather to the well resourced, than to the least resourced institutions in South Africa.

This favourable condition is not surprising. Being amongst the first South African higher education institutions to install a computer (in 1965), (Lawrie, 1997) and amongst the first institutions nationally and internationally that connected to the Internet (in 1988), (*ibid.*), Rhodes University established itself early on as a leader institution in the provision of information communication technology. Furthermore, by being one of the first South African universities to install a PLATO system for computer-based education (CBE) and establishing a CBE unit in 1983 (Oberem, 1993), this leadership role of Rhodes University was equally evident in the application of information technology to teaching and learning.

However, analysis of the current use of ICTs for teaching and learning suggests that, with regard to instructional technology, Rhodes University might have moved from a leader to a follower institution (Gilbert, 1996). Although considerable attention is focused on developing and maintaining the technical infrastructure and providing lecturing staff with access to these facilities, these efforts are not matched by programmes aimed at empowering teaching staff to use the facilities to enhance their teaching and their students' learning. While some lecturers certainly have the capacity and skills needed to maximise their use of the physical facilities, others are desperately in need of information, training, support and incentives to do so.

Although the reasons for the shift from leader to follower institution were not investigated during this research, the high cost of developing courseware as well as the realisation that computer-assisted learning has not quite lived up to its promise of improving learning, may have played a role. Lecturing staff at Rhodes University should now also take cognisance of the fact that the use of computers in education has moved beyond the traditional focus on computer-assisted learning (CAL) with its emphasis on instruction and knowledge transfer to a focus on the Internet, WWW and electronic communication emphasising knowledge production and the management of the educational process. (See Section 2.2.2.4 on page 15 and *New roles for students* in Section 2.3.1.2 on page 29).

Nevertheless, the institution may now benefit from a re-evaluation of its overall strategy, especially in the light of increasing external and internal pressure on higher education as described in Chapter 2. The analysis of the needs and expectations of lecturing staff certainly indicates that the time is ripe for such a re-assessment of Rhodes University's position with regard to the use of ICTs for teaching and learning.

Any attempt to increase the return on the University's substantial investment in information technology should be guided by the acknowledgement that information communication technology has a valid place in the quest to improve teaching effectiveness and learning productivity in higher education. According to Gilbert (1996), following the first two stages of technology integration (i.e. *automating common business administrative operations* and *enhancing current tasks*), education has entered the third stage of technology integration, namely *changing the core functions of teaching and learning*. This view is supported by Graves (1999):

> *"IT is no longer an experimental tool to be made available with minimal support to a few employees and students. Instead, it is a strategic asset that should be utilized by the entire faculty, staff, and student body to increase the productivity and mission-critical academic programs and the administrative services that support those programs. And nothing is more mission critical in higher education than instruction!" (p. 95).*

The engagement of all stakeholders in a process of developing a technology strategy seems to be essential for any efforts to maximise return on investments in information technology. According to Daniel (1996) "the collegial tradition of academic governance makes it unlikely that a technology strategy developed without extensive faculty input would have any impact" (p. 137). It is therefore proposed that Rhodes University embark upon such a technology strategy development process.

References

Some argue that it is now imperative for academics to embrace change [within their teaching function] because the latest manifestations of technology actually alter the relationship between people and knowledge.

- John Daniel, 1996

References

Alessi, S.M. & Trollip, S.R. (1991). Computer-Based Instruction: Methods and Development. Second Edition. Englewood Cliffs, New Jersey: Prentice Hall.

Amory, A. (1999). Puzzles to solve problems. Abstracts of Technology in Interactive Education Conference, University of Natal, Durban. [Online]. Available: http://www.nu.ac.za/tie/abstractcontents.asp?id=32 [1999, January 13].

Bogle, D.C., Nicol, J. & Heath, S.B. (1997). Resource Directory for Computer Based Learning in Land Use and Environmental Sciences. Aberdeen: CLUES. [Online]. Available: http://www.clues.abdn.ac.uk:8080/directory/intro/intro.html [1999, October 26].

Boughey, C.M. (1997). Learning to write by writing to learn: a group-work approach. ELT Journal, April, 51(2), 126 – 134.

Butcher, N. (1998). The Possibilities and Pitfalls of Harnessing ICTs to Accelerate Social Development: A South African Perspective. Johannesburg: SAIDE. [Online]. Available: http://www.saide.org.za/butcher1/unrisd.htm [1999, October 28].

Butcher, N. (1999). Making appropriate educational technology choices: a South African perspective. UNESO Regional Workshop on Teaching and Learning in Higher Education. Johannesburg: University of the Witwatersrand. 14-16 September.

Cohen, L. and Manion, L. (1985). Research Methods in Education. Second Edition. Kent: Croom Helm.

Collis, B.A. (1996). Computers in Education. In Plomp, T. & Ely, D.P. (Eds.). International Encyclopaedia of Educational Technology. Second Edition. Oxford: Pergamon. (pp. 402 – 408).

Cronjé, J.C. (1997). Education for Technology, Technology for Education. In Van Harmelen, T. (Ed.). Guidelines for Technology-Enhanced Education at the University of Pretoria. Volume I, Appendix B. University of Pretoria.

Cuttle, M., Young, C. & Heath, S. (s.a.). A practical introduction to creating CAL courseware with Microsoft Excel. [Online]. Available: http://www.clues.abdn.ac.uk:8080/local/exceltut.html [1999, October 26].

Daniel, J.S. (1996). Mega-Universities and Knowledge Media: Technology Solutions for Higher Education. London: Kogan Page.

Daniel, J.S. (1997). Why Universities Need Technology Strategies. Change. July/August, 11-17.

Daniel, J.S. (1998). Can you get my hard nose in focus? Universities, mass education and appropriate technology. In Eisenstadt, M. & Vincent, T. The Knowledge Web: Learning and Collaborating on the Net. London: Kogan Page.

Department of Education. (1996). Technology-Enhanced Learning Investigation in South Africa: A Discussion Document. Pretoria: Department of Education.

Department of Education. (1997a). Technology-Enhanced Learning Initiative in South Africa: A Strategic Plan. Pretoria: Department of Education.

Department of Education. (1997b). A Programme for the Transformation of Higher Education. White Paper No. 3. [Online]. Available: http://www.polity.org.za/govdocs/white_papers/highed.html [1999, October 9].

Department of Education. (1999). Higher Education Institutional Plans: An Overview of the First Planning Phase – 1999/2001. Pretoria: Department of Education.

Ehrmann, S.C. (1995). Asking the Right Questions: What Does Research Tell Us About Technology in Higher Education? Change. March/April, 20 – 27.

Eisenstadt, M. & Vincent, T. (1998). Knowledge Media takes off on the Web. In Eisenstadt, M. & Vincent, T. The Knowledge Web: Learning and Collaborating on the Net. London: Kogan Page.

Emig, J.A. (1983). Writing as a Mode of Learning. In Goswami, D. & Butler, M. The Web of Meaning: Essays on Writing, Teaching, Learning & Thinking. Portsmouth: Heinemann.

Farrington, G.C. (1999). The New Technologies and the Future of Residential Undergraduate Education. In Katz, R.N. (Ed.). Dancing with the Devil: Information Technology and the New Competition in Higher Education. San Francisco: Jossey-Bass Publishers.

Foundation for Research Development. (1998). Internet Connectivity Needs Analysis: User Questionnaire. Pretoria: Foundation for Research Development.

Gates, W.H. (1995). The Road Ahead. Viking.

Gibbons, M. (1998). Higher Education Relevance in the 21st Century. [Online]. Available: http://www.worldbank.org/html/extdr/educ/edu-pb/giboeng3.doc [1999, December 3].

Gilbert, S.W. (1996). Making The Most a Slow Revolution. Change. March/April, 10 - 23.

Gilbert, S.W. (1997). Re-Focus on Learning and Teaching: Educational Uses of Information Technology for Everyone. The Technology Source. [Online]. Available: http://horizon.unc.edu/TS/vision/1997-04.asp [1999, September 2].

Graff, G. & Berube, M. (1995). To Enhance Learning While Reducing Costs. Planning for Higher Education. Summer, 23, 59 - 62.

Graves, W.H. (1999). Developing and Using Technology as a Strategic Asset. In Katz, R.N. (Ed.). Dancing with the Devil: Information Technology and the New Competition in Higher Education. San Francisco: Jossey-Bass Publishers.

Greaves, D. (1997a). Information Technology and the Future of the University. [Online]. Available: http://innerweb.und.ac.za/depts/itd/ac/dg/forum1610.html [1999, October 9].

Greaves, D. (1997b). Defining Student Computer Literacy: Survey of Academic Staff Opinion. [Online]. Available: http://innerweb.und.ac.za/depts/itd/ac/dg/survey.html [1998, November 27].

Greaves, D. (1998a). Academic Computing at the University of Natal, 1997 – 2001. Discussion Document No. 2. [Online]. Available: http://innerweb.und.ac.za/depts/itd/ac/dg/plndrft1.html [1999, October 3].

Greaves, D. (1998b). Survey of Academic Staff Opinion: Requirements for Computer-Assisted Learning Resources. [Online]. Available: http://innerweb.und.ac.za/depts/itd/ac/pmbres.html [1998, November 27].

Green, K.C. (1996a). The Seventh National Survey of Desktop Computing and Information Technology in Higher Education. The Campus Computing Project.

Green, K.C. (1996b). The 1996 National Survey of Information Technology in Higher Education. The Campus Computing Project. [Online]. Available: http://ericir.syr.edu/Projects/Campus_computing/1996/index.html [1998, June 1].

Green, K.C. (1996c). The Coming Ubiquity of Information Technology. Change. March/April, 24-28.

Green, K.C. (1999). The 1999 National Survey of Information Technology in Higher Education: The Continuing Challenge of Instructional Integration and User Support. The Campus Computing Project. [Online]. Available: http://www.campuscomputing.net/summaries/1999/index.html [1999, October 22].

Green, K.C. & Jenkins, R. (1998). IT Financial Planning 101. Developing an Institutional Strategy for Financing Technology. NACUBO Business Officer. March, 32- 37.

Hawkridge, D., Jaworski, J. & McMahon, H. (1990). Computers in Third-World Schools: Examples, Experiences and Issues. London: MacMillan.

Hewlett-Packard. (1999a). Asset Tracking and Lease Advisory Services (AT&LAS) for Businesses [Online]. Available: http://www.hp.com/ssg/financsing/business_asset.html [1999, December 3].

Hewlett-Packard. (1999b). Exchange Rental. [Online]. Available: http://www.hp.com/ssg/financing/index_content.html [1999, September 21].

Hodgkinson, C.A. (1993). Effects of Word Processing on Writing Quality of Adult English Second Language Learners. Unpublished M.Ed (CAE) dissertation, University of Pretoria.

Jurow, S. (1999). Change: The Importance of the Process. Educom Review. September/October, 34(5), [Online]. Available: http://www.educause.edu/ir/library/html/erm995a.html [1999, October 21].

Kleeman, J. (1998). Now is the time to computerise pen and paper tests! [Online]. Available: http://www.qmark.com/company/1998paper.html [1999, December 13].

Knoetze, J.G. (1993). Rekenaargebruik in onderwys. In Louw, W.J. (Red.), Klaskamerpraktyk: 'n oriëntasie. Academica, Pretoria.

Kotter, J.P. (1999). What Leaders Really Do. USA: Harvard Business Review.

Kuiper, J. (1999). The Social Construction of a Post-Graduate Experience: A Case Study of a Master's Course in Science Education. Proceedings of the Second Postgraduate Experience Conference, University of Cape Town.

Laing, M.D., Lee, R.F., Nowell, D.C., Marsella, M. & Putter, C.A.J. (1999). GPPIS: a Multimedia Database for Global Plant and Pest Information Using a Decentralized Interactive Learning System. Proceedings of Technology in Interactive Education Conference. University of Natal, Durban.

Laudon, K.C., Traver, C.G. & Laudon, J.P. (1996). Information Technology and Society. Second Edition. Cambridge: Course Technology.

Laurillard, D. (1993). Rethinking University Teaching: a framework for the effective use of educational technology. Routledge: London.

Lawrie, M. (1997). The History of the Internet in South Africa: How it began. [Online]. Available: http://www2.frd.ac.za/uninet/history/ [1999, August 17].

Lemmer, L. (1998). A new context for the University? Postmodern strands in international patterns of education policy and practice. Progressio. 20(1), 16-33.

Lenzner, R. & Johnson, S.S. (1997). Seeing things as they really are. Forbes.com. [Online]. Available: http://www.forbes.com/forbes/97/0310/5905122a.htm [1999, October 11].

Lippert, R.C. (1993). Computer-Based Education and Training in South Africa. Pretoria: JL van Schaik.

Mallinson, B. (1999). Private communication.

Malone, T.W. (1981). Toward a Theory of Intrinsically Motivating Instruction. Cognitive Science. 4, 333-369.

Massy, W.F. & Zemsky, R. (1995). Using Information Technology to Enhance Academic Productivity. Washington: Educom. [Online]. Available: http://www.educause.edu/nlii/massy.html [2000, January 4].

Noble, D.F. (1998). Digital Diploma Mills: The Automation or Higher Education. firstmonday. [Online]. Available: http://www.firstmonday.dk/issues/issue3_1/noble/index.html [1999, October 2].

Norman, M.M. (1999). Seton Hall Structured for Change. Converge Magazine. October. [Online]. Available: http://www.convergemag.com/Publications [1999, October 2].

Oberem, G.E. (1993). A decade of computer-assisted learning at Rhodes University. In Lippert, R.C. Computer-Based Education and Training in South Africa. Pretoria: J.L. van Schaik. (pp. 29 – 49).

Oberlin, J.L. (1996). The Financial Mythology of Information Technology: The New Economics. CAUSE/EFFECT. 19(1), 21-29.

Odendaal, J.G. (1992). Private communication.

Oppenheimer, T. (1997). The Computer Delusion. The Atlantic Monthly. [Online]. Available: http://www.theatlantic.com/issues/97jul/computer.htm [1999, January 26].

Plomp, T. (1999). Higher Education for the 21st Century and the Potential of ICT. In Maltha, H.W., Gerrissen, J.F. & Veen, W. (Eds.). The Means and the Ends: ICT and Third World Education. Amsterdam: Nuffic.

Porter, J.H. (1993). Business Reengineering in Higher Education. CAUSE/EFFECT. Winter, 39-46. [Online]. Available: http://www.educause.edu/ir/library/text/cem934a.txt [2000, January 4].

Rhodes University. (1999a). Strategic Plan 2000 – 2002. [Online]. Available: http://www.rhodes.ac.za/library/archives/admin/strategic/strategicplan.pdf [1999, December 6].

Rhodes University. (1999b). A Comprehensive Guide for New Staff. Academic Development Centre, Rhodes University.

Rhodes University. (s.a.). Further particulars relating to the post of Coordinator – Computer Based Education Unit in the Information Technology Division. Rhodes University.

Rodenburg, D. (1998). Shifting Perspectives in Educational Technology. The Technology Source. [Online]. Available: http://horizon.unc.edu/TS/vision/1998-12.asp [1999, September 2].

Russell, T.L. (1997). Technology Wars: Winners & Losers. Educom Review. 32(2), March/April. [Online]. Available: http://www.educause.edu/pub/er/review/reviewArticles/32244.html [1999, October 22].

Saettler, P. (1990). The Evolution of American Educational Technology. Englewood, Colorado: Libraries Unlimited, Inc.

Stahlke, H.F.W. & Nyce, J.M. (1996). Reengineering Higher Education: Reinventing Teaching and Learning. CAUSE/EFFECT. 19(4), 44-45. [Online]. Available: http://www.educause.edu/ir/library/html/cem9649.html [1999, October 6].

Tidball, J. (s.a.). Creating CAL courseware with Microsoft Excel 5. [Online]. Available: http://www.clues.abdn.ac.uk:8080/local/cal_xl.html [1999, October 26].

Twigg, C.A. (1995). The One Percent Solution. Educom Review. 30(6). [Online]. Available: http://www.educause.edu/pub/er/review/reviewArticles/30616.html [1999, September 10].

University of Cape Town. (1999). Multimedia Education Group. [Online]. Available: http://www.meg.uct.ac.za/ [1999, December 7].

University of Zululand. (1998). Workshop on Information Services Restructure. Unpublished Minutes. Bosberaad held on 16-17 November at Canefields Conference Centre, Empangeni. University of Zululand.

Van Harmelen, T. (1997). The Development of a Technology-Enhanced Strategy for the University of Pretoria. M.Ed.(CAE) dissertation, University of Pretoria.

Wade, R. (1998). *CAMESE*. [Online]. Available: http://www.und.ac.za/und/ling/camese.html [1999, December 7].

Woods, D.R. (1998). Vice-Chancellor's Report. In Minutes of the Convocation and Old Rhodian Union Annual General Meeting held on 12 September 1998, Rhodes University.

Wulf, W.A. (1998). University Alert: The Information Railroad is Coming. In *The Future of Higher Learning: Digital Diploma Mills or Educational Enhancement?* Virginia.edu. 2(2). [Online]. Available: http://www.itc.virginia.edu/virginia.edu/fall98/mills/comments/c1.html [1999, October 15].

Appendices

Considering the above problems or challenges it is evident that those institutions that are able and willing to adapt and change and that are capable of giving their educational processes new and fresh dimensions will be the ones to suffer less trauma and to prosper and flourish in the long run.

- D.J.J. van Rensburg, 1997

Appendix A Survey Questionnaire

Academic Development Centre

Educational Technology

A survey of the use of Information Communication Technologies to enhance teaching and learning at Rhodes University

Dear Colleague

This survey is part of a study that aims to document the use of Information Communication Technologies (ICTs) to enhance teaching and learning at Rhodes University and attempts to assess the needs and expectations of academic staff in this regard. Your response will contribute to a better understanding of the ways our institution could be planning for the use of information communication technologies for teaching and learning purposes.

Thank you for taking a few minutes to complete this questionnaire. If you require any assistance in completing this questionnaire, please contact **Markus Mostert** at ext. 8171 or M.Mostert@ru.ac.za. **Kindly return the questionnaire via internal mail to ADC before Thursday, 23 September 1999.**

Chrissie Boughey
Director
Academic Development Centre

Markus Mostert
Educational Technology
Academic Development Centre

Personal Information

Title, Name, Surname			
Faculty			
Department			
Subject area / Discipline			
Courses taught			
Email address		Extension	

Instructions

1. Circles O are used to indicate a multiple choice option where only **one** response is required.
2. Squares ☐ are used to indicate multiple response options where **all** applicable options should be checked with a ✔ while those that are not applicable should be left open. *If you do not check either of the boxes, it will be assumed that the question is not applicable to you or your needs.*
3. Please feel free to add any other relevant information or explanations in the margins or on separate pages.

1. Kindly indicate the Information Communication Technologies (ICTs)
   (a) which you currently have access to, ***or***
   (b) which you would like to have access to. (Please check all that apply)

		Have now	Would like
	Hardware in your office (i.e. daily access)		
1.1	Computer		
	286 ☐ 386 ☐ 486 ☐ Pentium ☐ Pentium II ☐ Pentium III ☐ Apple Mac / iMac ☐		☐
1.2	Printer		
	Dot-matrix ☐ Monochrome Inkjet ☐ Monochrome Laser ☐ Colour Inkjet ☐ Colour Laser ☐		☐
1.3	Multimedia		
	CD-ROM ☐ Soundcard ☐ Speakers ☐		☐
1.4	Scanner	☐	☐
1.5	Voice recognition system	☐	☐
1.6	Other. Please specify.	☐	☐
1.7	.....	☐	☐
	Hardware in your department (i.e. relatively easy access)	Have now	Would like
1.8	Printer		
	Dot-matrix ☐ Monochrome Inkjet ☐ Monochrome Laser ☐ Colour Inkjet ☐ Colour Laser ☐		☐
1.9	Scanner	☐	☐
1.10	Digital camera	☐	☐
1.11	Video camcorder	☐	☐
1.12	Other. Please specify.	☐	☐
	.....	☐	☐

	Hardware within the University (i.e. reasonable access by booking)	Have now	Would like
1.13	Liquid Crystal Display (LCD) panel / slate	☐	☐
1.14	Data projector	☐	☐
1.15	Scanner	☐	☐
1.16	Digital camera	☐	☐
1.17	Video camcorder	☐	☐
1.18	Other. Please specify.	☐	☐
1.19	.....	☐	☐

	Software	Have now	Would like
1.20	Word processor (WordPerfect, MS Word)	☐	☐
1.21	Spreadsheet (Quattro Pro, MS Excel, Lotus)	☐	☐
1.22	Database (Dbase, MS Access)	☐	☐
1.23	Presentation software (Corel Presentation, MS PowerPoint)	☐	☐
1.24	Graphics Software (Corel Draw, MS Paint)	☐	☐
1.25	Electronic Mail (Pegasus Mail, MS Outlook)	☐	☐
1.26	Web Browser (Netscape, MS Internet Explorer)	☐	☐
1.27	Hypertext Markup Language (HTML) Editor (MS FrontPage, Dreamweaver)	☐	☐
1.28	FTP Software (File Transfer Protocol)	☐	☐
1.29	Desktop Publishing Software (Aldus Pagemaker, MS Publisher)	☐	☐
1.30	Authoring packages (Quest, Authorware)	☐	☐
1.31	Programming Languages (C++, Visual Basic)	☐	☐
1.32	Electronic Encyclopaedia (MS Encarta, Grolier)	☐	☐
1.33	Other. Please specify.	☐	☐
1.34	.....	☐	☐

	Computing facilities at home (i.e. daily after-hours access)	Have now	Would like
1.35	Computer: compatible with office computer	☐	☐
1.36	Computer: non-compatible with office computer	☐	☐
1.37	Printer	☐	☐
1.38	Software: compatible with software on office computer	☐	☐
1.39	Software: non-compatible with software on office computer	☐	☐
1.40	Data connection to University network with access to home directory on server	☐	☐
1.41	Data connection to University network with access to the Internet and email	☐	☐
1.42	Other. Please specify.	☐	☐
1.43	.....	☐	☐

2. For the purpose of **using** ICTs to enhance **your teaching**, please indicate those applications
   (a) that you are currently using ***or***
   (b) that you would like to use. (Please check all that apply) ***and***
   (c) that you need training to be able to use it.

	Preparation	Use now	Would like	Need training
2.1	Word processing software to prepare student study guides, etc.	☐	☐	☐
2.2	Presentation software to prepare overhead transparencies	☐	☐	☐
2.3	Desktop publishing software to design study material	☐	☐	☐
2.4	Electronic encyclopaedia on CD-ROMs to collect information	☐	☐	☐
2.5	Web browser to access information on the Internet	☐	☐	☐
2.6	Web browser to search library catalogues	☐	☐	☐
2.7	Search engines to search for information in the Internet	☐	☐	☐
2.8	Subscription to a electronic discussion group (eg. a listserv) with educators of similar disciplines as your own at other institutions	☐	☐	☐
2.9	HTML editor to prepare study material for students to access on the web	☐	☐	☐
2.10	FTP program to transfer material to a web server for students to access	☐	☐	☐
2.11	Graphics software to manipulate pictures, diagrams, graphics, etc.	☐	☐	☐
2.12	Scanner to scan pictures, diagrams & graphics to use in study material	☐	☐	☐
2.13	Digital camera to take digital photographs to use in study material	☐	☐	☐
2.14	Video camcorder to capture video clips for use in presentations, etc.	☐	☐	☐
2.15	Voice recognition systems to enter data into software applications	☐	☐	☐
2.16	Other. Please specify.	☐	☐	☐
2.17	.....	☐	☐	☐

	Presentation of Lectures	Use now	Would like	Need training
2.18	Electronic presentations (with computer, data projector & presentation software)	☐	☐	☐
2.19	Presentation handouts (created with presentation software)	☐	☐	☐
2.20	Web browser and Internet access for demonstrations	☐	☐	☐
2.21	Computer conferencing for communication with colleagues / students	☐	☐	☐
2.22	Audio conferencing for communication with experts/colleagues/students	☐	☐	☐
2.23	Video conferencing for communication with experts/colleagues/students	☐	☐	☐
2.24	Other. Please specify.	☐	☐	☐
2.25	.....	☐	☐	☐

	Communication	Use now	Would like	Need training
2.26	Email to interact with individual students	☐	☐	☐
2.27	Mailing / distribution lists to communicate with groups of students	☐	☐	☐
2.28	List servers (Listservs) to facilitate electronic group discussions	☐	☐	☐
2.29	Web pages to distribute study material, announcements, etc.	☐	☐	☐

2.30	Network server with directory allocated to distribute study materials			☐	☐	☐
2.31	Word processors' "comments" feature for feedback on students' word processed documents			☐	☐	☐
2.32	Other. Please specify.			☐	☐	☐
2.33	.....			☐	☐	☐
	Practicals / Tutorials			Use now	Would like	Need training
	Dedicated educational software	Please supply title (eg. *A.D.A.M.*)	Publisher (eg. *Macromedia*)	☐	☐	☐
2.34	Drill and practice	.....	.....	☐	☐	☐
2.35	Computer tutorials	.....	.....	☐	☐	☐
2.36	Computer simulations	.....	.....	☐	☐	☐
2.37	Educational games	.....	.....	☐	☐	☐
	Other. Please specify.					
2.38	.....	.....	.....	☐	☐	☐
2.39	.....	.....	.....	☐	☐	☐
	Specialised software	Please supply title (eg. *AutoCAD*)	Publisher (eg. *Autodesk*)	☐	☐	☐
2.40	Computer Aided Design	.....	.....	☐	☐	☐
2.41	Mapping Software (GIS)	.....	.....	☐	☐	☐
2.42	Mathematical software	.....	.....	☐	☐	☐
2.43	Statistical software	.....	.....	☐	☐	☐
	Other. Please specify.					
2.44	.....	.....	.....	☐	☐	☐
2.45	.....	.....	.....	☐	☐	☐
	Assessment			Use now	Would like	Need training
2.46	Computer Based Testing software to deliver self-assessed quizzes			☐	☐	☐
2.47	Computer Based Testing to deliver semester tests or examinations			☐	☐	☐
2.48	Network server with directory allocated for submission of assignments			☐	☐	☐
2.49	Web publishing on a Web server for submission of assignments			☐	☐	☐
2.50	Spreadsheet to capture and calculate test and examination marks			☐	☐	☐
2.51	Web pages to deliver feedback on tests / assignments			☐	☐	☐
2.52	Other. Please specify.			☐	☐	☐
2.53	.....			☐	☐	☐
	Evaluation of your teaching and courses			Use now	Would like	Need training
2.54	Computer Based Testing to deliver teaching or course evaluations			☐	☐	☐
2.55	ADC's *Evaluation Assistant* to deliver teaching or course evaluations			☐	☐	☐
2.56	Other. Please specify.			☐	☐	☐
2.57	.....			☐	☐	☐

3. For the purpose of **using** ICTs to enhance **your students' learning**, please indicate those facilities
   (a) that they currently have access to, ***or***
   (b) that you would like them to have access to. (Please check all that apply)

	Computing facilities	Have now	Would like
3.1	Computers in a departmental lab	☐	☐
3.2	Number of computers in departmental lab(s): 1 2 3 4		
3.3	Computers in a public lab	☐	☐
3.4	Multimedia computers (i.e. with soundcard and speakers / earphones)	☐	☐
3.5	CD-ROM drives	☐	☐
3.6	Laser printer	☐	☐
3.7	Colour printer	☐	☐
3.8	Scanner	☐	☐
3.9	Digital camera	☐	☐
3.10	Video camcorder	☐	☐
3.11	Other. Please specify.	☐	☐
3.12	.....	☐	☐

4. What are your students' needs regarding **public lab time** for each of the courses that you will be teaching next year (2000)? (If you teach more than three courses that need public lab time, kindly indicate the rest on a separate sheet of paper.)

		Course codes:	(a)		(b)		(c)	
		Semester:	**1**	**2**	**1**	**2**	**1**	**2**
4.1	number of (45 min) lecture periods *per student per week* (booked):							
4.2	hours outside lectures *per student per week* (non-booked), e.g. for essay and report writing, internet searches and email:							
4.3	anticipated number of students:							
4.4	for how many of the 13 or 14 weeks of the **semester**:							

5. Are your students currently required to enrol for a computer literacy course? Kindly fill in the course codes of the courses that you teach, and answer this question for each course seperately.

	Course code:	no	no, but I would like them to enrol	yes, for non-credit purposes	yes, for credit-purposes
5.1	.....	①	②	③	④
5.2	.....	①	②	③	④
5.3	.....	①	②	③	④

6. What are your expectations regarding the computer literacy skills of your students? (Please check all that apply)

6.1	Word processing: Student assignments should be typed (word processed and printed)	☐
6.2	Communications: Students should be able to communicate via email	☐
6.3	Web publishing: Students should be able to publish assignments on the Web	☐
6.4	Other. Please specify.	☐
6.5	.....	☐

7. Which computer skills are
(a) advisable, ***or***
(b) essential to a graduate of your faculty seeking professional employment, ***and*** which of those are
(c) currently provided for in your course or degree program? (Please check all that apply)

		Advisable	Essential	Provided
7.1	Word processing	☐	☐	☐
7.2	Working with spreadsheets	☐	☐	☐
7.3	Database management	☐	☐	☐
7.4	Touch typing	☐	☐	☐
7.5	Email communication	☐	☐	☐
7.6	Computer graphics	☐	☐	☐
7.7	Desktop publishing	☐	☐	☐
7.8	Computer aided design	☐	☐	☐
7.9	Internet searching	☐	☐	☐
7.10	Web publishing	☐	☐	☐
7.11	Other. Please specify.	☐	☐	☐
7.12	.....	☐	☐	☐

8. Are you or your department
(a) currently involved with, ***or***
(b) planning to get involved with. (Please check all that apply)

		Do now	Plan to do
8.1	teaching off-campus under-graduate students?	☐	☐
8.2	teaching off-campus post-graduate students?	☐	☐
8.3	developing educational / instructional software?	☐	☐
8.4	entering into collaboration agreements with another institution(s) to develop educational software?	☐	☐
8.5	acquiring a departmental computer lab?	☐	☐
8.6	Other. Please specify.	☐	☐
8.7	.....	☐	☐

9. Please indicate the type of **incentives, support and assistance** you believe should be provided by Rhodes for staff who wish to use ICTs to enhance their teaching. (Please check all that apply)

9.1	Training for academic staff to provide them with the skills needed for the instructional use of Information Communication Technologies	☐
9.2	A formal program to recognise and reward the use of ICTs as part of the routine academic staff review and promotion process	☐
9.3	A library of academic courseware for review, evaluation and use by academic staff	☐
9.4	Recognition and reward for educational software development by academic staff, similar to the compensation received from publishing articles in SAPSE-accredited journals.	☐
9.5	Technical assistance for academic staff who wish to develop educational software	☐
9.6	A technology resource centre that provides staff with access to development facilities to develop educational software.	☐
9.7	A special unit dedicated to develop instructional software for academic staff	☐
9.8	Other. Please specify.	☐
9.9	.....	☐

10. If you were using ICT in the past to enhance your teaching, but are not using it anymore, could you briefly describe what you were using or doing, and explain why you are not using it anymore.

.....

.....

.....

.....

11. If the use of ICT to enhance your teaching **is documented** in any way, could you kindly supply the references to the(se) document(s)?

.....

.....

.....

.....

12. If you are experiencing a specific educational problem or general difficulty regarding your teaching or your students' learning which you think could be addressed using educational technology, kindly describe it here. (Please use a separate sheet of paper or email M.Mostert@ru.ac.za, if necessary).

.....

.....

.....

.....

Thank you for your assistance.
Kindly return the completed questionnaire to ADC via internal mail.

Appendix B Questionnaire Results

Conventions

1. The format and question numbering of the original questionnaire has been retained in this report.

2. The results of the quantitative analyses are indicated in bold numbers within a box, e.g. **6**.
   The figure indicates the **percentage** of respondents who selected a particular option. Percentages are rounded to the nearest integer.

3. To reveal possible trends, the higher incidences of responses in each category are marked in colour, e.g. **86**

4. The results of the quantitative analyses are printed below the relevant questions in a different font (*Times New Roman, italic*) while the number appearing to the right of the text indicates the respondent identification number (assigned arbitrarily as questionnaires were returned), e.g.

   Especially on sabbatical – access to email at home would be so beneficial. | 20 |

5. Comments by the researcher appear in angular brackets, e.g. *[remote sensing]*.

6. General comments of respondents appear at the end of Question 12. These comments were received in response to the invitation extended in the "Instructions" of the questionnaire, to "add any other relevant information or explanations in the margins or on separate pages".

1. Kindly indicate the Information Communication Technologies (ICTs)
   (a) which you currently have access to, ***or***
   (b) which you would like to have access to. (Please check all that apply)

		Have now	Would like
	Hardware in your office (i.e. daily access)		
1.1	Computer		
	Private 4 / 286 1 / 386 5 / 486 18 / Pentium 40 / Pentium II 22 / Pentium III 1 / Apple Mac / iMac 1 / Not indicated 7		5
1.2	Printer		
	Private 3 / None 24 / Dot-matrix 8 / Monochrome Inkjet 8 / Monochrome Laser 40 / Colour Inkjet 9 / Colour Laser 1 / Not indicated 3		9
1.3	Multimedia		
	CD-ROM 59 / Soundcard 43 / Speakers 39		17
1.4	Scanner	11	20
1.5	Voice recognition system	1	19
1.6	Other. Please specify.		
1.7	*Plus portable*	81	
	I have my own Pentium, dot-matrix printer, CD-ROM, soundcard and speakers in my office. These are my personal possessions - not supplied by Rhodes.	77	
	Pentium II, Colour Inkjet, Multimedia. Note: This is personal, private, not Rhodes property.	82	
	These are all mine i.e. not purchased by Rhodes. This applies to all other staff in the Department.	93	
	Don't know what these are. Sorry - I am hopelessly out of my depth here. Step 1 of capacity building is information on what these things are or can do. Why would I want them?	62	
	Need major upgrade		70
	486 Private property. Would like Pentium III.		34
	Hardware in your department (i.e. relatively easy access)	Have now	Would like
1.8	Printer		
	None 2 / Dot-matrix 1 / Monochrome Inkjet 5 / Monochrome Laser 82 / Colour Inkjet 2 / Colour Laser 3 / Not indicated 4		3
1.9	Scanner	41	13
1.10	Digital camera	13	21
1.11	Video camcorder	25	20
1.12	Other. Please specify.		
	Laptop computer		14
	Data Projector		2, 17
	Colour laser		9, 91
	My office is remote from department.		82

		Have now	Would like
	Hardware within the University (i.e. reasonable access by booking)		
1.13	Liquid Crystal Display (LCD) panel / slate	23	8
1.14	Data projector	29	15
1.15	Scanner	24	8
1.16	Digital camera	5	21
1.17	Video camcorder	14	14
1.18	Other. Please specify.		
1.19	*Video projector. Decent video showing equipment is hard to come. Sound system is pretty poor*	6, 32, 40	
	Laptop	35	
	I don't know what is available or what I would use it for.	9	
	Photo slides scanner		42
	Need more than current holdings		92
	Software	Have now	Would like
1.20	Word processor (WordPerfect, MS Word)	91	0
1.21	Spreadsheet (Quattro Pro, MS Excel, Lotus)	75	3
1.22	Database (Dbase, MS Access)	40	6
1.23	Presentation software (Corel Presentation, MS PowerPoint)	62	5
1.24	Graphics Software (Corel Draw, MS Paint)	47	12
1.25	Electronic Mail (Pegasus Mail, MS Outlook)	87	1
1.26	Web Browser (Netscape, MS Internet Explorer)	81	5
1.27	Hypertext Markup Language (HTML) Editor (MS FrontPage, Dreamweaver)	23	13
1.28	FTP Software (File Transfer Protocol)	39	2
1.29	Desktop Publishing Software (Aldus Pagemaker, MS Publisher)	8	15
1.30	Authoring packages (Quest, Authorware)	2	11
1.31	Programming Languages (C++, Visual Basic)	14	5
1.32	Electronic Encyclopaedia (MS Encarta, Grolier)	13	15
1.33	Other. Please specify.		
1.34	*Linux + Utilities + Apps / Linux, Lyx & associated packages*	18,53	
	Statistica	53,66 89	56
	Statgraphics	89	
	SAS		53
	SPSS PC		2
	*Qualitative data analysis package / Nudi*st Statistical Software*		9,35
	GIS [Geographical Information Systems] & RS [Remote Sensing] software to produce maps	93	46
	Project Management (MS Project)		1
	Reference Manager (for managing research papers etc.) is sorely needed.		14

	Electronic Meeting System		14
	Scientific Word	66	
	Quark Xpress	69	
	Typesetting (Latex)	19	
	Finale (Music writing)	33	
	Arcinfo; Arcview	96	
	Photo Access	96	
	Adobe		12
	Pastell [Accounting Package]	28	
	Computing facilities at home (i.e. daily after-hours access)	Have now	Would like
1.35	Computer: compatible with office computer	58	25
	Laptop	23	
1.36	Computer: non-compatible with office computer	14	1
1.37	Printer	53	21
1.38	Software: compatible with software on office computer	48	25
1.39	Software: non-compatible with software on office computer	19	0
1.40	Data connection to University network with access to home directory on server	14	39
1.41	Data connection to University network with access to the Internet and email	26	37
	Especially on sabbatical - access to email at home would be so beneficial.		20
	We have been waiting for this for months now. Telkom have been & the modem has been bought. We're waiting for Rhodes.		78
1.42	Other. Please specify.		
1.43	*I take it as a matter of course that in order to have up to date equipment I must buy my own i.e. work at home.*		41
	Imaginet email address "says something itself". Own equipment at home.		61
	Work in my office after hours.		92

2. For the purpose of **using** ICTs to enhance **your teaching**, please indicate those applications
   (a) that you are currently using ***or***
   (b) that you would like to use. (Please check all that apply) ***and***
   (c) that you need training to be able to use it.

		Use now	Would like	Need training
	Preparation			
2.1	Word processing software to prepare student study guides, etc.	90	8	5
2.2	Presentation software to prepare overhead transparencies	57	24	22
2.3	Desktop publishing software to design study material	12	36	25
2.4	Electronic encyclopaedia on CD-ROMs to collect information	15	27	6
2.5	Web browser to access information on the Internet	80	12	12
2.6	Web browser to search library catalogues	72	15	15
2.7	Search engines to search for information in the Internet	71	11	11
2.8	Subscription to a electronic discussion group (e.g. a listserv) with educators of similar disciplines as your own at other institutions	43	16	9
2.9	HTML editor to prepare study material for students to access on the web	12	42	36
2.10	FTP program to transfer material to a web server for students to access	29	31	31
2.11	Graphics software to manipulate pictures, diagrams, graphics, etc.	33	36	28
2.12	Scanner to scan pictures, diagrams & graphics to use in study material	33	36	24
2.13	Digital camera to take digital photographs to use in study material	11	40	17
2.14	Video camcorder to capture video clips for use in presentations, etc.	9	36	17
2.15	Voice recognition systems to enter data into software applications	0	27	16
2.16	Other. Please specify.			
2.17	*Some I have but do not use because of limitations in lecture venues & traditional structure of courses*	52		
	Presentation of Lectures	Use now	Would like	Need training
2.18	Electronic presentations (with computer, data projector & presentation software)	23	38	29
	Need to be easily accessible in lecture halls.	69		
2.19	Presentation handouts (created with presentation software)	35	28	18
2.20	Web browser and Internet access for demonstrations	22	24	15
2.21	Computer conferencing for communication with colleagues / students	1	28	20
2.22	Audio conferencing for communication with experts/colleagues/students	1	22	15
2.23	Video conferencing for communication with experts/colleagues/students	4	22	12
2.24	Other. Please specify.			
2.25	*I avoid such accessories because nothing ever works in the lecture theatres - even basic videos!*	32		
	Heavens, who would have time to do all this - too much teaching!	62		
	Communication	Use now	Would like	Need training
2.26	Email to interact with individual students	86	6	3

				Use now	Would like	Need training
2.27	Mailing / distribution lists to communicate with groups of students			61	21	11
2.28	List servers (Listservs) to facilitate electronic group discussions			20	21	13
2.29	Web pages to distribute study material, announcements, etc.			24	41	34
2.30	Network server with directory allocated to distribute study materials			13	36	15
2.31	Word processors' "comments" feature for feedback on students' word processed documents			6	35	23
2.32	Other. Please specify.					
2.33	*Not exactly sure what some of the above mean but would be keen to learn and try*				52	
	Would like to have facility of email addresses of students on a particular course easily be compiled (off control base) to facilitate ongoing discussion of a course while it is on.				61	
	Practicals / Tutorials					
	Dedicated educational software	Please supply title (e.g. *A.D.A.M.*)	Publisher (e.g. *Macromedia*)			
2.34	Drill and practice			2	6	2
		Graphs & Tracks	*PAS*	17		
		Freebody	*PAS*	17		
		Proprietary		17		
2.35	Computer tutorials			13	14	8
		Xhosa		1		
		Principles of Physics		17		
		Syntax	*Rhodes University*	51		
		Question Mark	*Question Mark*	46		
		Proprietary		55		
		Anatut		92		
		Wits Tut System for Chemistry	*Wits*	30		
		CALnet Chem1R tutorial	*Rhodes University*	30		
2.36	Computer simulations			9	7	2
		Redshift	*Dorling-Kindersley*	1		
		Sensor		2		
		Crocodile Clips		2,19		
		Worlds in motion		17		
		CUPS		17		
		Life	*Freeware*	89		
		ADAM		92		
		TAIS		92		
		Simcity		93		
2.37	Educational games			1	6	2
		TAIS		92		

2.38	Other. Please specify.					
2.39	*Reference*	*History of the World*	*Dorling-Kindersley*	1		
	Reference	*Nature 2.0*	*Dorling-Kindersley*	1		
	Software Development	*Lots of different systems*		3		
		MS Office	*Microsoft*	3		
		Phonology Program		7		
	We use self-written custom software			12		
	[Reference]	*Ultimate 3D Skeleton*	*D&K*	24		
	[Reference]	*Ultimate Human Body*	*D&K*	24		
		Fry method	*Acad. Individual*	42		
		Stereonets	*Acad. Individual*	42		
	Dept of Physics has a library of s/w for use in lectures and pracs e.g. Physics Academic Software, CUPS.			19		
	Specialised software	Please supply title (e.g. *AutoCAD*)	Publisher (e.g. *Autodesk*)			
2.40	Computer Aided Design			4	2	2
		Turbocad		17		
		Humancad		55		
2.41	Mapping Software (GIS)			4	2	2
		Arcview		12,93,96,		
		TNTmips		12		
		ESRI		12,93		
		Microimages		12		
		IDRISI		89		
2.42	Mathematical software			8	2	1
		Graphpad		1		
		S+	*Mathsoft*	12		
		Mathcad		17		
		Matlab		18,19,29		
		Mathematica	*Wolfram Research*	18,19		
		Quattro Pro	*Corel*	29		
		MS Excel	*Microsoft*	29		
		NLREG		29		
		SCILAB	*GNU Public*	53		
		Maths	*Maple*	18		
2.43	Statistical software			14	5	3
		S+	*Mathsoft*	12		
		Statistica	*Statsoft Inc*	12, 38, 41, 46, 53, 56, 66, 89, 94		
		SPSS PC		2		
		Statview		55		

		BMDP		66		
		SAS	*SAS*	53,70		
		Statgraphics		89,92		
		Oriana		89		
	Qual Data Analysis	*Nud*ist*		62		
	Qual Data Analysis	*Atlas T.I*		62		
2.44	Other. Please specify.					
2.45	*Distributed programming*	*Linda*		3		
		CORBA		3		
	Network modelling	*OPNET*		3		
	Phylogenetic Software	*hennig86*	*private*	10,89		
		Photoshop 5	*Adobe*	11		
		Fractal Painter 5		11		
	Circuit modelling	*Croc Clips*		19		
	Accounting Package	*Pastell*		28		
		Sigmaplot		70		
	Systematics	*Hennig86*		89		
		Nona		89		
		Taxasoft		89		
		Delta		89		
		Intkey		89		
		Tgard		89		
	Several ergonomic programmes			92		
	Use some of my own software for honours pracs			23		
	I write my own!			4		
	Don't know the products			59		
	Don't know if this is relevant to what I teach?			62		
	No idea - need to search			70		

		Use now	Would like	Need training
	Assessment			
2.46	Computer Based Testing software to deliver self-assessed quizzes	3	31	17
2.47	Computer Based Testing to deliver semester tests or examinations	4	31	16
2.48	Network server with directory allocated for submission of assignments	1	25	15
2.49	Web publishing on a Web server for submission of assignments	1	23	13
2.50	Spreadsheet to capture and calculate test and examination marks	40	11	9
2.51	Web pages to deliver feedback on tests / assignments	4	31	18
2.52	Other. Please specify.			
2.53	*Marked card system (or similar) for computer marking of biweekly tests*		17	
	Network server with directory allocated for submission of assignments important!		1	
	Web pages to deliver feedback on tests / assignments important!		1	
	I have developed my own evaluation but would like it computerised as well. Not sure if this is possible.		20	
	Computer Based Testing software especially important!		52	
	Evaluation of your teaching and courses	Use now	Would like	Need training
2.54	Computer Based Testing to deliver teaching or course evaluations	15	24	11
2.55	ADC's *Evaluation Assistant* to deliver teaching or course evaluations	24	26	12
	Tried to use computer-generated evaluation questionnaire. Too time-consuming & questions were not relevant to my discipline. Eventually, resorted to developing questionnaire myself.	62		
	Can never access their website	88		
2.56	Other. Please specify.			
2.57	*Departmental program (Dr Cosser) [Chemistry]*	29		
	In-house questionnaire [Statistics]	53		
	Dept's teaching and course evaluations done on BMDP [Statistics].	66		
	I have developed my own evaluation but would like it computerised as well. Not sure if this is possible.		20	

3. For the purpose of **using** ICTs to enhance **your students' learning**, please indicate those facilities
   (a) that they currently have access to, ***or***
   (b) that you would like them to have access to. (Please check all that apply)

	Computing facilities	Have now	Would like
3.1	Computers in a departmental lab	56	19
3.2	Number of computers in departmental lab(s): (1 / 2 / 3 / 4)		
	6 departments (11 respondents): 2 – 3 computers		
	5 departments (9 respondents): 4 – 5 computers		
	4 departments (4 respondents): 6 – 7 computers		
	8 departments (12 respondents): 8 – 15 computers		
	5 departments (8 respondents): 20 – 30 computers		
	3 departments (3 respondents): 40 - 60 computers		
3.3	Computers in a public lab	43	11
3.4	Multimedia computers (i.e. with soundcard and speakers / earphones)	16	19
3.5	CD-ROM drives	23	21
3.6	Laser printer	43	11
3.7	Colour printer	14	13
3.8	Scanner	14	14
3.9	Digital camera	1	19
3.10	Video camcorder	5	11
3.11	Other. Please specify.		
3.12	.....		

4. What are your students' needs regarding **public lab time** for each of the courses that you will be teaching next year (2000)? (If you teach more than three courses that need public lab time, kindly indicate the rest on a separate sheet of paper.)

		Course codes:	(a)		(b)		(c)	
		Semester:	**1**	**2**	**1**	**2**	**1**	**2**
4.1	number of (45 min) lecture periods *per student per week* (booked):							
4.2	hours outside lectures *per student per week* (non-booked), e.g. for essay and report writing, internet searches and email:							
4.3	anticipated number of students:							
4.4	for how many of the 13 or 14 weeks of the **semester**:							

A combined submission from Comp Sci will be more meaningful here than a per course submission. We use the public labs all the time. 3

This table doesn't capture our usage for practicals and lectures. 93

5. Are your students currently required to enrol for a computer literacy course? Kindly fill in the course codes of the courses that you teach, and answer this question for each course separately.

	Course code:	no	no, but I would like them to enrol	yes, for non-credit purposes	yes, for credit-purposes
5.1	*Course a*	27	17	5	13
5.2	*Course b*	20	6	4	5
5.3	*Course c*	17	5	1	3
	Average	21	9	4	7

Ours are Comp Sci students - they need to know most things about ICT	3
Comp Sci students de facto do this.	4
Many MA students come from outside Rhodes & might even be computer illiterate.	9
I think only / mostly the weaker / disadvantaged students would need this & as they seem to be loaded enough as it is, this extra course would be counter productive.	10
CSc101 is compulsory for all students wanting to do IS2 & IS3 (in fact most Commerce students) as well as for CSc 102.	13
If 201/202 allows the students to be computer literate then 301/302 will not be necessary.	50
By GOG 301 they probably should have done a literacy course but I am dubious of the courses currently offered.	93
I have no idea how to answer this without quite a lot of research and I don't think our small student numbers justify such an effort.	33
Unknown.	82

6. What are your expectations regarding the computer literacy skills of your students? (Please check all that apply)

6.1	Word processing: Student assignments should be typed (word processed and printed)	79
	Not essential.	32
	But don't have to be.	32
	Would be nice, but not compulsory.	65
	Students won't be reprimanded if assignments [are not printed].	79
	I would expect the above from 2nd and 3rd year students / Higher levels only.	56, 95
6.2	Communications: Students should be able to communicate via email	77
	Eventually.	32
	I would expect the above from 2nd and 3rd year students.	56
	Would be nice, but not compulsory.	65
6.3	Web publishing: Students should be able to publish assignments on the Web	11
	One day.	12
	Would be nice, but not compulsory.	65
	Would like them to.	76
6.4	Other. Please specify.	
6.5	*In the second semester all essays must by type on word processor*	6
	Search Internet / WWW knowledge	9, 80, 86
	Familiarity with Paint () & photo manipulation software (Photoshop)	11
	Students should be able to access the server and use Quattro Pro.	17
	Spreadsheets.	18, 29, 44, 96
	Use spreadsheet after being taught in the dept.	19
	By Honours students should also have spreadsheet skills	23
	Produce graphics & maps using spreadsheets and GIS.	89
	Programming	18
	Run simple applications.	19
	Students should be able to write music exercises or compositions using music software, and be able to use MIDI.	33
	Using computers for dispensing medicines, check doses and interactions.	34
	Statistical analysis - students should have understanding of using STATISTICA.	53, 70, 89
	Students must manipulate text & images for print production [DTP].	69
	Use graph plotting software	70
	None	81

7. Which computer skills are
   (a) advisable, ***or***
   (b) essential to a graduate of your faculty seeking professional employment, ***and*** which of those are
   (c) currently provided for in your course or degree program? (Please check all that apply)

		Advisable	Essential	Provided
7.1	Word processing	18	72	25
	They are expected to learn themselves			9
	We don't offer courses in these but students quickly pick these skills up.			23
7.2	Working with spreadsheets	23	45	27
	We don't offer courses in these but students quickly pick these skills up.			23
7.3	Database management	27	22	13
7.4	Touch typing	35	11	2
7.5	Email communication	22	61	22
7.6	Computer graphics	26	19	8
7.7	Desktop publishing	1	5	3
7.8	Computer aided design	9	4	2
7.9	Internet searching	27	46	20
7.10	Web publishing	19	6	4
7.11	Other. Please specify.			
7.12	*Software Design*		3, 9	9
	Programming		3, 31	
	Systems Design		31	
	Computer interfacing		19	19
	Computer Simulations	38		
	Knowledge of Accounting packages		28	
	Statistical Analysis	53	38, 53, 89	38, 89
	GIS skills		93	93
	We don't offer courses in these but students quickly pick these skills up.			23

8. Are you or your department
   (a) currently involved with, ***or***
   (b) planning to get involved with. (Please check all that apply)

		Do now	Plan to do
8.1	teaching off-campus under-graduate students?	12	4
	At Fort Hare	89	
8.2	teaching off-campus post-graduate students?	22	0
	MSc level	89	
8.3	developing educational / instructional software?	14	13
8.4	entering into collaboration agreements with another institution(s) to develop educational software?	5	2
8.5	acquiring a departmental computer lab?	23	5
	Small & outdated	10	
	Have got - needs upgrade	23	
	Small GIS lab	96	
8.6	Other. Please specify.		
8.7	*Teaching teachers in schools [Physics]*	17	
	I don't know. We don't discuss this. Personally, I have no time to think about these things. Too busy teaching!!	62	

9. Please indicate the type of **incentives, support and assistance** you believe should be provided by Rhodes for staff who wish to use ICTs to enhance their teaching. (Please check all that apply)

9.1	Training for academic staff to provide them with the skills needed for the instructional use of Information Communication Technologies	**73**
9.2	A formal program to recognise and reward the use of ICTs as part of the routine academic staff review and promotion process	**36**
	Yes, but what is the pedagogical value of ICT?	9
	This is scary - not all of us need to use technology to be good at our jobs!	10
	I don't know what the implications of these points would be? Could it disadvantage the ? courses & programmes? Possibly, I think.	20
	but with regard for applicability to discipline.	51
	No: If it is useful, it is so because it is easier. Why then an incentive? It is my right not to use this. Why then make it a virtue through promotion & prejudice and problem?	61
	Oh no!	62
	This is dangerous - lots of ICTs doesn't always mean good teaching.	65
	Definitely.	76
9.3	A library of academic courseware for review, evaluation and use by academic staff	**65**
	No - this still is never well used unless it is explicitly bought for a task.	3
	Most of the courseware I have seen is so subject specific that you will [need] a collection the size of the library if you go this route!	56
9.4	Recognition and reward for educational software development by academic staff, similar to the compensation received from publishing articles in SAPSE-accredited journals.	**49**
	I don't know what the implications of these points would be? Could it disadvantage the ? courses & programmes? Possibly, I think.	20
9.5	Technical assistance for academic staff who wish to develop educational software	**61**
	but in a self-help way	3
	And time!!!	9
9.6	A technology resource centre that provides staff with access to development facilities to develop educational software.	**49**
9.7	A special unit dedicated to develop instructional software for academic staff	**36**
	This would be nice, but the money spent this way in the past has not shown good returns at Rhodes.	3
	Ideal	32
9.8	Other. Please specify.	
9.9	*None of above.*	81
	Courses accredited by NQF as part of ongoing professionalism.	45
	Incentives to encourage staff to explore opportunities to attempt curriculum development using ICT.	52
	Help, training, knowing what's out there.	80
	Appropriate venues where it can be used.	52

10. If you were using ICT in the past to enhance your teaching, but are not using it anymore, could you briefly describe what you were using or doing, and explain why you are not using it anymore.

For many years we used PLATO and CBE software we developed ourselves (Oberem & Helm). ***The students did not like it.*** *It is not worth the effort to develop one's own CBE programs.*	17
CALnet - University has withdrawn ***technical support.*** *(We plan to convert it to a new format).*	32
Computer simulated teaching. ***Change in hardware & software.***	40
Time *consuming and lack of* ***support*** *and* ***facilities.***	8
General comment: Recent experiences of ***network unreliability*** *makes me very hesitant to continue using distribution lists, email, etc, for communication with students. Unless the networks become more reliable, I intent to keep to traditional methods*	7
Hardware problems *in fountain lab in the 1st semester 1999 caused lots of problems with practicals & severely hindered students learning & enjoyment of practicals.*	53
It is very hard to book public lab time. Departmental ***facilities*** *are grossly overused. University won't provide staff with appropriate technology. ALL lecture & public lab venues need dedicated computers, data projectors, and blockouts.*	93
I have cut down on web based tuts due to the ***slowness of the system*** *compare to say 1995.*	56
Have abandoned some WWW tutorials because ***downloads were too slow.***	89
I offer Bioch 301 an internet assignment to model 3-dimensional structures of enzymes. And the problem has been daily access to the Internet for "plug-ins", software programmes and general ***'slowness'*** *of the system.*	50
Lecture ***facilities*** *(ie. Slate in Arts Major & data projector in Chem major): either too low quality, image not large enough, or access to keys a nuisance, too unreliable.*	14
We have developed CDROM courses & plan to do more in the future. Using WWW format & need to acquire Adobe Publisher.	12

11. If the use of ICT to enhance your teaching **is documented** in any way, could you kindly supply the references to the(se) document(s)?

Teaching portfolio	42
http://www.chem.ru.ac.za/chemlink.html (resource site)	44
Supplied pages to students with a list of useful websites.	58
http://www.ru.ac.za/zoology/martin/forensic_ent.html	89
http://www.ru.ac.za/zoology/martin/insects.html	89

12. If you are experiencing a specific educational problem or general difficulty regarding your teaching or your students' learning which you think could be addressed using educational technology, kindly describe it here. (Please use a separate sheet of paper or email M.Mostert@ru.ac.za, if necessary).

*Student **word processing**, including preparation of theses - content pages, etc.*	75
*Teaching "**computer literacy**" to "**disadvantaged students**" - CAI tutorials??*	1
*Courses in areas such as statistics where large differentials in **students' preparedness** would be better taught on the screen. Where they can more easily backtrack, return to more basic tuition where necessary , and so on.*	61
*The CAMESE software is great & will help enhance the ELAP [English Language for Academic Purpose – for **'disadvantaged students'**] course greatly. However, I would also like to think of writing as a possible venture as well.*	6
My L2 [Second Language] students' needs are varied but a major problem is to be able to SPEAK IsiXhosa or to communicate with L1 interlocators[?]. I would appreciate some kind of course material which would expose them to communication in IsiXhosa.	84
Would like a phonology program which demonstrates sounds and accents. Sounds should demonstrate South African pronunciation, not American or British.	7
Would like to have facility of email addresses of students on a particular course easily be compiled (off control base) to facilitate ongoing discussion of a course while it is on.	61
Marked card system (or similar) for computer marking of biweekly tests	17
*Major problem is the **size of the first year class** (500+) which makes assignment evaluation very difficult.*	65
I would like to supply readings, lecture notes, etc. on the web.	58
*Require auto **attendance tracking** at lectures and practicals. Technology is presently available form Tube-train ticketing systems which can register a student's presence from an ID card as he walks in the door.*	81
*Possible **staffing problems** for next years computer graphics workshops - I'm not sure that we will have ..., as our present tutor is leaving and I am the only staff member who regularly works with computer graphics.*	11

13. General comments.

*I'm afraid I regard much of this questionnaire as overkill! I use this sort of stuff very cautiously and carefully. It's too easy to get swept up by **hype**.*	4
*I question the value of too much "**glitz**" for the sake of having it, or worse still, "showing off" one's personal technical wizardry.*	10
*I have never used it, but I would imagine that it involves **more preparation & time** rather than less. Also some of this stuff, I believe, becomes an end in itself. **Also it effaces good old-fashioned interpersonal & communication skills**.*	61
Concern: Techno will separate students from lecturer = split up the relationship on a face-face basis.	20
*I feel completely **inadequate** in this regard. Don't know what is available, and have **no time to develop skills**, e.g. attend workshops.*	12
On-line evaluation would be easier if it didn't invoke so much organisation and so many folk – but is very valuable.	89