Learning in a Constructivist On-Line Environment

By
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LEARNING IN A CONSTRUCTIVIST ON-LINE ENVIRONMENT

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Declaration

Apart from the assistance which is acknowledged and quotations specifically referenced in the text, this thesis is entirely my own work, and has not been submitted for a degree at any other university.

Signed by: 
D.W.Govender

Date: 25/03/03

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ABSTRACT

Most universities are incorporating elements of Asynchronous Learning Networks (ALN) into their traditional classrooms. However, it is not known how well learners who are used to traditional face-to-face learning environments and who do not necessarily prefer ALN adapt when placed in such environments. This study was initiated to investigate the use of ALN with university students from traditional face-to-face classrooms. Second year Computer Science Education students from the Department of Computer Science in the Faculty of Education participated in a constructivist on-line learning environment (mixed mode of delivery).

The aim of creating this constructivist learning environment using a mixed mode of delivery was to firstly create an environment for students where they can construct knowledge for themselves as well as to provide access to scholarly resources; provide access to data during student's time; promote self directed learning; enable active engagement with course content; facilitate communication with students; and to provide to some extent a way of accommodating different learning styles.

A qualitative study was done on the attitudes of students to a constructivist online learning mode as compared to a total face-to-face (traditional) mode of instruction. Part of a second year module, Data Communication, was offered as an on-line module to students. The process began with converting the existing course to a mixed mode delivery form. Conversion required a re-think of the learning activities and objectives within the context of an electronic asynchronous learning environment, as well as the options and resources available, the limitations, a redesign taking note of how to meet the instructional objectives and how to assess learning.

The on-line module was developed using WebCT (WebCT Inc.). The module ran for three weeks and thereafter Q-methodology and qualitative data analysis techniques (questionnaires) were used to analyse response of students to the course. The hypotheses tested where: Mastery of course material in the virtual classroom (VC) will be equal or superior to that in the traditional classroom (TC) and VC students will report higher

subjective satisfaction with VC than the TC under a number of dimensions, including improved overall quality, better use of time and assessing the experience as being better in some way as when compared to TC. In addition students were able to compare this type of course delivery to total face-to-face course delivery that they took in the first semester.

The results showed a positive trend towards the acceptance of a constructivist on-line environment for learning. All students involved in the mixed mode said that it was the mode of delivery that enabled them to benefit from this course, they had more contact with the lecturer and they were motivated to work. Most students felt that the efficiency and quality of education had improved. These results prove that the hypotheses were not refuted and therefore give grounds to my vision of offering existing courses in a constructivist way.

CHAPTER ONE

INTRODUCTION

For many years various types of learning practices have co-existed in tertiary education. Practices are influenced by changing learning methods and often borrow their formats from the traditional teaching, the expert knowledge of the practitioner and more recently from the development and use of information and communication technologies (ICTs) in education. This chapter will briefly address concepts and issues related to this. The concepts and issues include learning styles, life long learning, learning environment, constructivism, practice centred learning, cooperative/collaborative learning, on-line learning and asynchronous learning networks (ALN).

Educators have been exploring ways to combine theories of different learning styles and student-constructed knowledge with the theory of practice-centred learning (learning by doing). A learning style is a way in which a learner begins to concentrate on, process and retain new and difficult information (Mcnall, 1997). Instead of being passive recipients of knowledge, students are now considered to be capable of constructing their own knowledge with guidance from a teacher. Part of this guidance can be provided by setting up an environment that will provide students with the resources necessary for independent exploration. In using emerging computer-based technology as a resource students are encouraged to explore their own interests and to become active educational workers with opportunities to solve problems.

Historically educators have not done a very good job of implementing the concept of learner-centred education and lifelong learning. As Thornburg (1991) points out, it is difficult, at best, to instil a mindset of lifelong learning in others if we do not understand it and demonstrate it ourselves. One of the reasons for this failure is that tools were not available to do much besides deliver education (as opposed to enable learning). Now, computers and telecommunications have opened the way to formats other than pen- and-paper courses and allow for a more interactive, integrated learning environment.

The type of change enabled by computer-mediated communication (CMC) does not just involve adding new technology to old ways of organizing teaching and learning (Moore, 1993). The paradigm shift is from a teaching environment to the use of a learning environment. As knowledge in many fields increases exponentially we cannot hope to fill up students as if they were passive, empty vessels. During formal schooling aspiring professionals can only make a small start to begin to take in the amount of information that they will need during their career life times. The knowledge base of certain fields may have appeared static for decades, but this is no longer an accepted view. Therefore, we must teach students to become lifelong learners by helping them locate the resources to continue learning.

Educators are now beginning to focus on a related set of notions: (a) there are different learning styles, (b) students create their own meaning when learning new things, and (c) what makes a difference in content retention and transfer is not so much what is done by teachers but what students as learners can be encouraged to do themselves.

The body of literature on constructivism, which has emerged over the past few decades, has also contributed to our understanding of learning styles. Constructivist theory posits that students make sense of the world by synthesizing new experiences into what they have previously understood. When content is meaningless to the students' world view, when they are taught as if they were passive recipients of knowledge, or when they have little engagement in the instructional tasks, students have no incentive to construct their own knowledge and little motivation to retain information or transfer its use to novel situations.

The notion of practice-centred learning (PCL) is important. As we learn more about how learning occurs, it becomes increasingly clear that the educational process takes place in a complex internal and external environment. One of the teacher's roles is to become the creator of an effective external learning environment that stimulates the environment within. How do teachers and developers of instruction create environments that are conducive to and enhance student learning? A technology that can help provide these

new environments for education has emerged. This technology allows us to utilize such methods as cooperative learning, to recognize such concepts as interdisciplinary needs in education, and to provide an environment in which collaborative efforts are rewarded. These methods foster a view of knowledge in which expertise is distributed and created among the different participants (Collins, 1991). However, educational vision needs to fully embrace the use of technology and modern educational philosophies to create new educational environments.

The last ten years have seen the widespread development of digital processing and communication coupled to networked computing. This has opened up a broad set of teaching and learning opportunities, allowing a new emphasis on interaction and concept exploration. These early extensions have tended to follow the already established distance learning conventions, or those of the classroom. Little work has been done to identify opinion typologies that characterize the student population with respect to lifestyle and learning style. Ultimately, understanding the opinion types of a student population permits educators to optimise effectiveness in the delivery of course content using technology.

Commenting on the psychological satisfactions provided by the classroom setting, Batstone (1997) writes that the information contained in Internet offerings usually is not enough. To be most effective, such offerings must provide users with a credible virtual environment, one that gives users a sense of community. This author further asserts that in the zeal of universities to build computer and video infrastructures, they run the risk of neglecting the ways in which technology could help them stay connected with students through tailored education approaches. The success of online learning hinges on its capacity to simulate a dynamic campus classroom. Students are not willing to sacrifice that shared experience merely for the convenience of studying at home. Andriole (1997) asserts that the uniqueness of technology-based instruction makes it necessary to adopt more rigorous course requirements and design, development, delivery and evaluation.

Most universities are incorporating elements of Asynchronous Learning Networks (ALN) into their traditional classrooms. Asynchronous Learning Networks (ALN) are people networks for anytime-anywhere learning. ALN combines self-study with substantial, rapid, asynchronous interactivity with others. In ALN learners use computers and communications technologies to work with remote learning resources, including coaches and other learners, but without the requirement to be online at the same time. The most common ALN communication tool is the World Wide Web. However, it is not known how well learners who are used to traditional face-to-face learning environments and who do not necessarily prefer ALN adapt when placed in a situation that requires learning via an ALN. In order to address this I examined a situation where university students from a traditional face-to-face classroom environment took a class in an ALN environment.

I decided to test the response of second year Computer Science Education students to a mixed mode of delivery (online/electronic course delivery and face-to-face) as compared to the traditional face-to-face (FTF) delivery mode.

The aim of this mixed mode of delivery was to provide access to scholarly resources, provide access to data during student's time, promote self directed learning, enable active engagement with course content, facilitate communications with students, create opportunities for students to be knowledge builders and provide to some extent a way of accommodating different learning styles.

A qualitative study was done on the attitudes of students to a constructivist online learning mode as compared to a total face-to-face (traditional) mode of instruction. Part of a second year module, Data Communication, was offered as an on-line module to students.

The purpose of this study was to identify and categorize the opinions of a sample of students at the University of Natal (Edgewood Campus) in order to acquire an understanding of their acceptance of, or resistance to, the application of technology to learning in a constructivist online learning mode as compared to a total face-to-face mode

of delivery. The results (chapter 4) draw attention to opinions of what students think about mixed mode course delivery and the positive and negative aspects thereof. The application of web-based technology to education introduces a host of administrative, communication medium (one-on-one and face-to-face interaction), as well as technical concerns. The interactions of course presentation with these types of concerns may significantly push individuals away from considering web-based courses. By understanding student opinions, we can better design and provide instruction for web-based courses.

The next chapter will review current literature in the area of on-line learning.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

An examination of existing literature shows that on-line learning/mixed mode delivery is somewhat equivalent if not superior to the traditional face-to-face learning method based on responses from participants in an on-line learning environment. Responses emphasized better understanding and better organization of the learning environment for educational purposes, greater re-investment of knowledge through personal exploration and individualized Web page construction, information sharing through electronic bulletin boards and better assimilation and comprehension of concepts and knowledge based on multiple links in the database. This chapter explores studies that have shown how Information Communication Technologies (ICT) can be used to complement face-to-face (FTF) meetings and improve the quality and flexibility of learning. One of the studies explored shows the relevance of integrating ICTs in the training of future teachers. Thereafter the educational theories, concepts and issues related to the creation of an effective learning environment are explored. Some of these theories, concepts and issues discussed include Information sharing, Constructivism, Asynchronous Learning Networks (ALN), ALN and Constructivism, Learning Experience and Effectiveness of On-line Environments and Rich Environments for Active Learning.

2.2 Current Practice

In Quebec, two researchers at the École Nationale d'Administration Publique (ENAP) (Maltais and Rondeau, 1997) undertook to provide part of their instructional material on the Web, specifically the syllabus and specialized articles used in their course which had previously been offered by a traditional teaching method with lectures and face-to-face meetings. The two course instructors also decided to provide part of the teaching, facilitating and coaching through email and FirstClass software which enabled them to

establish individualized communication and electronic conferences reserved for participants alone.

The changes to the traditional format led to a complete reformulation of the course. From 12 weekly three-hour face-to-face meetings the researchers shifted to three monthly six-hour meetings, and instead of 12 themes, they reorganized the material to be taught into three integrated modules. Thirteen graduate students, (most living in Montreal and three in Quebec City), registered for the course. Ten students had regular employment and three others were full-time students. Apart from the technical difficulties inherent in effective use of the electronic support the researchers and students generally accepted the new format for dissemination and communication of information. Centered on active learning by students the format created many exchanges and direct interactions that facilitated more continuous and individualized coaching and distributed sharing of information among participants. Collaborative and co-operative formats appeared that showed instructional support equivalent if not superior to the traditional face-to-face learning method.

However, the above Quebec experiment is only the tip of the iceberg. For nearly twelve years, Hiltz (1992) from the Department of Computer and Information Science (CSI) at the New Jersey Institute of Technology, has been conducting various studies on similar mixed learning practices. Hiltz (1997) reports on a learning environment developed by the Institute, the Virtual Classroom, which supports a type of co-operative learning in asynchronous time. The Virtual Classroom is made up of virtual spaces that promote interaction between participants through online tools that provide electronic mail, transmission and reception of educational projects and communication of formative and summative evaluations. The Virtual Classroom is currently being used in various ways. It can be paired with a face-to-face communication format, constituting the sole main source of transmission of information, or be combined with other types of media: videos, audio and graphic material, CD-ROMs and software tools.

The Virtual Classroom serves students on the university campus or students taking distance courses from the Institute program. According to Hiltz (1997) no matter what

instructional format mix is selected, co-operative learning offers obvious advantages for knowledge construction. Participation and interaction between students and teachers contribute socially to the emergence of an interactive dynamic that facilitates certain processes of knowledge and skill assimilation and acquisition, processes often identified with peer exchange and discussion (self-explanation, internalization and appropriation).

At the New Jersey Institute of Technology the Virtual Classroom has been used in numerous courses in the regular programme. Between 1993 and 1995, 26 courses were converted to a specific instructional format using the Virtual Classroom with another type of knowledge diffusion: the video. Hiltz's (1994) experiment and the subsequent comparative evaluation of classes using the Virtual Classroom distance education method paired with videos and classes operating in face-to-face meetings (on campus) with videos accessible by computer network have been the subject of a statistical study based on questionnaires distributed at the end of the courses.

After explaining the methodology for statistical data collection and its limitations, the researcher explains the various problems experienced by the students using the mixed electronic teaching method: problems of access to work stations and/or Internet or Intranet lines, varying degrees of success in individual management of studies and greater difficulty establishing and consolidating lasting connections among themselves. The students located off campus, however, found online teaching more stimulating than their classmates located on campus. The off-campus students were more engaged in knowledge construction by exchanging with their peers and instructors. All the students involved in the mixed modes considered they benefited from better access to their professors and preferred this kind of teaching to more traditional teaching. These students were also more motivated to perform better while recognizing the instructional usefulness of being able to access the work of their classmates. Most felt that they learned better with the mixed mode and that it substantially improved the quality of teaching. From the teachers' point of view, the experience showed the necessity of reviewing the size of instructional groups based on the make-up of the classes. A maximum number of 25 students per class were considered a desirable and acceptable standard to guarantee the quality of academic management.

Other instructional experiments show a recurrence of these gains. Kapur and Stillman (1997), professors of computing and mathematics at James Cook University in Australia, initiated two undergraduate university courses in computing for students: in first-year biology, the first group (Introduction to Computing for Biologists), and in humanities and social sciences, the second group (Introduction to Computing for Arts and Social Sciences). In the second group, they used the Web as the main tool for transmission of information and skills. The students had access to a Web site that had course notes in various media, assessment and self-assessment tests, a course plan and corresponding agenda, electronic bulletin board, various formative feedback forms and individualized Web pages that were to be created by the students registered.

The researchers reported on the second instructional experiment, for students in humanities and social sciences, and reviewed it compared to the first group of biology students, who had not benefited from access to the Web. The target group for the study was made up of 60 to 100 learners, the majority of whom had limited knowledge of computer environments. Weekly, two 50-minute sessions were scheduled along with three hours of practical work over a 13-week semester. After explaining in detail how the instructional activities were conducted, the researchers focused on the results. They noted an increase in the performance of students involved in the second group. All the students in that semester satisfactorily completed the course requirements, 49% of them even completed the course with higher than average marks (Distinction and High Distinction), while the authors recorded a failure rate of 10% for students in the first group, and only 26 % of them earned Distinction and High Distinction. The authors also pointed out an increase in performance in subjects other than the subjects covered in the computing course. For the first group, the increase was 51%, and for the second group, it was 78%. In conclusion, the authors stated that using the Web as the main source of information communication proved very motivating for the students in introductory computing. They also emphasized the instructional gains achieved: better understanding and better organization of the learning environment for educational purposes, greater re-investment of knowledge through personal exploration and individualized Web page construction;

information sharing through the electronic bulletin board; better assimilation and comprehension of concepts and knowledge based on multiple links in the database.

The study by Light, Colbourn and Light (1997) also shows how ICTs (electronic mail, discussion list and Web site) can be used as a complement to face-to-face meetings and to improve the quality and flexibility of practical work done by students registered in a psychology course (first, second and third year). For the first-year students, results show an improvement in interaction with teachers, neutralization of the gender effect observed in face-to-face interactions and an increase in the visibility of students' work. For students in second and third year, the skywriting activity was perceived more as a means of information exchange and sharing in a community of learners, even by students more accustomed to forming small groups (Light *et al.,* 1997). However, the researchers maintain that it is risky to generalize from the results obtained, keeping in mind that the use of ICTs depends on several factors, such as the cognitive abilities and the attitudes of learners toward technology. This caution is reinforced by the conclusion reached by Crook (1997) when studying the impact of the inclusion of hypertext documents in a traditional class: "The findings reported here stress the need to recognize that teaching interventions with educational technology are always located within cultures of existing educational and social co-ordination".

A new field of practice and research thus seems to be emerging, which is the result of a mix of practices using the face-to-face method and the telepresence method with computer networks. It is also influencing teacher education. In this area, the National Council for Accreditation of Teacher Education (1997) in the United States has established an advisory board, made up of approximately twenty university faculty members who specialize in teacher education, to explore the strategic relevance of integrating ICTs in the training of future teachers in that country. While validating all the instructional benefits already presented, the report points out the importance of adopting new approaches and new attitudes toward the new information transmission and communication methods and practices required with the arrival of the third millennium. We have to know how to adapt to contemporary society and not fear taking risks: "Breaking away from traditional approaches to instruction means taking risks and

venturing into the unknown. But this is precisely what is needed at the present time" (National Council for Accreditation of Teacher Education, 1997).

Commenting on the numerous deficiencies of many teacher education programs, the advisory board proposed a complete transformation of the organizational culture of departments, which make fuller use of the social characteristics and features arising from the integration and use of ICTs in their curricula. Some fifteen examples of departmental reorganization are presented as an appendix to the report. Most cite real experience with networking among future teachers in training, teachers on the job, students and university researchers who question and interact with each other through the virtual power of ICTs (San Diego State University, Curry School of Education of the University of Virginia, Boise State University), the emergence of networks of university teachers sharing common and joint experiences (Houston Consortium) and the introduction and use of ICTs in new curricula (University of Hartford, Valley City State University [North Dakota], University of Northern Iowa, Peabody College of the Vanderbilt University, Indiana University, College Park of the University of Maryland, Western Illinois University, Arizona State University).

The operation and use of ICTs are varied and may take many forms in instructional application in the field of teacher education. All the examples cited combine mixed learning methods that are virtually changeable. In this area, Moon (1997) relates the experience of the Open University in Great Britain, which innovatively offers future British and European teachers an 18-month distance program of study via the Internet. Using Codiless (software) and its sophisticated system of electronic conferences that provide both theoretical training and sustained coaching at the required stages, the teaching offered is flexible, open, based on exchange, collaboration and accessible 24 hours a day. Time, space and face-to-face meetings are no longer impediments to learning and communicating knowledge and expertise.

In the next section information sharing and related issues are discussed.

2.3 Information Sharing

In order to facilitate the transfer and sharing of information, human beings have, for centuries, used a variety of communication aids (such as maps, books, journals, papers, art, the spoken word and music). As time has passed these aids have had to evolve and adapt in order to support the ever growing and diverse types of information that are continually being created. Historically, there have been four significant advances in communication technology to facilitate information transfer. These have involved the development of: various aids to facilitate reading and writing activities; printing/photocopying for the mass distribution of information; radio and TV broadcasting for the global dissemination of non-interactive, non-print material and the use of computers for the realization of interactive information systems (Stephen *et al.*, 1996).

Presently there is the global sharing of electronic resources through the use of an "Information Super-Highway". Obviously, this represents a further important development with respect to the creation of technologies that support information.

In the past, paper- based technologies have been the ones most extensively used for information sharing applications. However, in the light of new developments in information technology it is important to consider whether or not paper is still the most efficient and effective way to record and disseminate information. Within educational systems the issues of efficient and effective information transfer are particularly important especially in an era of diminishing financial support. For example, in many universities, lecture courses (that are augmented by books, journal articles, hand-outs and other print-based resources) are very often presented to large groups of students. Some times these lectures are relayed electronically and in a non-interactive way to various sites. Naturally there are many limitations associated with these traditional teaching methods. I believe that electronic course delivery is a viable alternative delivery mechanism to facilitate the effective and cost-effective presentation of learning and training resources within a university context.

Electronic course delivery (ECD) is concerned with the use of electronic materials and delivery platforms to support and enhance teaching and learning experiences either on an individual or a group basis. In order to realize the goals of ECD there are a number of underlying areas that need to be addressed. These include the use of electronic lectures; mechanisms to facilitate lectures-on-demand; the extensive use of tele-teaching, tele-tutoring and collaborative learning at a distance and support facilities such as electronic libraries. Obviously, the use of electronic libraries will be an important foundation for the successful use of ECD. It is through such facilities that users will gain access to electronic books, magazines, journals, newspapers, Internet resources and various other artefacts that are published electronically using "digital paper". As well as ensuring that the necessary storage, communication and delivery technologies are in place to support ECD, it is also imperative that appropriate software and courseware resources are made available. Naturally, the courseware products that are used must fully implement three important pedagogic activities. Firstly, they must provide methods and strategies which will ensure that students are adequately assessed. Secondly, they must embed appropriate remediation facilities (for use in situations where their use is deemed necessary). Thirdly, they must make available suitable performance support tools which will facilitate effective and efficient skill development (Stephen *et al.,* 1996).

Some of the issues involved in making provisions for these requirements are discussed in the following section.

2.4 Assessment, Remediation and Performance support

Information is a fundamental pre-requisite of learning activities and problem solving. With the advent of the Information Superhighway individuals are able to browse or search a vast distributed information resource and retrieve information in a wide range of media forms. What is often lacking, however, is any consideration of how such information is processed by the reader, thus becoming usable knowledge. This section addresses some of the issues surrounding the facilitation of information use. Such facilitation can take place either with respect to the provision of working knowledge (to

address current task problems) or to the provision of deep knowledge (providing understanding in the longer term). Information can be enhanced through the introduction of performance tools and/or assessment and/or remediation strategies. In other words, access to information is not sufficient to allow knowledge construction. It is the changes that occur in end-users that are important

2.4.1 Assessment

In order to provide understanding in the longer term (deep knowledge) reflection or reflective observation need to be initiated in users (Kolb, 1984; Race, 1994; Richards and Gavin, 1996). Reflection implies an interaction with information without which knowledge transfer could not take place. Often, individuals reflect on their learning experiences while not actively engaged with an information resource. This can either be a subconscious process-typified by the Gestalt notion of illumination (Wallas, 1926) or the conscious processes that learning materials are intended to foster. In other words, knowledge transfer implies processes that can be encouraged or facilitated and go beyond the simple viewing of information.

There are several issues involved in the transfer of information into deep knowledge. Firstly, it is important to develop mechanisms that can actually assist the conversion process. Secondly, it is important for users to be able to assess their progress. Thirdly, any discrepancies that arise between information content and users' interpretations must be remediated. One of the most important techniques that can be used in this regard (and one that is used in many learning situations) is the use of assessment strategies. When people are engaged in learning they need to interact with the learning material. For many people, information access can often be a passive process unless targeted at undertaking specific tasks. Nevertheless, people often do access information to gain knowledge rather than to solve particular problems and it is under these circumstances that the provision of mechanisms for the application of information becomes crucial.

Assessment has a number of useful characteristics that can be utilized. The following points can summarize these: motivation, activity, completeness and correctness. For many people, assessment is inherently motivating (Richards and Nott, 1995). People actually want to know how much they know. It also links into basic competitive drives that cause individuals to strive for high performance. Of course, engaging learners in a practical activity allows them to apply what they have learnt. It takes students away from relatively passive information processing to an active style of interaction. Furthermore, the corollary of individuals having an indication of what they know is that they can also become aware of what they do not know. This includes information that has been misinterpreted and/or misunderstood. Finally, assessment provides the mechanism by which the need for remedial action can be identified. This can be action initiated by the student as a result of computer-based feedback. On the other hand, it can originate from a learning facilitator who may be monitoring student progress electronically as might be seen in a computer-based distant learning programme.

2.4.2 Performance Support Systems

As was suggested in the previous section, assessment is a useful mechanism for monitoring progress and giving learners an indication of how well they are doing. If necessary, remediation can then be used to help those who are under-performing. In contrast, performance support techniques are intended to extend human ability beyond the levels that are normally accessible to them. The study of performance support is therefore concerned with the design and provision of mechanisms, techniques, technology and tools to facilitate and augment an individual's (or a group's) skill and knowledge performance within a given task domain. The tasks that are involved may be either physical or intellectual.

Increasingly, computer technology is being used as a basis for the realization of performance support systems. A system that is based upon some form of embedded computer facility is often referred to as an electronic performance support system (EPSS). According to Banerji (1995) an EPSS can be define as "a human-activity system that is able to manipulate large amounts of task-related information in order to provide

both a problem solving capability as well as learning opportunities to augment human performance in a job task by providing information and concepts in either a linear or a non-linear way, as and when they are required by a user." There are two important implications of this definition. First, the use of a just-in-time (or on demand) instructional paradigm; and second, the use of an on-the-job learning/training situation. Electronic performance support systems are now increasingly being used within educational settings. When used within this area an EPSS can help support staff and students in two important ways. First, by accelerating skill and knowledge acquisition. Second, by enhancing the ability levels of both staff and students. In order to accelerate skill acquisition, computer-based assessment tools can be used to provide assessment mechanisms that provide real-time monitoring and feedback. In addition, advanced knowledge-based tools (such as expert systems and intelligent tutoring facilities) can be used to deliver deep knowledge and remediation embedded within the context of original learning/training tasks. Through the use of EPSS techniques, students and staff can thus be provided with more complete, varied, valid and stimulating information.

Numerous examples of the use of EPSS techniques within education are now starting to appear in the literature. Stevens and Stevens (1995), for example, describe the "School Year 2000" initiative in Florida, USA. This is intended to provide students, teachers, administrators and others involved in the education of children with performance support tools in eleven different areas - including curriculum planning, instructional management, assessment, delivery of instruction, access to educational resource materials, and so on. Similarly, within a university context, Barker *et al.* (1995) described the application of EPSS techniques for the operation of an electronic "Open access student information service"(OASIS). The electronic OASIS is a basic mechanism to support ECD based upon the use of electronic lectures and various forms of automated (computer-based) assessment of students.

Electronic course delivery represents a major step forward with respect to the realization of more efficient access to education through information sharing. However, if this approach is to be successful it requires both inter-departmental co-operation and

collaboration and an institutional commitment to the use of computer-based technology for the realization of teaching and learning activities. It also requires a solid foundation and a supportive framework within which to develop and integrate pedagogic and administrative resources.

In the next section the educational theories, concepts and other issues related to the creation of an effective and efficient learning environment are explained.

2.5 Constructivism

2.5.1 Theoretical Framework

The philosophy of learning, that proposes learners need to build their own understanding of new ideas, has been labeled constructivism. Much has been researched and written by many eminent leaders in the fields of learning theory and cognition. Scholars such as Jean Piaget, Eleanor Duckworth, George Hein, Vygotsky and Howard Gardener have explored these ideas in-depth.

A major theme in the theoretical framework of Bruner (1966) is that learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so. Cognitive structure (i.e. schema, mental models) provides meaning and organization to experiences and allows the individual to "go beyond the information given". As far as instruction is concerned, the facilitator should try and encourage students to discover principles by themselves. The facilitator and student should engage in an active dialog. The task of the facilitator is to translate information to be learned into a format appropriate to the learner's current state of understanding. Curricula should be organized in a spiral manner so that the student continually builds upon what they have already learned.

Bruner (1960) states that a theory of instruction should address four major aspects: predisposition towards learning; the ways in which a body of knowledge can be

structured so that it can be most readily grasped by the learner; the most effective sequences in which to present material; and the nature and pacing of rewards.

Good methods for structuring knowledge should result in simplifying, generating new propositions, and increasing the manipulation of information. In his more recent work Bruner (1986, 1990) has expanded his theoretical framework to encompass the social and cultural aspects of learning.

Bruner's theory is a general framework for instruction based upon the study of cognition. Much of the theory is linked to child development research (especially Piaget). The ideas outlined in Bruner (1960) originated from a conference focused on science and mathematics learning. Bruner illustrated his theory in the context of mathematics and social science programs for young children (Bruner, 1973). The original development of the framework for reasoning processes is described in Bruner, Goodnow and Austin (1956).

Constructivism is a very broad conceptual framework in philosophy and science and Bruner's theory represents one particular perspective. This example is taken from Bruner (1973):

"The concept of prime numbers appears to be more readily grasped when the child, through construction, discovers that certain handfuls of beans cannot be laid out in completed rows and columns. Such quantities have either to be laid out in a single file or in an incomplete row-column design in which there is always one extra or one too few to fill the pattern. These patterns, the child learns, happens to be called prime. It is easy for the child to go from this step to the recognition that a multiple table, so called, is a record sheet of quantities in completed multiple rows and columns. Here is factoring, multiplication and primes in a construction that can be visualized."

The following principles with respect to instruction were noted: Instruction must be concerned with the experience and contexts that make the student willing and able to

learn (readiness); Instruction must be structured so that it can be easily grasped by the student (spiral organization); Instruction should be designed to facilitate extrapolation and or fill in the gaps (going beyond the information given); Educators must focus on making connections between facts and fostering new understanding in students – rely heavily on open-ended questions and promote extensive dialogue among students.

Educational technologists have often stated that an effective way to integrate technology into the teaching and learning process is to follow a constructivist model (Dede, 1995; Jonassen, 1996). Constructivist theory posits that students make sense of the world by synthesizing new experiences into what they have previously understood. They form rules through reflection on their interaction with objects and ideas. When they encounter an object, idea, or relationship that does not make sense to them, they either interpret what they see to conform to their rules or they adjust their rules to better account for the new information (Brooks and Brooks, 1993).

Although not so much a theory of teaching as of learning, there is some behaviour teachers can emulate if they wish to follow a constructivist paradigm: Constructivist facilitators organize information around conceptual clusters of problems and questions as opposed to facts in isolation; activities should be authentic (tasks should be relevant or of emerging relevance to students). Such activities are often problem-based rather than drill-and-practice; instead of concentrating on knowledge acquisition, problem-based activities allow students to develop a deeper understanding of the knowledge domain; technology is used as a tool to help students solve the problem. Technical literacy should not be taught as an isolated subject, nor should activities with technology be isolated from other activities in the classroom. This does not mean that time should not be spent teaching students content or how to use a technology tool. However, assimilating the content should occur at the time the students need to master the material, and only as much instruction as they need to complete their project should be provided. It is not necessary to teach students everything about a particular tool or concept before they start using it; constructivist facilitators allow student responses to drive lessons, shift instructional strategies and alter content. This does not mean that if students are not interested in a

topic, it should not be taught. Instead, students' knowledge, experiences and interests occasionally do coalesce around an urgent theme. When events occur that exert an irresistible pull on students' minds (such as during a scandal involving the President or a tragedy in the community), continuing with preplanned presentational lessons is often fruitless (Brooks and Brooks, 1993). Instead, facilitators should relate the concepts and skills to be learned to students' current interests; constructivist facilitators encourage student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other. The questions are designed to challenge students to look beyond the apparent, delve into issues deeply and broadly, and form their own understandings. Often, there is no one "right" interpretation, even though some analyses are more sophisticated and useful than others. Students are encouraged to talk to each other and the facilitator. This gives students the opportunity to present their own ideas and to hear and reflect on the ideas of others.

In a Constructivist classroom students are more actively involved in the learning process than in a traditional classroom. They are sharing ideas, asking questions, discussing concepts and revising their ideas and misconceptions. Such activity involves collaboration, with occasional competition, among students. Collaborative environments can encourage the knowledge construction needed for more lasting learning (Jonassen, 1996).

Jonassen (1996) proposed that there are eight characteristics that differentiate constructivist learning environments: Constructivist learning environments provide multiple representations of reality; Multiple representations avoid oversimplification and represent the complexity of the real world; Constructivist learning environments emphasize knowledge construction instead of knowledge reproduction; Constructivist learning environments emphasize authentic tasks in a meaningful context rather than abstract instruction out of context; Constructivist learning environments provide learning environments such as real-world settings or case-based learning instead of predetermined sequences of instruction; Constructivist learning environments encourage thoughtful reflection on experience; Constructivist learning environments "enable context- and

content- dependent knowledge construction"; and constructivist learning environments support "collaborative construction of knowledge through social negotiation, not competition among learners for recognition".

2.5.2 Implementation Issues with Constructivism

Two important notions orbit around the simple idea of constructed knowledge. The first is that learners construct new understandings using what they already know. There is no innate ideas on which new knowledge is etched. Rather, learners come to learning situations with knowledge gained from previous experience, and that prior knowledge influences what new or modified knowledge they will construct from new learning experiences.

The second notion is that learning is active rather than passive. Learners confront their understanding in light of what they encounter in the new learning situation. If what learners encounter is inconsistent with their current understanding, their understanding can change to accommodate new experience. Learners remain active throughout this process: they apply current understandings, note relevant elements in new learning experiences, judge the consistency of prior and emerging knowledge, and based on that judgment, they can modify knowledge.

Constructivism has important implications for teaching. First, teaching cannot be viewed as the transmission of knowledge from enlightened to unenlightened; constructivist teachers do not take the role of the "sage on the stage." Rather, teachers act as "guides on the side" who provide students with opportunities to test the adequacy of their current understandings.

Second, if learning is based on prior knowledge, then teachers must note that prior knowledge and provide learning environments that exploit inconsistencies between learners' current understanding and the new experiences before them. This challenges teachers for they cannot assume that all learners understand something in the same way.

Further, learners may need different experiences to advance to different levels of understanding.

Third, if students must apply their current understandings in new situations in order to build new knowledge, then teachers must engage students in learning, bringing students' current understandings to the forefront. Teachers can ensure that learning experiences incorporate problems that are important to students, not those that are primarily important to teachers and the educational system. Teachers can also encourage group interaction, where the interplay among participants helps individual students become explicit about their own understanding by comparing it to that of their peers.

Fourth, if new knowledge is actively built, then time is needed to build it. Ample time facilitates student reflection about new experiences, how those experiences line up against current understanding, and how a different understanding might provide students with an improved (not "correct") view of the world.

If learning is a constructive process, and instruction must be designed to provide opportunities for such construction, then what professional development practices can bring teachers to teach in student-centered ways?

Firstly we need to recognize that construction in learning is not just the domain of children but of learners, all learners. Constructivist professional development gives teachers time to make explicit their understandings of learning (e.g. is it a constructive process?), of teaching (e.g. is a teacher an orator or a facilitator and what is the teacher's understanding of content?), and of professional development (e.g. is a teacher's own learning best approached through a constructivist orientation?). Furthermore, such professional development provides opportunities for teachers to test their understanding and build new ones. Training that positively impacts student-centered teaching cannot come in one-day workshops. Systematic, long-term development that allows practice and reflection on that practice is required (SEDLetter, 1996).

It is also useful to remember the educator's maxim. Teachers teach as they are taught, not as they are told to teach. Thus, trainers in constructivist professional development sessions model learning activities that teachers can apply in their own classrooms. It is not enough for trainers to describe new ways of teaching and expect teachers to translate from talk to action; it is more effective to engage teachers in activities that will lead to new actions in classrooms.

Constructivism represents one of the big ideas in education. Its implications for how teachers teach and learn to teach are enormous. If our efforts in reforming education for all students are to succeed, then we must focus on students. To date, a focus on student-centered learning may well be the most important contribution of Constructivism.

Research has shown that the more constructivist the learning environment, the greater the teachers' average use of the Internet (SEDLetter, 1996). The next section explores Asynchronous Learning Networks (ALN).

2.6 Asynchronous Learning Networks

2.6.1 Definition

Asynchronous Learning Networks (ALN) are people networks for anytime-anywhere learning. ALN combines self-study with substantial, rapid, asynchronous interactivity with others. In ALN learners use computer and communications technologies to work with remote learning resources, including coaches and other learners, but without the requirement to be online at the same time. The most common ALN communication tool is the World Wide Web.

2.6.2 Theories

Building and testing theory should be the purpose of any empirical study. Measurement in the absence of theory is generally worthless. Theory consists of a set of concepts, the relationships among them, and most importantly, the "why" that explains those relationships. A good theory leads to a study that asks new questions, or old questions in a new way. It provides the framework and the story line that holds together the entire

study, from design of measures and data collection methods to the presentation of results. Usually, a causal model that shows the predicted relationships among concepts can summarize the theory.

There are three major sources of theory for ALN : pedagogical theories from educational research, media effect theories from communications research and group interaction/social influence theories from social psychology and sociology. Each of these can be adapted, applied and integrated to help to explain what happens and why in on-line classes (Kolb, 1984).

From pedagogical theory, one of the major themes is the difference between objectivist approaches and constructivist approaches (Glasser and Bassok, 1989). The former holds that there is a body of objective knowledge that can be delivered to students through presentation and explanation (lectures, Computer Aided Instruction (CAI), etc.). The purpose of teaching is to transfer knowledge from archival sources and from the brain of the teacher to the brain of the learner. The constructivist theory holds that knowledge has to be discovered, constructed, practiced, and validated by each learner; learning involves "active struggling by the learner" (Duffy and Cunningham, 1996). Pedagogical methods using this constructivist approach, including collaborative learning, create learning situations that enable learners to engage in active exploration and/or social collaboration, such as laboratories, field studies, simulations, and case studies with group discussion.

One of the best known media characteristics theories is media richness, conceived and popularized by Daft and colleagues (Daft and Lengel, 1986). It holds that characteristics of media vary in terms of their ability to support task uncertainty and ambiguity; face-to-face is the richest medium and others fall along a continuum. Furthermore, task performance will be improved when task needs are matched to a medium's ability to convey information. A related set of concepts is social presence theory (Rice, 1984, 1992) the ability of a medium to give the impression of the presence of others. Recent scholarship has critiqued this concept stating that all media have an inherent degree of richness. For instance, Nunamaker *et al.,* (1991) suggest media synchronicity theory as a

more comprehensive replacement. According to media synchronicity theory there are five important media characteristics (feedback, symbol variety, parallelism, rehearsability, and reprocessability). No medium is richest on all media characteristics and the relationships between communication processes and media capabilities will vary between established and newly formed groups and will change over time.

Among the group interaction theories that can be applied to on-line classes is the process gains and process losses approach to analyzing group meetings (Steiner, 1972, Nunamaker *et al.,* 1991). According to time, interaction, and performance (TIP) theory (McGarth and Hollingshead, 1994) groups are a complex, intact social system that engage in multiple, interdependent functions on multiple, concurrent projects while nested within and loosely coupled to surrounding systems. You cannot apply something like an ALN technology to groups and expect them all to react the same way. This is a similar concept to adaptive structuration theory (Poole and DeSanctis, 1990), which states that a group may choose to faithfully or unfaithfully appropriate the structures and tools provided by the technology, heuristic, environment, etc.

2.6.3 Implementation of ALN

ALN are useful in many educational arenas but have been used primarily for off-campus education, continuing education and corporate training (Bourne, 1998). Some schools even use ALN to offer degree programs. For example, the New Jersey Institute of Technology offers the B.A. in Information Systems and the B.S. in Computer Science via an ALN system called the Virtual Classroom (Hiltz, 1997). Another example is the campuses of the State University of New York (SUNY) that offer complete degree programs through an ALN. Corporate training professionals also propose using ALN as a valuable and efficient way to enhance the computer literacy of their employees (Geffen, 1999).

In addition to the more traditional implementations of ALN in distance education, there are also applications of ALN in on-campus education. Frequently, ALN are used in on-

campus settings as a means for managing large classes by enhancing learning opportunities, reducing costs, and providing outreach (Arvan, 1998; Hawisher, 1997; Bourne, 1996). For instance, Bourne describes how an ALN is integrated into a large on-campus engineering science course to enhance learning at Vanderbilt University. In addition, ALN have been used in hybrid on-campus/distance models in cases where students in a class on one campus might benefit from regular interactions with a class on a different campus. An example of this hybrid model is the urban design course offered simultaneously at the University of Illinois at Urbana-Champaign (UIUC) and the University of Illinois at Chicago, described by Al-Kodmany *et al.* (1999).

The boundaries for implementing ALN are being extended with the broad public availability of new technologies and the emergence of the research findings of the existing implementations.

The next section explores Learning Experience and Effectiveness of On-line environments.

2.7 Learner Experience and Effectiveness of On-line Learning

Some common themes have emerged across the literature on learning experience and the effectiveness of online environments, such as learner satisfaction, learning outcomes, online communication, attitude toward technology, technological support, computer experience, prior participant knowledge, online learner skills and gender differences.

What follows is a review of the existing research in the areas of learner satisfaction and learning outcomes, the two indicators employed in many studies, to look at how the student functioned in a distance learning environment where they were separated from their academic peers. The relevant literature is reviewed in the areas of online learning environments, online learner skills, prior experience, and gender differences - areas of possible explanation for observed variance in students' satisfaction and learning outcomes in an ALN course.

2.7.1 Learner Satisfaction

Learner satisfaction and learning outcomes are the two most commonly used indicators of course effectiveness, especially in the online learning studies (Webster and Hackley, 1997). Satisfaction relates to perceptions of being able to achieve success and feelings about the achieved outcomes (Keller, 1983). Studies of learner satisfaction are typically limited to one-dimensional post-class assessments of learners' perceptions. Learner satisfaction often is measured with "happy sheets" that ask the learners to rate how satisfied they were with their overall learning experience. However, it is also meaningful to explore the notion of satisfaction through a multidimensional analysis of a wide variety of critical variables in order to provide effective measures that guide improvements in instructional design for online programs (Johnson *et al.*, 1999). Therefore, some researchers have been trying to identify some critical variables in online learning. For instance, Jegede *et al.* (1995) identified eight components of effective learning environments: interactivity, instructional support, task orientation, teacher support, negotiation, flexibility, technological support and ergonomics. Similarly, some case studies focusing on the online students' perspectives propose a set of importance issues such as online communication, technical support, and course design (Mory *et al., 1998*; Everett, 1998; Hara and Kling, 1999).

Online interaction and communication have long been regarded as important factors for successful online learning (Sims, 1997; Wegerif, 1998; Haythornthwaite, 1999). Lack of communication is one of the most common frustrations in online learning (Saunders *et al.*, 1997).

During this study the students from Computer Science (COMSC) were transformed from full-time classroom students into distant learners who participated in class on-line from a distance or one of the LANs on campus and alone. Thus, their communication with the teaching staff and with fellow classmates, as well as their perceptions of the communications level was expected to be important to their learning.

With respect to the instructor's role in an ALN, technical support and course design have been cited as the primary responsibilities of the instructor in facilitating online learning. Case studies by Mory *et al.* (1998) indicate the importance of technical support when students face technical problems, and found that even temporary outages of the technology supporting ALN had a negative impact on students and their learning outcomes. Similarly, Webster and Hackley (1997) found course design to have a crucial influence on students' success in an online environment.

2.7.2 Learning Outcomes

Another very common measure of course effectiveness is student performance. Final grades in a class are always used as indicators of program quality and student learning (Webster and Hackley, 1997).

2.7.3 Online Learning Environments

In traditional classrooms, learning occurs within physical boundaries - for example, a classroom, a school, and field trips, and various other locations (Relan and Gillani, 1997). By contrast, with ALN(s), learning can happen anywhere and anytime without the limit of physical location (Mayadas, 1997). There has been a lot of research studying pedagogical aspects of "online learning environments" (Hill, 1997). However, relatively little research addresses physical characteristics of the overall learning environment, such as learning areas and Internet connections. During this study, the students' perceptions of the physical settings from which they connected to and used the ALN were addressed, and how that might have influenced their satisfaction and learning outcomes.

2.7.4 Special Sets of Skills

The ALN learning environment often is very different from traditional face-to-face classroom settings. Previous ALN research has identified individual characteristics that seem to describe a successful online student. For instance, (Gibson, 1996) finds that it is critical for distance students to be focused, better time managers, and able to work both independently and as group members, depending on the delivery mode and location of the distance course. Other studies suggest that important characteristics for online students include strong self-motivation, self-discipline, independence, and assertiveness.

The full-time students in COMSC were used to traditional, face-to-face instruction and to having peers available both in class and in their living situations. In the ALN version of COMSC, they were transformed into distance learners who participated in class online from a distance or one of the campus LANs and, moreover, alone. These changes probably required a different set of skills, the lack of which might pose barriers to their learning. Thus, we were interested in the degree to which these traditional students possess the special set of skills required in an ALN environment such as motivation, self-discipline and time-management, and their potential influence on the students' satisfaction and achievement levels.

2.7.5 Prior Experience

Smith's (1982) Learning-How-To-Learn (LHTL) theory suggests that learners rely on a "bag of tricks" including prior learning strategies and tactics, as well as things that worked in other situations to make sense of a new environment. Eastmond's (1995) study also indicates that prior learning experience, familiarity with technology, among other factors, is important for students to adjust to online learning.

Familiarity with the technologies used in the online course is especially important for students who take a course online. The case study by Al-Kodmany *et al.* (1999) of using ALN to teach one class to students on two different campuses found that without prior exposure to the technologies involved, the technologies used in the course became barriers to learning. One of their suggestions for online instruction is not to attempt teaching the technology and the course at the same time, rather, to impose certain prerequisites on technologies that are used in the course or include a mini-course on the technologies that is not the part of the course itself.

Researchers have also argued that the successful implementation of any new technology depends on factors related to users' attitudes and opinions (Davis *et al.*, 1989). For instance, Webster and Hackley (1997) studied the teaching effectiveness in technology-mediated distance learning and found a positive relationship between students' attitudes toward technology and their learning outcomes.

In addition, prior experience with online classes might be helpful when taking a new class in an online version, although little research has explicitly addressed this issue. Presently on- campus courses are trying to integrate computers and Internet technologies into the classroom, however, only a small portion of the content in traditional courses is actually presented online and there still exists substantial opportunity to interact face-to-face. As a result, traditional students typically have very little experience with online courses.

During this study at least 73% of students did agree that they felt they needed prior trouble shooting skills for this on-line course.

2.7.6 Gender Difference

Gender difference may have an impact on experience with an ALN environment. It has been suggested that females are more techno-phobic (Karma, 1994), have more negative attitudes toward computers (Dambrot, 1995), and are less confident in their use of computers (Cully, 1998) than males when they enter universities. The conclusions drawn by several researchers are that by the time students enter the university, males are more familiar with computers than are females (Gutek and Bikson, 1995). Still other researchers speculate that females are also less comfortable with the way that computers are used at many universities (Merrill, 1991). However, Ory, *et al.* (1997) found no gender difference in the use of and attitudes toward ALN in a university setting. According to his study, both males and females made similar use of ALN, had similar (positive) attitudes about their "computer experience," and shared a common desire to take more courses using computers.

The previous sections have outlined the theoretical aspects related to creating a constructivist learning environment. In the next section more specific practical considerations are presented.

2.8 Rich environment for active learning

Grabinger and Dunlap (1995) have summarised the constructivist approach as a "rich environment for active learning", characterised by five principles described below. Lebow (1993) and Jonassen *et al.*, (1993) developed similar lists.

2.8.1 Authentic assessment

The major motivation for degree students is assessment. Therefore, inappropriate assessment will undermine any course design. Assessment must test the learning outcomes. In particular, the assessment of skills must involve using the skills not describing them verbally (Gagne, 1985). Assessment must be authentic: realistic in complexity, requiring students to contextualise their knowledge, requiring knowledge in depth rather than breadth, and diverse in form to allow for students' differing intelligence and strengths (Wiggins, 1989). Students must be told the assessment criteria at the start of a course, revealing the standards of the domain to the student and as well as revealing student performance to the examiner.

2.8.2 Student responsibility and initiative

Students should have initiative, responsibility and control in their learning. This self-regulation promotes a reflection on their own learning processes that is typical of "adult" learners (Ferrence and Vockell, 1994). This reflection will improve learning.

2.8.3 Generative learning strategies

Active learning involves using knowledge and skills to "generate" a product, such as text, diagrams, or a physical artefact that embodies knowledge. This may involve investigating to create a solution to a problem.

2.8.4 Authentic learning contexts

Learning experiences should be realistic and faithful to the original phenomena, rather than abstract descriptions or "inert knowledge". Instruction should be anchored in real-world problems, events or issues that may be appealing and meaningful to students. Realistic problems allow students to take ownership of their solutions, develop deeper,

richer knowledge structures, require more systematic problem solving methods and are more likely to benefit from collaborative efforts.

2.8.5 Co-operative support

Collaboration with fellow students can have several benefits to learning. Students can encounter different points of view that may identify effective solutions to problems, clarify misconceptions, and give rise to synergistic insights. Group members must understand their different roles and learn to accommodate conflicting ideas. This re-enforces individual responsibility and has been shown to benefit learning (Slavin, 1991).

2.9 Conclusion

Although the body of literature is large and growing, the subset of research literature dealing with student attitudes toward technology and web-based computer-mediated online learning is small. Others have substantiated this view. Zhang (1998) states, "few studies report the actual uses of Internet technologies alone or in combination with other technologies in effective online learning." Other online education practitioners confirm the problem of too little data on the use of technology and its effectiveness. Biner (1997) suggests that students' attitudes toward online education are as important a measure as students' achievements in determining the effectiveness of online education. Therefore the need for continued research in this field is of utmost importance. This study tested the following hypothesis:

A) Mastery of course material in the virtual classroom (VC) will be equal or superior to that in the traditional classroom (TC) and

B) VC students will report higher subjective satisfaction with the VC than the TC on a number of dimensions, including improved overall quality, better use of time, convenience and whereby the student assesses the experience as being 'better' than TC in some way, involving learning on the whole.

The chapter that follows explains the materials and methods involved in this study.

CHAPTER 3

MATERIALS AND METHODS

3.1 Edgewood Scenario

Many universities are incorporating elements of ALN into their traditional classrooms. However, it is not known how well learners who are used to traditional face-to-face learning environments and who do not necessarily prefer ALN adapt when placed in a situation that requires learning via an ALN. This study examines a situation where university students from a traditional face-to-face classroom environment took a class in an ALN. During the second semester of 2002, the Department of Computer Science in the Faculty of Education at University of Natal (Edgewood Campus) participated in a new way of applying ALN in higher education. Rather than the typical ALN offering in which self-selected students who prefer ALN enroll (similar to other campuses), in this case study an ALN system was used to offer a course Data Communication (COMSC) to full-time traditional undergraduate students.

The primary tool in addition to standard email and Internet browsers for this class was WebCT. WebCT is a password-protected web-based course management system that is on the main server at the University of Natal. WebCT housed lecture notes, additional resources, quizzes, and homework assignments. The students logged into WebCT to engage in chats, take quizzes, download homework, assignments, and to submit tasks for assessment. They could also check their grades on WebCT. WebCT is also a computer conferencing system that enables students and teaching staff to communicate online synchronously and asynchronously. For COMSC, WebCT was used for asynchronous class discussions, technical support, handing in homework assignments and communication between teaching staff and students and among students, which was either asynchronous or in a synchronous chat room.

As the ALN model would suggest, most of the COMSC course was conducted asynchronously with only scheduled chat appointments (2) or spontaneous chats taking place synchronously.

Assessment of the ALN used two approaches. In the first, Q-methodology (Stephenson, 1953) was used to identify and categorise the opinions of the sample of students in order to acquire an understanding of their acceptance of, or resistance to, the application of technology to learning in a constructivist on-line learning mode as compared to a total face-to-face mode of delivery.

For the second method, attitude and perception data was obtained through a questionnaire completed by the same group of students during the last face-to-face session at the end of the course. Data was thereafter analysed.

It was envisaged that the factors extracted, as a result of Q-Methodology, will confirm the hypotheses. Assessment scores of the total face-to-face (FTF) module was compared to the mixed mode module to determine mastery of course material (hypothesis A). Because of the subjective nature of hypothesis B, Q-methodology was ideal to test this hypothesis. The results of the Q study was then compared to the data obtained via the questionnaire. Frequencies and medians were analysed for each statement in the questionnaire. The course grade for the FTF course was compared to the mixed mode course. The next section explores the WebCT course and its development.

3.2 WebCT Development

In order to develop the WebCT course I had to acquaint myself with Hyper-Text Markup Language (HTML). WebCT will only accept HTML files since it operates via a Web browser. As a start I used an HTML editor (Arachnophilia) which helped to speed up the process. The following screen dumps give an idea as to what had to be designed and what options were given to students.

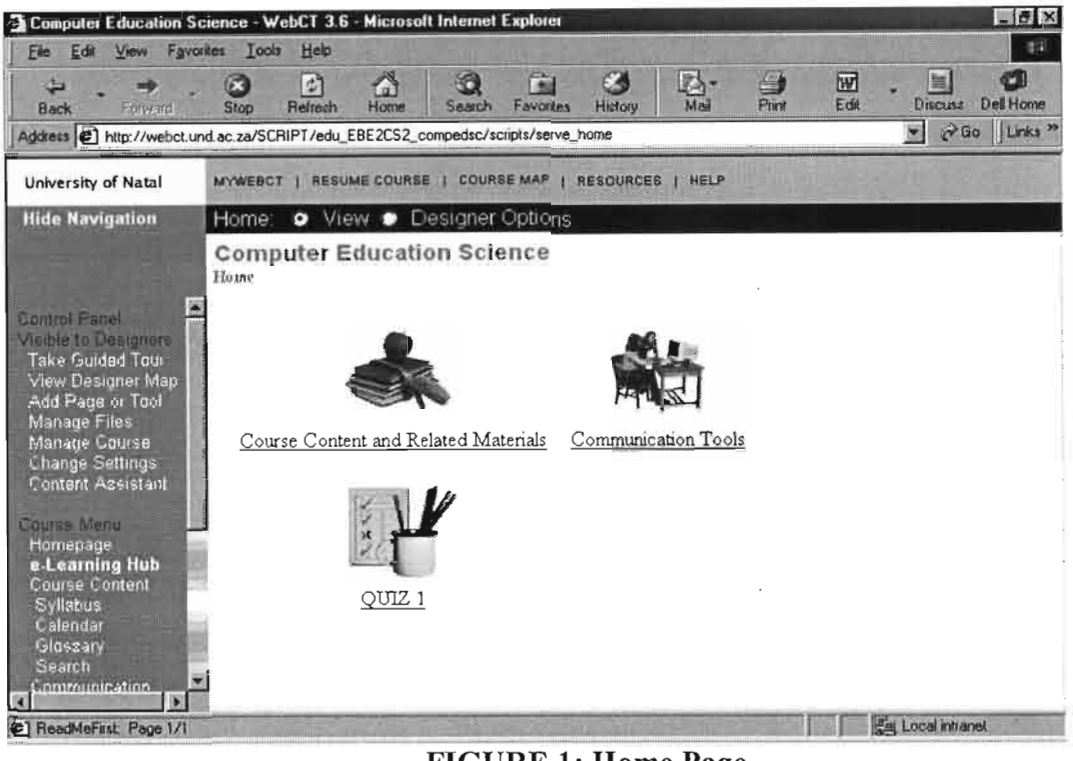


FIGURE 1: Home Page

Fig. 1 shows the home page where students were presented with three sections (through icons) that covered all that the course had to offer. The contents of "Course Content and Related Materials" are shown in Fig. 2.

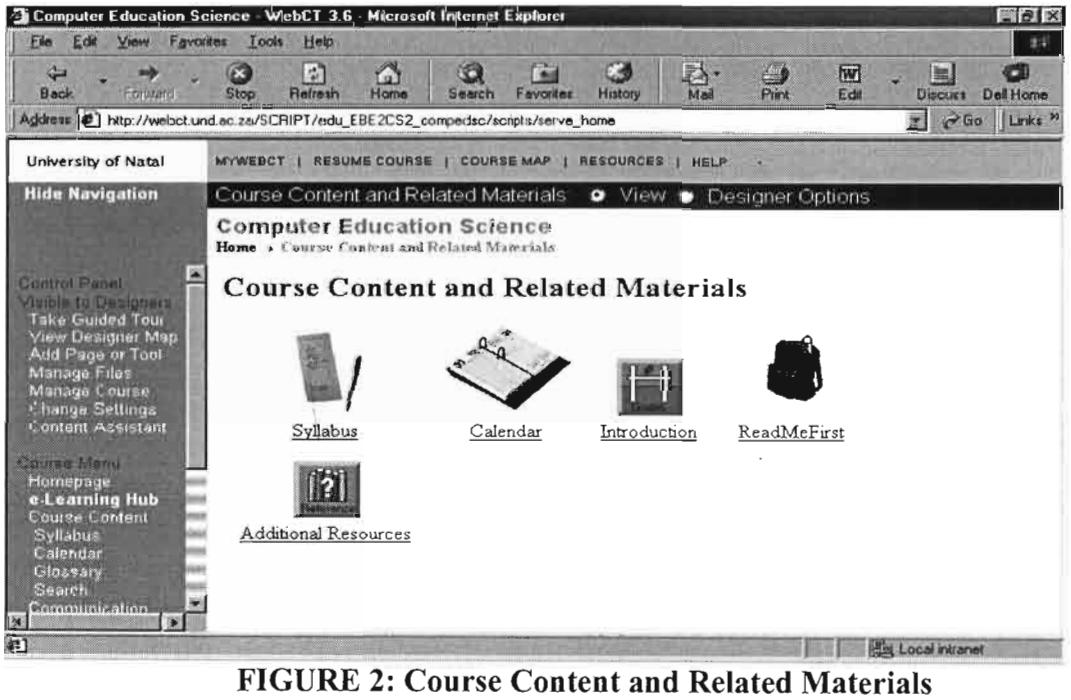


FIGURE 2: Course Content and Related Materials

The "Syllabus" option outlined the instructor information (name and contact details), course information and the course goals. The "Calendar" option was used to give students a suggested work plan/schedule highlighting the due dates for the various tasks. The "Introduction" option was a simple theoretical introduction to data communication. The "ReadMeFirst" option outlined the entire course activities as well as the assessment criteria. Each activity listed was a separate link to another HTML page. Figures 3, 4, 5 and 6 show part of the listing as well as the assessment criteria. The "Additional Resources" option had hyper-links to other literature on Data Communication.

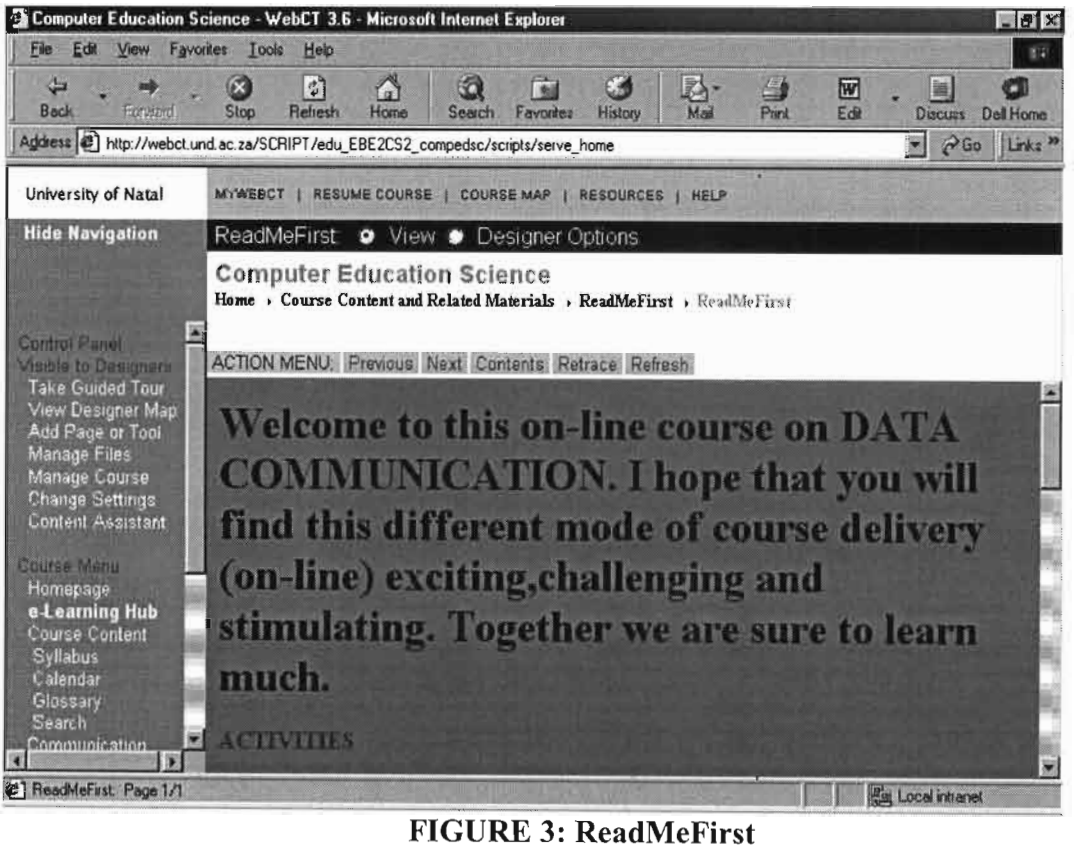


FIGURE 3: ReadMeFirst

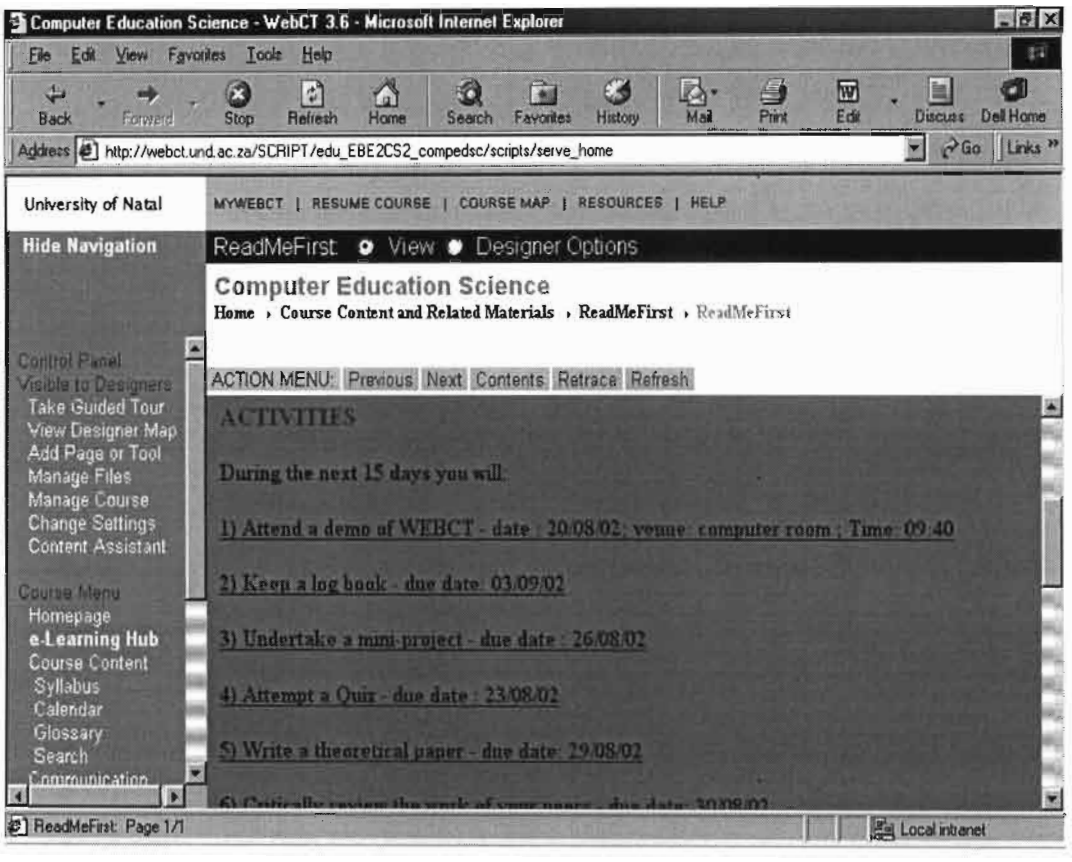


FIGURE 4: Activities

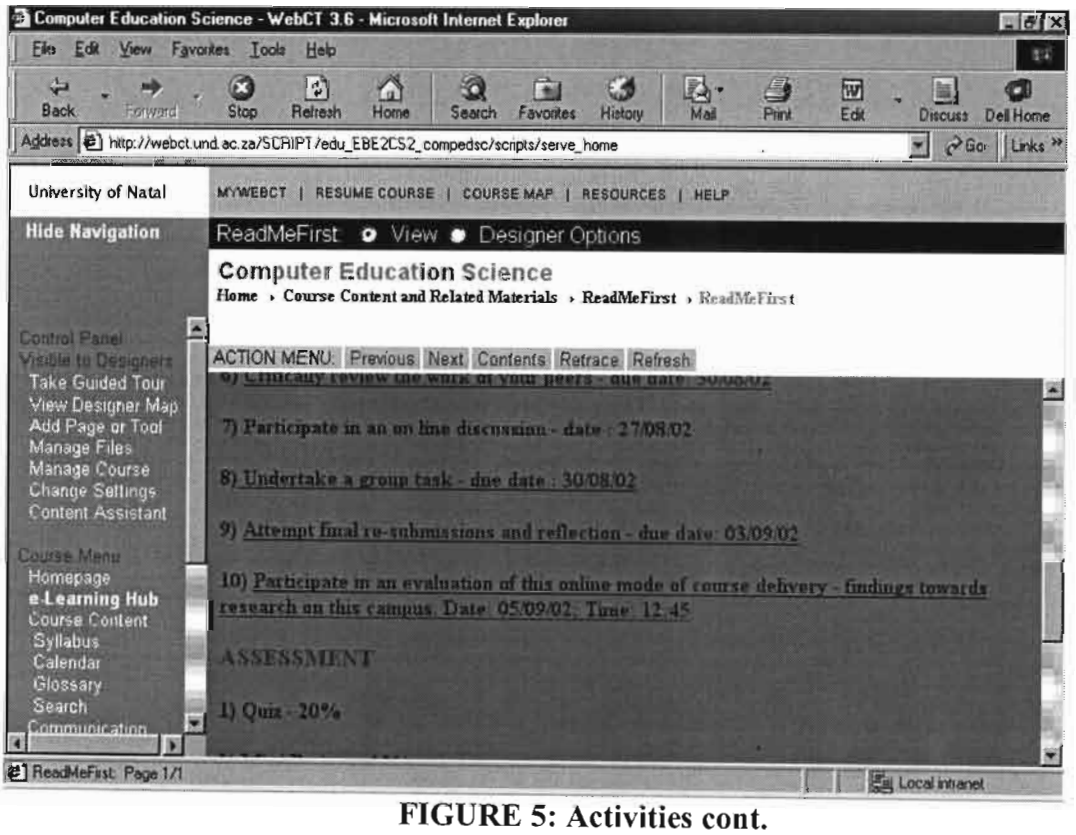


FIGURE 5: Activities cont.

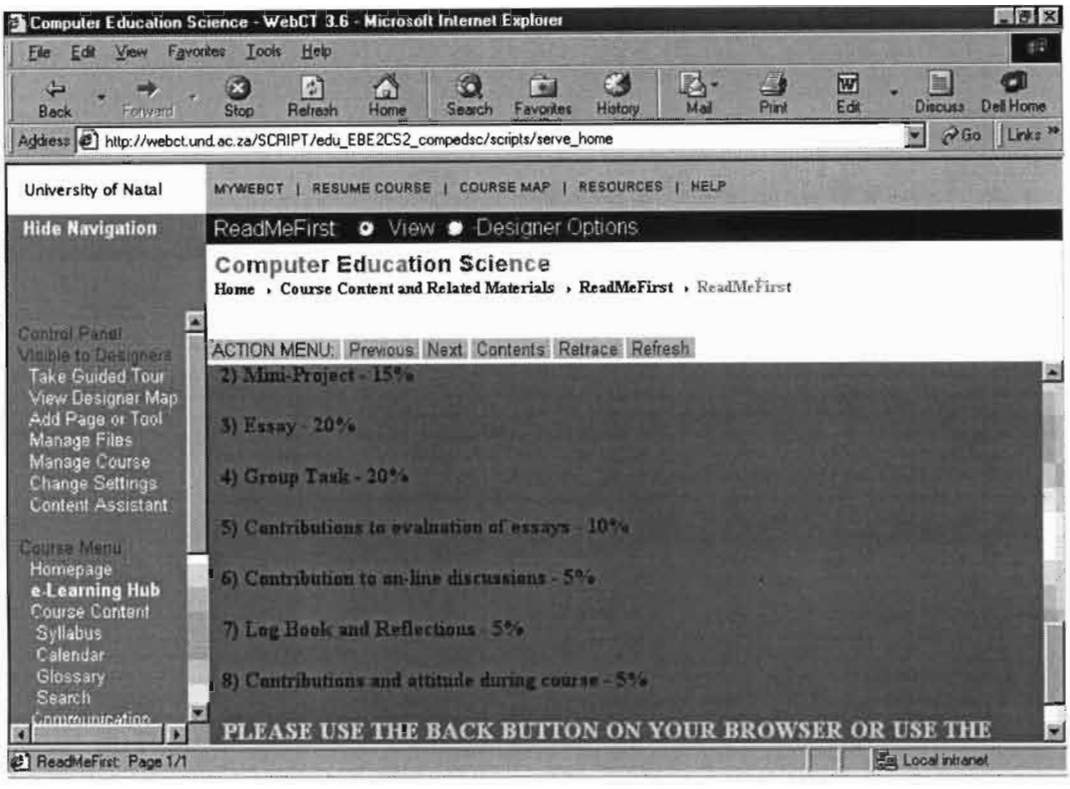


FIGURE 6: Assessment

Fig. 7 shows the options presented when selecting "Communication Tools" from Fig. 1. Students could use the discussion forum which targeted the entire group. E-mail was for messages to specific students as well as the course facilitator. Chat was for general classroom chating or prearranged chat as determined by the course facilitator.

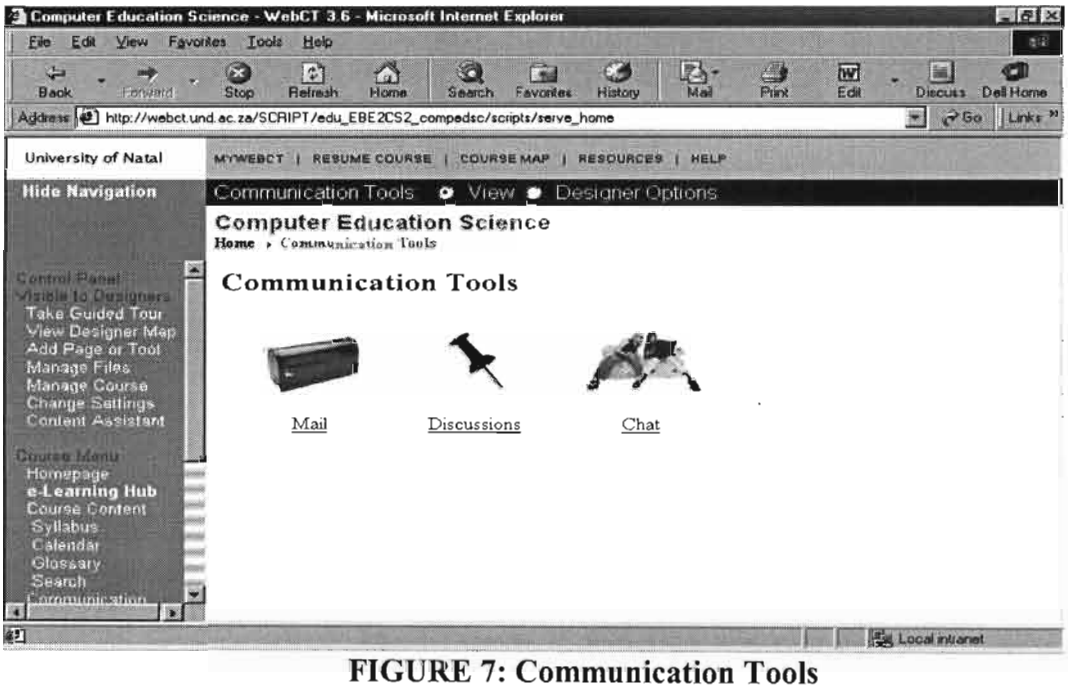


FIGURE 7: Communication Tools

The "Quiz" option on Fig. 1 was for taking the quiz. This option was only made available on a predetermined day from 08:00 to 24:00. The next section lists ALN components that were used in my course and how they fit into Piaget's four processes (assimulation, accommodation, equilibrium and disequilibrium) involved in the construction of knowledge.

3.3 Course components within an ALN environment

In accordance with this research, the choice of instructional design for the mode of delivery for this course was a deliberate decision. All attempts were made not to make just an online course, but to make a constructivist online course. Instead of outcome, I focused all my energies on processes and tried to facilitate the students' own ability to acquire knowledge.

What are the facilities provided by ALN that make implementing the constructivist approach more feasible? To examine this, the instructional principles of a constructivist environment need to be more rigidly defined. Piaget's processes for knowledge construction are: Assimilation - Associate new events with background knowledge and prior conceptions; Accommodation- Change existing structures to new information; Equilibrium - Balance internal understanding with external "reality" (e.g. other's understanding); Disequilibrium - Experience of a new event without achieving a state of equilibrium (Akyalcin, 1997). Each of these processes were applied to this study.

Table 1 maps Piaget's four processes involved in the construction of knowledge, the principles involved and how they map to an ALN environment (adapted from Akyalcin, 1997). In order to gauge the learner's previous knowledge and experience students were asked to post an introductory message using the discussion forum. Learners were orientated to their learning environment by the use of e-mail, synchronous chats and a simple to-do list. Soliciting learner problems was done mainly through the discussion forum. The Quiz helped to support and challenge the learner's thinking. Facilitative questions were put onto the discussion forum from time to time by the facilitator. The group task did contribute towards an authentic learning environment. Students were given

opportunities to take note of comments by peers and the course facilitator and thereafter resubmit work if so desired.

TABLE 1: Constructivist Components within an ALN environment

PROCESSES	INSTRUCTIONAL PRINCIPLES	ALN COMPONENTS
Assimilation	Gauge the learner's previous knowledge and experience.	Introductory Posts by students.
Assimilation	Orient the learner to his learning environment.	Broadcast E-mails, Syllabus, Resources, To Do Lists, Course Information, Synchronous Chat
Assimilation	Solicit problems from the learner and use those as a stimulus for learning activities.	Discussion Forum, Synchronous Chat On-line, Lectures and readings, Non-graded starter activities, Facilitative Questions
Assimilation	Support the learner in developing ownership for the overall problem.	Discussion Forum feedback by students and facilitator
Accommodation	Design the Learning environment to support and challenge the learner's thinking.	Modularise content so as to scaffold learning, Quizzes for reinforcement, Compare and contrast activities, Facilitative questions, Discussion Forum feedback by learners and facilitator.
Accommodation	Encourage testing ideas against alternative view and context.	Modularise content to introduce new concepts quickly, Compare and contrast activities, Interactive essay, Facilitative questions.
Equilibrium	Design an authentic task. An authentic Learning environment is one in which the cognitive demands are consistent with the demands in the environment for which the learner is being prepared.	Group Task – school based problem presented to students.
Disequilibrium	Opportunity for changing and enhancing, drafting and redrafting.	Summaries of student discussions. Re-submissions

The section that follows takes the five principles of Grabinger and Dunlap (1995) that were presented in section 2.8 and explores how they were implemented in this course.

3.4 Environment for active learning

Grabinger and Dunlap (1995) have summarised the constructivist approach as a "rich environment for active learning", characterised by five principles.

3.4.1 Authentic Assessment

In this study the assessment philosophy, criteria and administration were described to the students in the first lecture which was a face-to-face (FTF) session. This appeared on a Web page. The written exam was replaced by a course mark made up of the different tasks as per assessment activities. Tasks included a Mind-map, a group project and an individual essay. Students were required to keep a diary/journal of daily course activities.

3.4.2 Student Responsibility and Initiative

The essay allowed for individual choice of specific aspects in data communication that was researched. The task on the mind-map allowed for individual choice of tool. Students were encouraged to use their diary/journal to reflect on their learning. Students were able to manage their own time because of the mode of course delivery. However, it was felt that a calendar of scheduled events be provided to encourage steady progress.

3.4.3 Generative Learning Strategies

Generative practical activities included the creation of a mind-map to represent specific aspects of data communication. Software tools used to generate these mind-maps were a word processor (MSWord), a desktop publishing package (MSPublisher), and a concept map editor (Inspiration 6).

3.4.4 Authentic Learning Contexts

Practical tasks and group work involved using the Internet extensively. The group task targeted a realistic problem that one may be faced with at a school (involved setting up a computer room with internet access). Students had to come up with suggested solutions to the problem.

3.4.5 Co-operative Support

Students were encouraged to work together. Students had to work in groups of three for their group task. Students used the chat rooms, discussion forum and e-mail extensively. It was quite encouraging to find students assisting each other via the discussion forum.

3.5 The Course Development Process

In developing this on-line course, a course design guide was used. The State University of New York (SUNY) Learning Network (SLN) is the on-line instructional program created for the 64 colleges and nearly 400,000 students of SUNY. The foundation of the program is freedom from schedule and location constraints for faculty and students. The primary goals are to bring SUNY's diverse and high quality instructional programs within reach of learners everywhere and to be the best provider of asynchronous instruction for learners in New York State and beyond. Some of the recommendations of SLN are examined.

It is believed that the person teaching the course (facilitator/instructor) should also develop the course so that they have a complete understanding of the course and how it functions. This was true in this study. The SLN has developed a course-design process to help faculty create instructionally and technically robust learning environments in which to teach and learn. This was used in the development of the on-line course (Data Communication) for this study. It was found to be an excellent guide and aid in the development of this course.

The section that follows will elaborate on this course design process as designed by SLN and what is considered effective in the design of asynchronous learning environments.
As a first, it is recommended that courses be complete on the day the course starts or before for several reasons. A complete course gives students the sense of the course as a whole. A stable environment with a consistent design and redundant instructional cues must be designed and tested. Common complaints from course facilitators/instructors include that students will work ahead in the class, or that this prevents the spontaneity or

flexibility that exists in the traditional classroom. In the same way that classroom students will rarely read ahead in a book or begin assignments in advance, one has learnt that on-line students rarely work ahead of the pace set by the instructor. The advantage to students is that, with the course structure complete, they can get a sense of the topic and of the scope of the activities they will be doing in much the same way as browsing through the course syllabus or leafing through the chapters of a book. It is also believed that the way to insure a flexible on-line classroom is to pre-design a consistent course module structure that contains explanations and shell documents that can accommodate the interests of the students, the spontaneity of the instructor, or that can incorporate current events. A complete course will also allow course facilitators to concentrate on teaching and managing the course and participating fully with the students rather then trying to plan the next lesson or checking functionality. I found all of the above true in my course development process. The following is a suggested sequence of steps that a course facilitator/instructor may follow.

3.5.1 Step One: Get Started

Before beginning work on the course template, it is recommended that you begin to visualize your courses in an asynchronous on-line environment. You need to assess your current instructional practices and relate them to distance learning principles. You need to reflect on what you do in the classroom compared to what you imagine doing in the on-line version of your course. You start by identifying some learning activities and methods of evaluation appropriate to asynchronous learning. Thereafter you draft a profile of your course. Much of the conceptual work in designing the course and your current understandings of effective course design are built into this stage of course development.

You need a profile of your course that responds to these questions as though a student has asked them : "What will I get out of taking this course?"; "What is this study about?" "How is this course organized?"; "What exactly will I be doing when I take this course?"; "How will you assess my work?"; "What constitutes 'good' work in the course?";

You need to make your profile user friendly by writing your responses as though addressing a single student. What happens is we shift our thinking about addressing a classroom of students toward addressing the individual on-line student sitting alone in front of a computer interacting with their on-line course materials and activities. Well articulated answers to these questions become the foundation for the actual course information and orientation documents that are necessary for students to be well oriented and welcomed into an on-line classroom.

3.5.2 Step Two: Create an Orientation

There are certain specific orientation information that is effective in introducing the student to the on-line learning environment. Students, who are well orientated to the instructor, the course, and the instructor's expectations, will have fewer questions and feel more comfortable. Nine orientation documents that provide students with the walls to their on-line classroom have been identified. The purposes of orientation documents are to cover the range of initial information students may need to become familiar with the instructor, the course and general course-related information. They are:

Welcome - Introduces the instructor and the course to the students. One can think of it as a letter of introduction. It sets the tone and is the students' first glimpse of the instructor. In the WebCT course the "Introduction" icon gave the user access to an introductory page.

Contact Information - Details specific information about the course, how to contact the instructor, and the instructor's schedule. In the WebCT course this was provided via the Syllabus and Calendar icons.

Course Overview and Objectives - Describes the course and course objectives in greater detail. In the WebCT course this was accessible via the "ReadMeFirst" icon.

Readings and Materials - Details the texts and/or materials to be used in the course. Can list optional/additional reading materials or resources for the course. This was provided in the WebCT course through the "Additional Resources" icon.

Learning Activities - Describes specifically each type of activity that the students will be doing during the course. In the WebCT course each activity had a separate hyper-link detailing the activity.

How You Will Be Evaluated - Details specifically how each activity will be evaluated. In the WebCT course the assessment criteria are given under Assessment.

My Expectations - Details specifically what the instructor expects from students in terms of participation in the class and/or any other specific expectations the instructor may have for students in their class. In the WebCT course this was done through postings via the discussion forum.

Course Schedule - Clearly outlines every activity the student needs to do in the instructor's course, including reading assignments, assignment due dates, scheduled tests and quizzes, special projects, discussions, and group activities. Titles and references to documents and modules in the course must be consistent for the schedule to be effective. In the WebCT course the "Calendar" option gave a suggested work plan/schedule for the student.

Next Steps - Some of the next tasks a student should do might include reading any posted announcements, posting a personal profile, participating in an ice-breaking assignment, etc. In this study students posted an introduction to the discussion forum giving their personal profile and their expectations and or any fears they might have about the course.

3.5.3 Step Three: Chunk Course into Modules

In designing the modules of a course, the instructor's pedagogical approach, the nature of the content or discipline, and the constraints and features of the on-line asynchronous environment determine how an instructor will chunk his course. You need to look at your content, consider how you want to teach it, and see if chunks naturally emerge. It may be helpful to look at examples of how others have chunked their courses and provide model courses for observation for this purpose. Individuality in course structure is very important. This is the most important and most difficult step for a course designer.

Individuals must have ownership of and investment in their own courses, and ultimately the ability to teach and manage the courses without relying on support.

3.5.4. Step Four: Create Learning Activities in Course Modules

Just as the instructor's pedagogical objectives, the nature of their content, their personal style and the features and constraints of the web shaped the module structure of their courses, so, too, will they shape the section structure and specific learning activities for their courses. The following are suggestions: List the learning activities that you envision for each of your modules. You then draft a name or title for each activity; Do you foresee students working through the learning activities in a specific order? If so, draft the list of the learning activities in that order. If not, list them in a logical order for each module; and Does a pattern of activities emerge? For example, activities may be logically grouped by topic, task, or date. Grouping the activities in a logical and consistent scheme across modules will help the instructor enhance and organize course materials and activities. Consistency in the structure and order of activities across modules also helps students in their understanding and navigation of the course, materials, and activities.

The instructor then creates a draft name for each learning activity that is descriptive and unambiguous. Keep the titles short and to the point. Consider putting due dates, type of task, and a descriptive name in the title. It is recommended that the use of consistent naming conventions across modules and for similar types of activities be used.

Once the instructor has decided on the general module framework for the course, the task is to plan out the learning activities within each module. At this stage, sequencing and consistency will be very important. A well-designed course will be consistent and logical in its presentation and organization. For example, a typical module could begin with an overview, followed by some introductory material or lecture. Students are then typically given tasks such as a reading in a textbook, creating a written assignment, and/or participating in an on-line discussion, or directed to complete some on-line or offline project or activity.

You also need to think about how your students will interact with the materials and navigate the course. Any course management tool will have built-in navigational buttons and a web interface that facilitates students' navigation through all the levels of web screens. However, an instructor must not assume that students will know what to do and where to go next. You will need to create navigational documents and instructions on your documents that explicitly tell your students where to go next and what to do.

For maximum effectiveness of navigational instructions, they should be consistent. And it is recommended that they use the same font, put them in the same location on pages, and use consistent wording for the instructions. Instructors can also use the section title and the document title to highlight a type of task, a due date, or a time frame.

Careful consideration must be given to how students will be evaluated. Timed multiple-choice tests for example cannot be encouraged in this environment. Nor can students be observed in person to ascertain certain skills. Working in this environment may require creativity and the design of new evaluation methods. The following recommendations may be considered: Review the list of learning activities that you have created and think about how you plan to assess or evaluate student work, performance, or learning for each activity; Look at the evaluation document created in your syllabus and orientation area. Have you assigned appropriate values to the types of activities in your course? Do they match the actual activities you have planned? For example, is discussion 60% of the course and only 25% of the grade?; How will you evaluate discussion, if it is a component of your course?; Review the workload for students and for yourselves. How many students are you likely to have? What if you have a very small number of enrolments? What if you have a very large number of enrolments? Will the activities you planned still work? What alternatives do you have?; Give some thought to workload and course management. The more students know about the tasks, activities, expectations, requirements, and how they will be evaluated, the more comfortable and confident they will be participating in the course and the better able the instructor will be to manage the course.

3.5.5 Step Five: Walk Through Course

An integral part of the course development process is the evaluation and revision of the course modules as the instructor develops them. If possible and if time permits, you may want to have an outside reviewer such as a colleague or expert in the field, and/or an instructional designer review your course. Reviewers can give very valuable feedback about issues such as content, accuracy, technical quality, functionality, and user acceptability and usability, and issues associated with actually implementing and using the instruction. Whether a reviewer is used or not, it is important for you to evaluate and revise or refine the structure, materials and activities that you are designing during the development phase of your courses. I used a colleague from the Computer Science Department to review the course. The comment I got was " most impressive, where did you get the time to do all that?" Apart from a few ambiguities in instructions, my colleague was quite confident that students will find this mode of learning "most exciting and interesting".

3.5.6 Step Six: Get Ready to Facilitate Learning

Here are some recommendations and tips for getting off to a good start. At the beginning of the semester, encourage all students to get familiar with the web environment for their courses. You could provide a student-orientation course and encourage students to prepare for their courses by first going through the student orientation course. I found that an initial face-to-face meeting demonstrating all the features of WebCT was most appropriate. It is necessary to have a few warm-up activities designed in the first module of all courses to get everyone to know each other and to practice using the features specific to the web-class environment. This allows students to practice doing the kinds of activities they will be doing in the course, and can be designed to break the ice, i.e. introduce the course and the participants in the course to each other and practice certain activities. It also begins to support a sense of class community, something I have found to be a very important part of an effective on-line learning environment. In order to keep the class moving it is recommended that the instructor make sure that there is something new for the students at least every two to three days. If students are not moving the discussion along, the instructor might call on specific students to clarify a particular view or to provide support for a view, comment on existing responses, and invite students to

respond again or put a note in the announcements area encouraging students to participate. If some students continue to remain silent, the instructor can send individual students an e-mail message. You need to keep in mind that there may be something preventing a student's participation such as, a trip, illness, technical difficulties, etc.

3.5.7 Step Seven: Evaluate and Revise Course

In anticipation of the evaluation and revision stage, the facilitator is encouraged to keep notes during the teaching/facilitating learning phase of the courses. Notes on any issues or problems that emerge as one facilitates, or that are commented on by students, can help in the evaluation and revision of courses. Thoughts, general or specific, on the design, structure, pacing, and/or sequencing of the courses, or of any of your activities should be documented as the courses are taught.

This is the last step in the course developer process. Once instructors conclude the teaching/facilitating learning phase of their courses, they should evaluate the courses and their experience and review the notes they made as they taught to assess any improvements and revisions necessary to the structure or activities.

Once again it is most appropriate to think about what worked well? What did not? Why? What could be improved? How? Were discussions successful? Were assignments and other activities successful? Were students able to complete all the modules in the course? Did most students complete the course? How was the workload for the instructor and for the students? Was the instructor able to keep up? Was there anything missing? Were there any points in the course where students did not do or understand the activity?

All of the above steps go a long way in ensuring a well designed course.

The next section is an explanation of Q-Methodology and how it was used in this study.

3.6 Q-Methodology

3.6.1 Intoduction

Q methodology was designed in 1935 by British physicist-psychologist William Stephenson (1953) and is most often associated with quantitative analysis due to its involvement with factor analysis. Statistical procedures aside, however, what Stephenson was interested in providing was a way to reveal the subjectivity involved in any situation e.g. in aesthetic judgment, poetic interpretation, perceptions of organizational role, political attitudes, appraisals of health care, experiences of bereavement, and perspectives on life and the cosmos. "It is life as lived from the standpoint of the person living it that is typically passed over by quantitative procedures, and it is subjectivity in this sense that Q methodology is designed to examine and that frequently engages the attention of the qualitative researcher interested in more than just life measured by the pound" (Stephenson, 1953). Q methodology "combines the strengths of both qualitative and quantitative research traditions" (Dennis and Goldberg, 1996) and in other respects provides a bridge between the two (Sell and Brown, 1984). Some of the quantitative obstacles to the wider use of Q methodology have recently been rendered less daunting by virtue of software packages which have converted to button presses what before were tedious calculations. One such package, QMethod (Atkinson, 1992), is available as freeware from Kent State University's Listserver.

3.6.2 Process

Fundamentally, Q methodology provides a foundation for the systematic study of subjectivity, and it is this central feature which recommends it to persons interested in qualitative aspects of human behavior. Most typically, a person is presented with a set of statements about some topic, and is asked to rank-order them (usually from "agree" to "disagree"), an operation referred to as "Q sorting". The statements are matters of opinion only (not fact), and the fact that the Q sorter is ranking the statements from their own point of view is what brings subjectivity into the picture. There is obviously no right or wrong way to provide "my point of view" about something: health care, the Noble Peace Prize nomination, the reasons why people commit suicide, or anything else. Yet

the rankings are subject to factor analysis, and the resulting factors, inasmuch as they have arisen from individual subjectivities, indicate segments of subjectivity which exist. And since the interest of Q methodology is in the nature of the segments and the extent to which they are similar or dissimilar, the issue of large numbers, so fundamental to most social research, is rendered relatively unimportant. In principle as well as practice, single cases can be the focus of significant research. In short, the focus is all on quality rather than quantity, and yet some of the most powerful statistical mechanics are in the background, but sufficiently so as to go relatively unnoticed by those users of Q who are not interested in its mathematical substructure.

3.6.3 Concourse

In Q Methodology, the flow of communicability surrounding any topic is referred to as a "concourse" (from the Latin "concursus," meaning "a running together," as when ideas run together in thought), and it is from this concourse that a sample of statements is subsequently drawn for administration in a Q sort. The best references on concourse theory are found in Stephenson (1978), Stephenson (1980/a) and Stephenson (1986). "Concourse is the very stuff of life, from the playful banter of lovers or chums to the heady discussions of philosophers and scientists to the private thoughts found in dreams and diaries. From concourse, new meanings arise, bright ideas are hatched, and discoveries are made: it is the wellspring of creativity and identity formation in individuals, groups, organizations, and nations, and it is Q methodology's task to reveal the inherent structure of a concourse - the vectors of thought that sustain it and which, in turn, are sustained by it" (Stephenson, 1978).

A concourse can be achieved in a number of ways. The most typical is by interviewing people and jotting down or recording what they say, but commentaries from newspapers, talk shows, and essays have also been used. The level of discourse dictates the sophistication of the concourse: hence, factors which should be taken into account in decisions about who should receive a liver transplant at a particular hospital would likely involve the medical personnel, the potential recipients (and perhaps the donor), and possibly even a philosopher specializing in medical ethics (or sociologist with expertise

in medical sociology) who might be called in as a consultant. On the other hand, a study of public opinion would necessitate interviewing representatives of those segments of the society apt to have something to say about the issue in question (Stephenson, 1978)

A concourse comprises the raw materials for Q methodology. Statements, called the "Q sample" are drawn from the concourse, and it is this set of statements that are eventually presented to participants in the form of a Q sort. Generally, the person is given the Q sample and instructed to read through them all first so as to get an impression of the range of opinion at issue and to permit the mind to settle into the situation. At the same time, the person is also instructed to begin the sorting process by initially dividing the statements into three piles: those statements experienced as agreeable in one pile, those disagreeable in a second pile, and the remainder in a third pile. The rating scale is spread across the top of a flat area (like a kitchen table), and may range from +3 to -3, or +4 to -4, or +5 to -5, depending on the number of statements. The distribution is symmetrical about the middle, but usually flatter than a normal distribution. Both the range and the distribution shape are arbitrary and have no effect on the subsequent statistical analysis, and can therefore be altered for the convenience of the Q sorter; there are, however, good reasons for encouraging the participant to adhere to whatever distribution shape is adopted for the study.

It is important to note that a completed Q sort should be followed where possible with an interview so that the Q sorter can elaborate his or her point of view. The Q sort provides focus to the interview by indicating which of the various topics in the Q sample are most worth talking about: obviously those statements that scored +3 and –3 should be addressed first since they are demonstrably the most salient, but those scored 0 can be revelatory by virtue of their lack of salience.

3.6.4 Correlations

Strauss and Corbin (1990) are quite explicit in distinguishing qualitative from quantitative research: "By the term qualitative research we mean any kind of research

that produces findings not arrived at by means of statistical procedures or other means of quantification. One of the advantages of qualitative research, of course, is that it permits the systematic gathering of data which are not always amenable to quantification, but to appraise data on the basis of whether or not they have been subjected to statistical analysis is surely a case of misplaced emphasis". It is important to be able to assay the subjectivity at issue in a situation, which Q does: the fact that the resulting data are also amenable to numerical treatment opens the door to the possibility of clarity in understanding through the detection of connections which unaided perception might pass over. In Q, the role of mathematics is quite subdued and serves primarily to prepare the data to reveal their structure. Much of this is achieved firstly by looking at correlations. A correlation matrix will then be derived by comparing each of the participants Q sorts with each other. To determine how large a correlation must be before it is considered substantial, the standard error is calculated, a rough and ready estimate of which is given by the expression 1/(SQRT (N)), where N is the number of statements and SQRT is the square root. As a rule of thumb, correlations are generally considered to be statistically significant if they are approximately 2 to 2.5 times the standard error. It is rarely the case that the correlation matrix is of much interest since attention is usually on the factors to which the correlation matrix lead. The correlation matrix is simply a necessary way-station and a condition through which the data must pass on the way to revealing their factor structure (Stephenson, 1980/b).

3.6.5 Factor Analysis

"Few statistical procedures can be more daunting than factor analysis, but in Q methodology there is little more reason to understand the mathematics involved than there is to understand mechanics in order to drive a car. A certain minimal knowledge is required, such as when (but not necessarily why) to change the oil, but available and forthcoming software packages are lessening the need to understand factor analysis in detail, thereby freeing intellectual sojourners to remain focused on the road ahead while taking for granted the mathematics purring under the hood (Stephenson, 1980/b). Those interested in further details, presented here with as much simplicity as the subject matter allows, are referred to Adcock (1954), Brown (1980) and Stephenson (1980/b).

Fundamentally, factor analysis examines a correlation matrix and, in the case of Q methodology, determines how many basically different Q sorts are in evidence: Q sorts which are highly correlated with one another may be considered to have a family resemblance, those belonging to one family being highly correlated with one another but uncorrelated with members of other families. Factor analysis tells us how many different families (factors) there are. The number of factors is therefore purely empirical and wholly dependent on how the Q sorters actually performed. The interpretation of factors in Q methodology proceeds primarily in terms of factor scores. A factor score is the score for a statement as a kind of average of the scores given that statement by all of the Q sorts associated with the factor.

A statistician once characterised factor analysis as that branch of multivariate analysis in which the researcher grasps the data by the throat and screams "Speak to me!" and in Q methodology this is not all that far-fetched. Just as each Q sort portrays a version of the world "as I see it," so does each factor represent a version of the world that is commonly held and which speaks to us through the unison of the factor scores, and factor interpretations cannot stray far from the factors of which they are interpretations if they aspire to descriptive accuracy (Stephenson, 1991).

3.6.6 Conclusion

Qualitative research was born out of a disappointment with the capacity of so-called objective methods to capture significant features of human experience. The revolution provided a necessary corrective, but the enthusiasm that was generated in the process often led to an overshooting of the mark and to excesses in the opposite direction. "An extreme reaction has been to reject any procedure bearing the slightest resemblance to number, but the consequence has been to deprive the student of behaviour of devices which can extend perception beyond unassisted limits, and can secure those fresh and intellectually nutritious observations which a growth in knowledge requires". Q methodology is a useful addition to the qualitative researcher's arsenal: it is simple to the point of elegance, well fortified with mathematics (which need not be understood) , increasingly supported by computer software programs, and grounded in modern

philosophical and scientific principles. And it has a wealth of exemplary applications to help show the way. The qualitative analyst would be hard pressed to find a more adequate methodological ally (Brown, 1991).

3.7 METHODS

3.7.1 Q-Methodology

3.7.1.1 Process

As mentioned previously, in Q-methodology applying a hybrid of qualitative and quantitative statistical techniques are used to uncover commonly shared opinions regarding a specific topic. The qualitative methods of Q allow participants to express their subjective opinions and the quantitative methods of Q use factor analytic data-reduction and induction to provide insights into opinion formation as well as to generate testable hypotheses. Studies employing this method typically use small sample sizes as the method emphasizes the subjective opinion of a population, not how many in the population share the opinion. The methodology involves three stages: developing a set of statements to be sorted; having participants sort those statements along a continuum of preference (agree to disagree); and analysing and interpreting the data.

The subjects in this Q-methodology research study were asked to rank order a group of subjective statements (Appendix A) on a continuum from most important to least important. The set of instructions for sorting the statements, given to the research participant, is called the Condition of Instruction (Appendix B).

In this study, a large collection (concourse) of items relating to the application of mixed mode learning and of technology to education was developed. From the original concourse, 30 statements that represented aspects of lifestyle and learning preference were selected. These 30 statements represented the final Q-set (Appendix A). The final Q-set was distributed to the respondents, along with the Condition of Instruction (APPENDIX B). Participants had to determine which issues are important and which issues are not important to them when thinking about on-line learning in education?

Participants were to arrange the statements within the response grid with those on the left side being items considered most unimportant and those on the right side being items considered most important. Statements were not ranked within the columns. The result of this process, the Q-sort, was analysed using PQMethod, a statistical program that allows data entry in a way that reflects the response grid, computes inter-correlations among participants' responses, and results in a definition of factors.

3.7.1.2 Q-Participants

Fifteen students from the University of Natal – Edgewood Campus participated. None of the participants had previously taken a web-based course. These students were enrolled for the Computer Science Major (ECA2CSY) in the second semester of their second year of study.

3.7.1.3 Q-Procedure

All students received the same Q-set, which was administered at the end of the course. The instructions for the Q-instrument were given to the participants to read and follow. Total time for administering the instrument did not exceed 45 minutes.

3.7.2 The Questionnaire

3.7.2.1 Process

A questionnaire (Appendix C) was compiled using the concourse and some of the statements from the Q-set. The questionnaire contained statements for which participants had to fill in a response according to a five point scale from 1 to 5 where 1 indicated 'strongly disagree' and 5 indicated 'strongly agree'. This questionnaire was of low objectivity and high focus (Conole and Oliver, 1998). It consisted of 27 statements. SPSS software was used to determine frequencies and medians of the data. SPSS software provides access to a wide range of statistical analysis and data management procedures. The level of frequencies and medians were then compared to the factors that were achieved as a result of the Q-study.

3.7.2.2 Participants

The same fifteen students from the University of Natal – Edgewood Campus that participated in the Q-sort completed the questionnaire as well.

3.7.2.3. Procedure

All students met in a lecture venue and completed the questionnaire. The questionnaire was administered at the end of the course. The total time taken to administer the questionnaire was 25 minutes.

CHAPTER 4

RESULTS

4.1 Introduction

For this study I used a "multi-method" approach to evaluation. This includes the Q study, a post-course questionnaire completed by students, students reflective journals and comparison of course grades. The results presented here will rely primarily on the Q study and the questionnaires measuring subjective perceptions of learning.

4.2 Q-results

Q-methodology results in the identification of participant opinion profiles based on the similarities and differences by which they sort the statements in the Q-sample. By-person factor analysis and varimax rotation identified five opinion types (also called factors) among our participants that represented five different views regarding the use of mix mode instruction. Table 2 summarises the rankings among statements for each factor or opinion type, as generated by the statistical software. In Q, an understanding of participant viewpoints results from the examination of that factor's statements, after rank ordering the statements from +3 to -3. The five opinion types regarding mixed mode learning and the application of technology to education were titled: Mode of Learning; Motivation in Learning; Self Discipline; Efficiency and Quality in Education; and Time and Structure.

Table 2 : STATEMENT SCORES BY FACTORS/OPINION TYPES

	FACTORS				
STATEMENTS	**1**	**2**	**3**	**4**	**5**
1. Course content was interesting because of mode of delivery.	3	2	2	1	1
2. VC increased the quality of education.	3	0	3	3	0
3. VC increased the efficiency of education.	2	3	2	3	-1
4. I learnt more because of the use of VC.	0	3	2	1	-2
5. I had more communication with the lecturer compared to FTF.	1	2	-1	0	1
6. There was no need to work as hard as in a FTF mode.	-2	1	-1	-2	-1
7. I was motivated to work harder because others read my assignments.	2	3	-1	-1	-2
8. Reading others assignments was very useful.	1	-3	1	0	-3
9. Less sense of self-assessment in comparisons to others.	-1	-2	-1	-1	-1
10. I preferred this type of assessment as compared to a written exam only.	2	2	1	1	3
11. Fewer subtleties in teaching - instructor observation, speech, inflection, and immediate.	-1	-1	0	-1	0
12. Fewer opportunities to meet new people - social interaction.	-1	-2	-2	-3	0
13. Less enrichment from other perspectives.	0	-1	0	-2	2
14. Less informal learning - side comments by teacher and students.	0	-2	1	-2	2
15. Less discussion with participants.	-3	-1	0	-2	-2
16. Sometimes hard to find quiet time at home.	-3	0	-2	-1	-3
17. Sometimes computer time hard to get at home.	-3	0	-1	0	-2
18. Provides flexible time management.	3	0	1	2	3
19. Potential interference with other obligations.	-2	0	0	-3	0
20. If all courses were online, saves travel time.	0	2	-3	-1	0
21. Can work at home when I want.	-1	-3	0	1	2
22. Trouble getting access to Internet at home.	-1	-1	-2	0	-1
23. Requires basic skills in computer troubleshooting.	0	1	1	0	0
24. Must pay home phone line costs.	-2	-1	-3	-1	2
25. Access to Internet only through campus was problematic.	0	-2	-2	2	-1
26. No set class time was problematic.	-2	0	-3	-3	-3
27. Requires self-discipline.	1	1	3	3	3
28. Requires active learning and initiative.	1	1	3	2	1
29. You'll sure learn to use the Internet.	1	1	0	1	0
30. Can learn at my own pace.	2	-3	1	0	-3

Item Rankings: -3 = most unimportant in this sample ; 0 = ambivalent; +3 = most important in this sample.

Key for Table2: Factor 1 – Mode of Learning

Factor 2 – Motivation in Learning

Factor 3 – Self Discipline

Factor 4 - Efficiency and Quality in Education

Factor 5 – Time and Structure

Figures 8 to 12 show groupings of statements for each factor type. These groupings reveal the statements that a particular group felt as important, unimportant and what they felt neutral to. The statements in the important group all had factor scores of +2 or +3. The statements in the neutral group all had factor scores of zero. The statements in the unimportant group all had factor scores of -2 or -3.

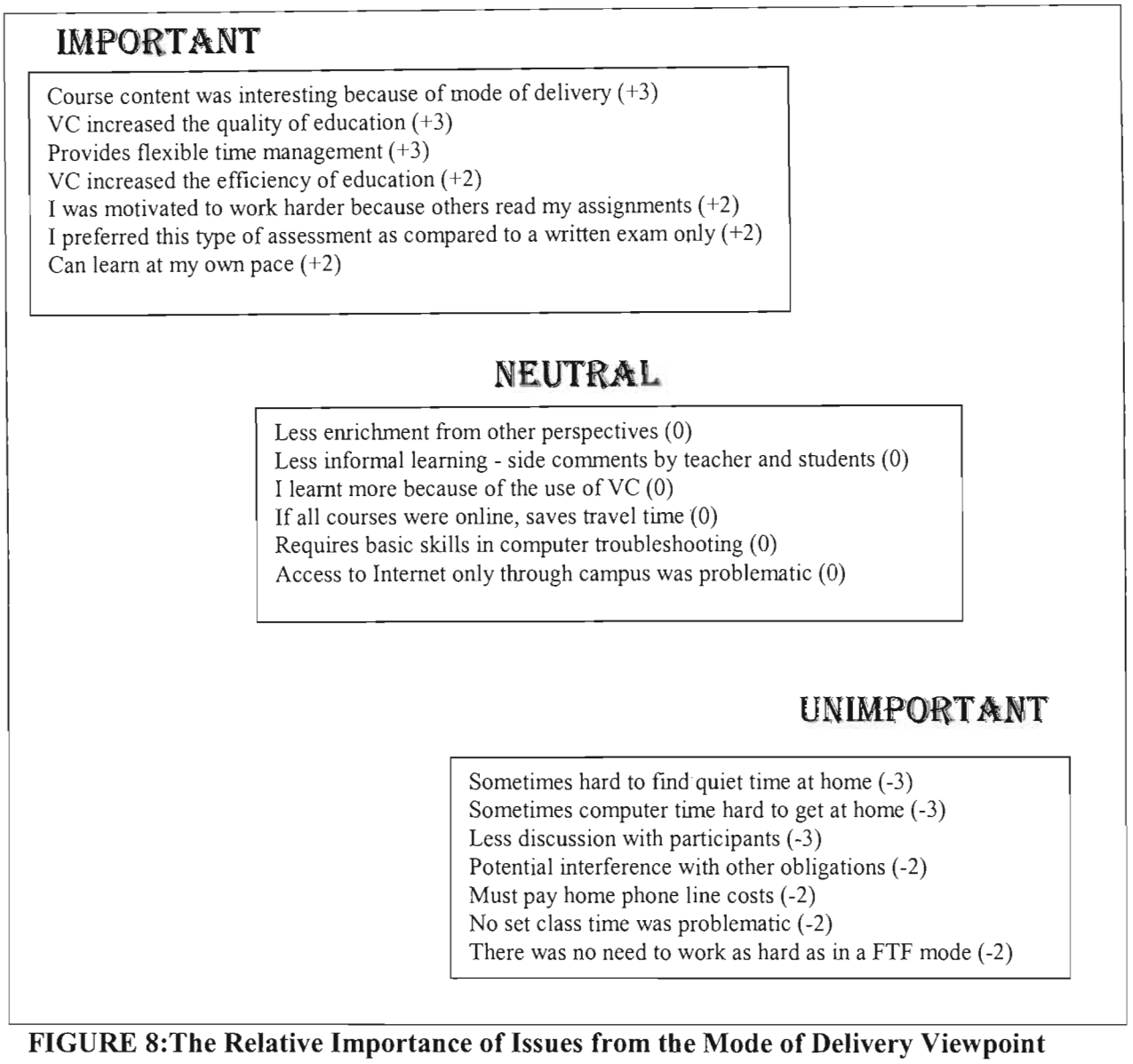


FIGURE 8:The Relative Importance of Issues from the Mode of Delivery Viewpoint

(NOTE: Statements were sorted on a continuum of –3 Most Unimportant to +3 Most Important. The numbers in parenthesis following each statement is the factor score for that item within this viewpoint.)

Factor 1 : Mode of Delivery

Most important to this group of students was that *the course content was interesting because of the mode of delivery.* They also felt strongly that *the mode of delivery (VC) increased the quality of education.* Statements 1 and 2 in Table 2 show that the score for factor type 1 was 3 (most important). This is also evident in Fig. 8. Therefore one can conclude that this group did view 'mode of delivery' as a key aspect. Also ranked

important was the *flexible time management*. At the same time this group reacted positively to being *motivated to work because others read their assignments, preferred this type of assessment compared to a written exam, VC increased the efficiency of education, and preferred learning at own pace*. This group was neutral to issues of *less enrichment from other perspectives, less informal learning, requires basic computer skills, and saving travel time*. Unimportant to this group was, *hard to find computer time at home, and hard to find quiet time at home*. These findings are illustrated in Fig. 8.

Factor 2 : Motivation in Learning

Most important to this group of students was that *they were motivated to work harder because others read their assignments, learnt more because of VC, and efficiency of education was increased because of VC*. Statements 4 and 7 from Table 2 show that the scores for this factor type was 3 (most important). This is supported by the contents of the important block in Fig. 9. Therefore one can conclude that motivation was an important aspect to this group of students. The group also reacted positively to, *course content was interesting because of mode of delivery, I had more communication with the lecturer compared to FTF, preferred this kind of assessment as compared to a written exam only, and saves travel time*. The group was neutral towards, *hard to find quiet time at home, computer time hard to find at home, flexible time management, interference with other obligations, VC increased quality of education, and no set class time was problematic*. Unimportant to this group was, *can work at home when I want, can learn at my own pace, and reading others assignments was useful*. These findings are illustrated in Fig.9.

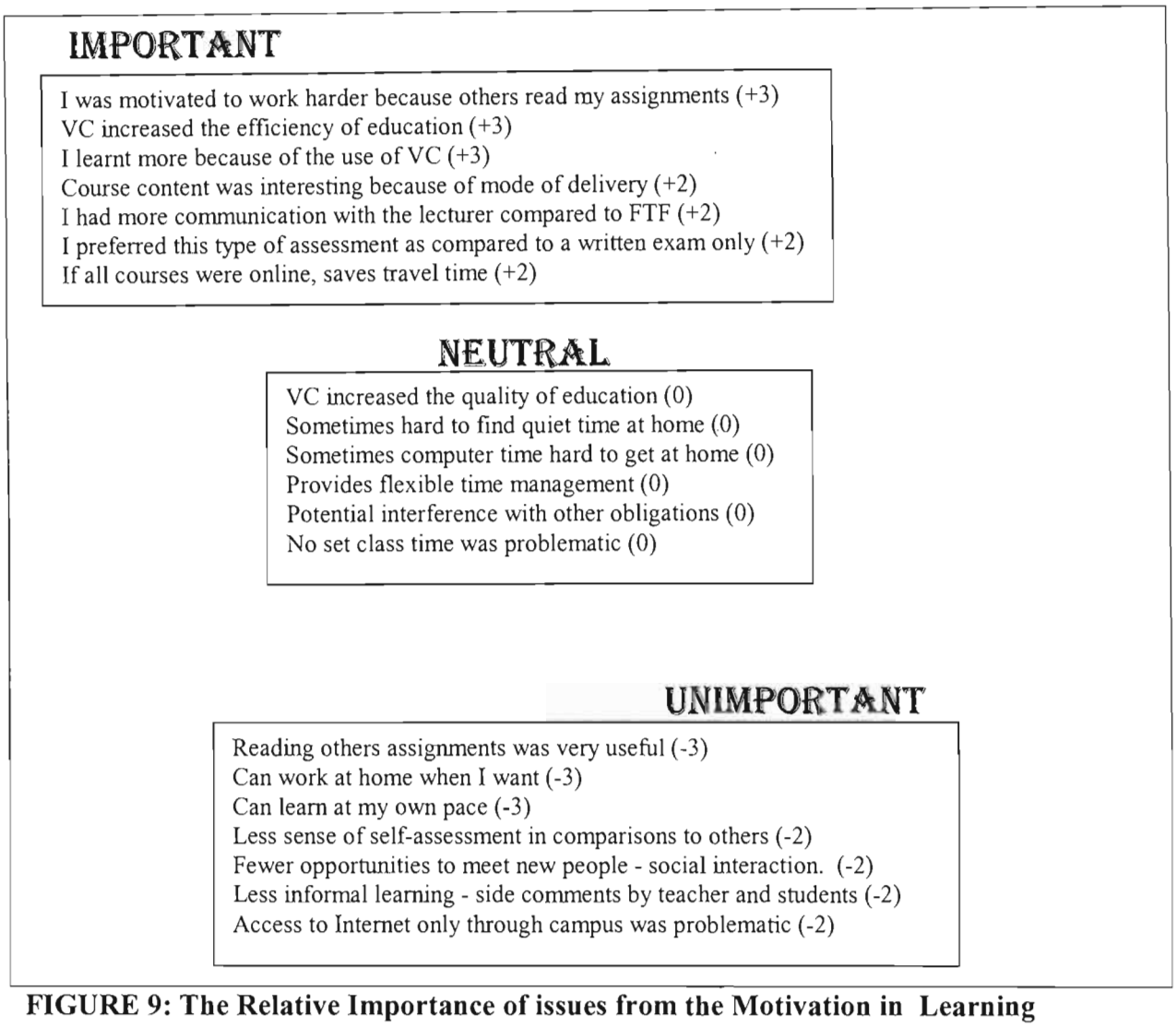


FIGURE 9: The Relative Importance of issues from the Motivation in Learning Viewpoint.

(NOTE: Statements were sorted on a continuum of –3 Most Unimportant to +3 Most Important. The numbers in parenthesis following each statement is the factor score for that item within this viewpoint.)

Factor 3: Self Discipline

Requires self discipline and requires active learning and initiative were of utmost importance to this group of students. Statements 27 and 28 from Table 2 show that the scores for this factor type was 3 (most important). This is also evident in Fig. 10. Therefore one can conclude that self-discipline was an important issue to this group of students. They also responded positively to *course content was interesting because of*

mode of delivery, VC increased the quality of education, VC increased the efficiency of education, and I learnt more because of VC. The group was neutral on, *fewer subtleties in teaching, less enrichment from other perspectives, less discussion with participants, potential interference with other obligations, can work at home, and you will sure learn to use the Internet.* Unimportant to this group was, *saves travel time, must pay home phone bills, and no set class time.* These findings are illustrated in Fig. 10.

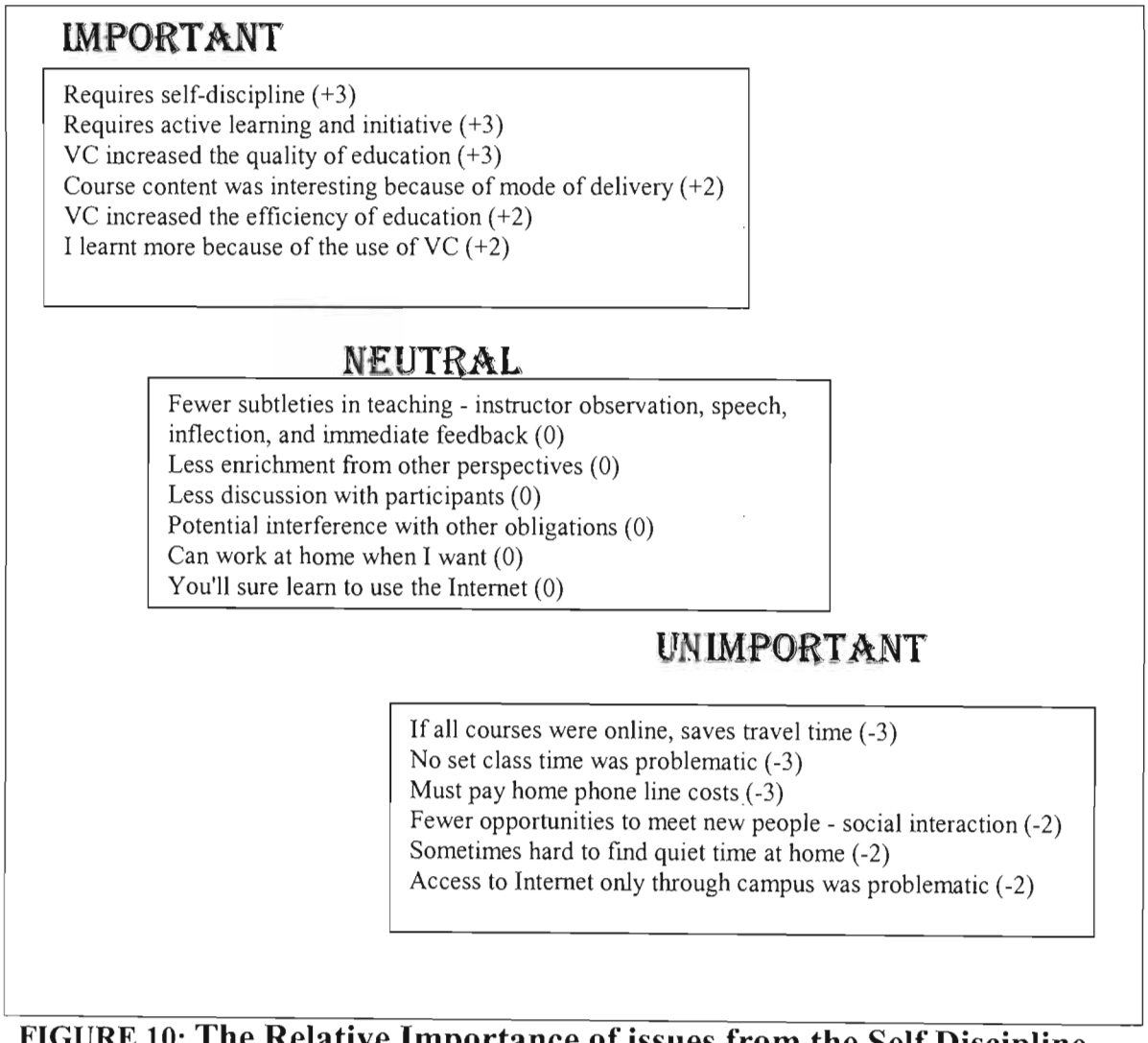


FIGURE 10: The Relative Importance of issues from the Self Discipline Viewpoint

(NOTE: Statements were sorted on a continuum of –3 Most Unimportant to +3 Most Important. The numbers in parenthesis following each statement is the factor score for that item within this viewpoint.)

Factor 4: Efficiency and Quality of Education

This group of students found that an *increase in the quality and efficiency of education* was of utmost importance. Statements 2 and 3 from Table 2 show that the scores for this factor type was 3 (most Important). This is also evident from analysis of Fig. 11. Therefore one can conclude that efficiency and quality of education were important aspects to this group of students. Also ranked important were, *requires self discipline, requires active learning and initiative, access to the Internet only on campus was problematic and provides flexible time management.* The group was neutral to, *reading other's assignments was very useful, I had more communication with the lecturer, computer time hard to get at home, trouble getting Internet access at home, requires basic skills in computer troubleshooting and can learn at my own pace.* Unimportant to this group was, *no set class time was problematic, potential interference with other obligations and fewer opportunities to meet new people.* These findings are illustrated in Fig. 11.

Factor 5 : Time and Structure

Most important to this group of students was *flexible time management.* Statement 18 in Table 2 has a score of 3 (most important) and statement 26 a score of –3 (most unimportant) for this factor type. This is also evident in Fig. 12. One can quite easily conclude that flexible time was a very important aspect for this group. This group also reacted positively to *preferred this type of assessment as compared to a written exam only, less informal learning, must pay home phone costs and requires self discipline.* The group was neutral towards, *you will sure learn to use the Internet, requires basic skills in computer troubleshooting, saves travel time, potential interference with other obligations, fewer opportunities to meet new people, fewer subtleties in teaching and VC increased the quality of education.* Most unimportant to this group was that *no set class time was problematic, can learn at my own pace, hard to find quiet time at home, and reading other's assignments was very useful.* These findings are illustrated in Fig. 12.

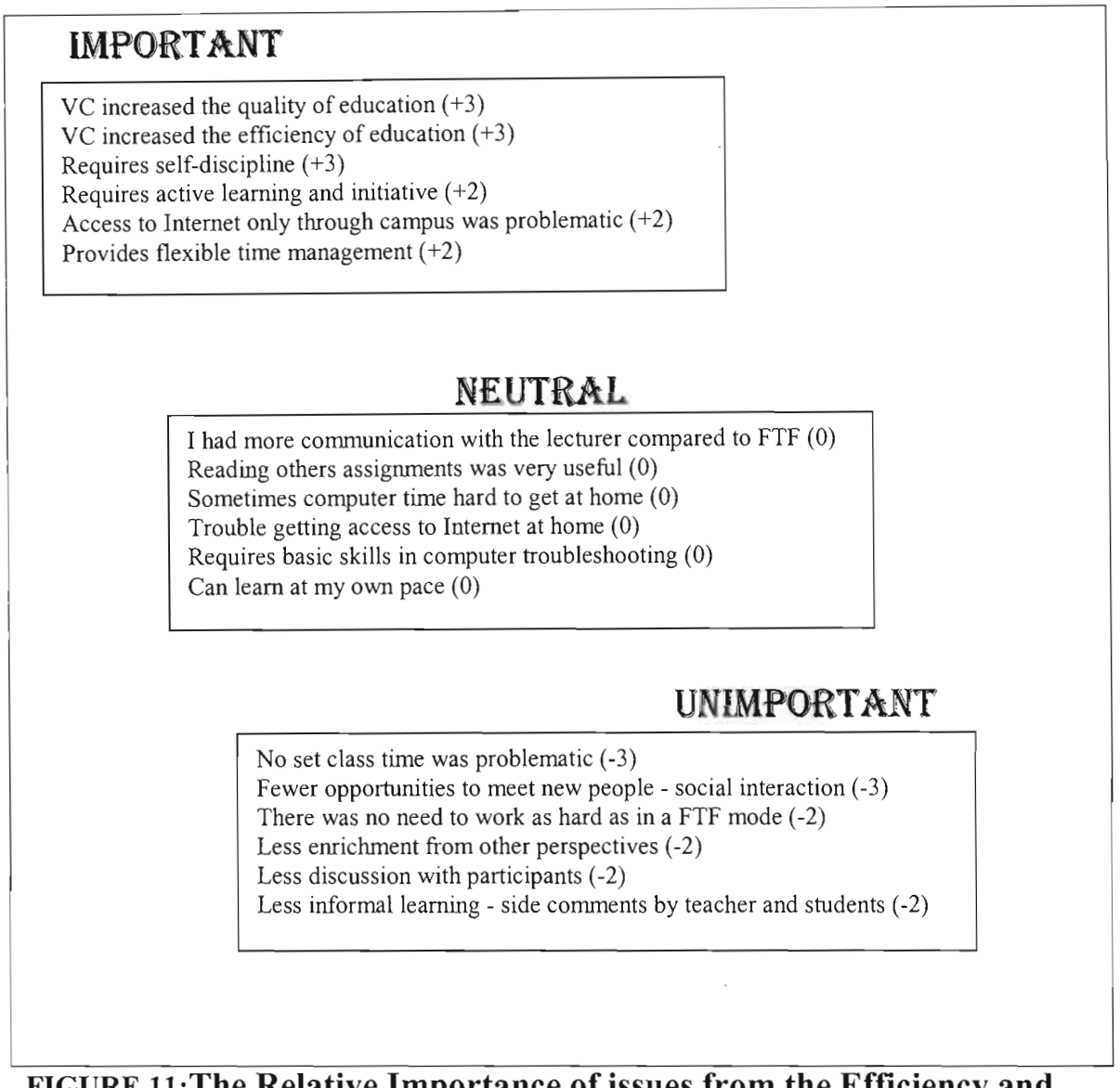


FIGURE 11:The Relative Importance of issues from the Efficiency and Quality of Education Viewpoint

(NOTE: Statements were sorted on a continuum of –3 Most Unimportant to +3 Most Important. The numbers in parenthesis following each statement is the factor score for that item within this viewpoint.)

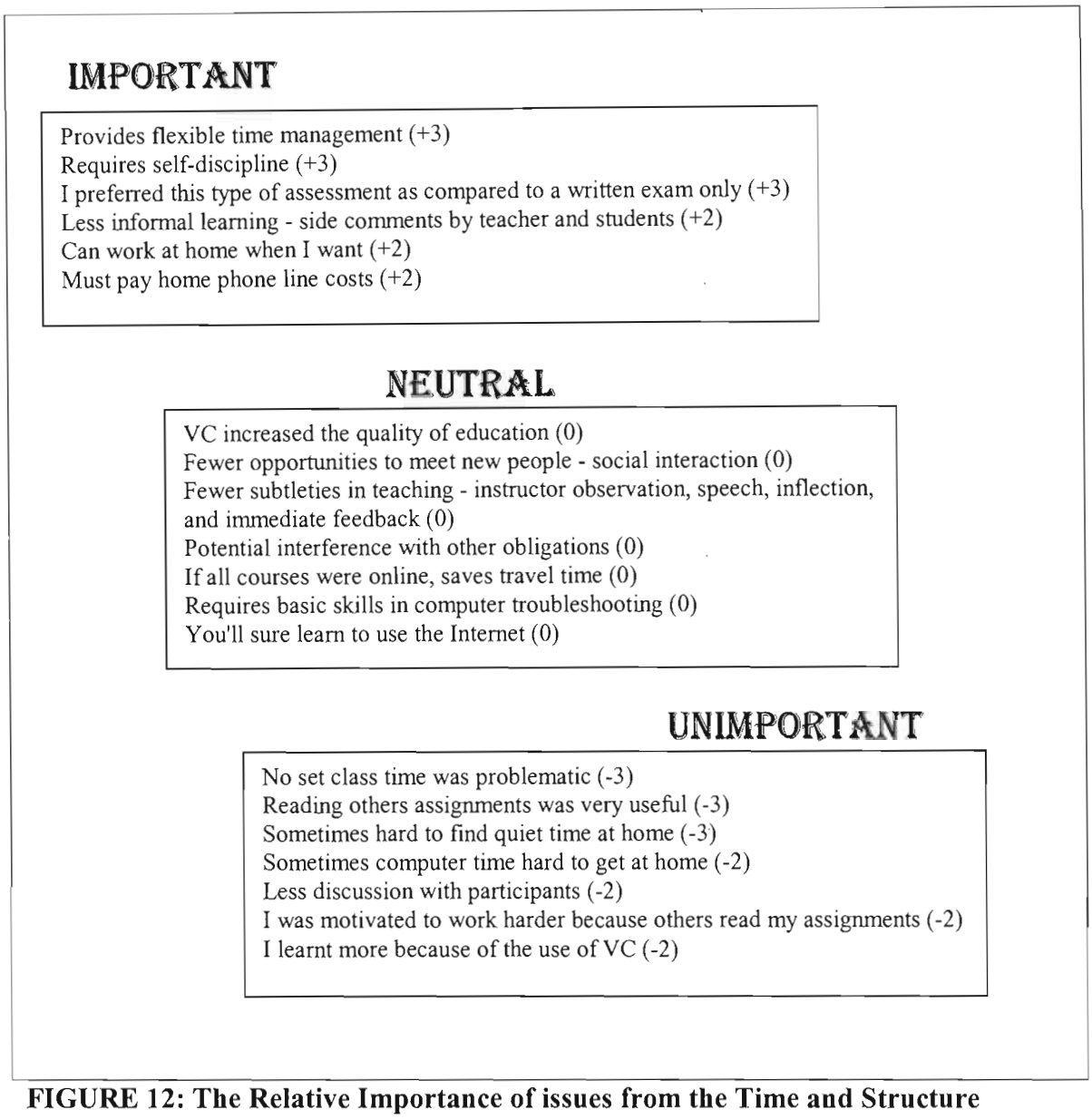


FIGURE 12: The Relative Importance of issues from the Time and Structure Viewpoint

(NOTE: Statements were sorted on a continuum of –3 Most Unimportant to +3 Most Important. The numbers in parenthesis following each statement is the factor score for that item within this viewpoint.)

Consensus Statements

Important to all five groupings was that *the course content was interesting because of mode of delivery (VC).* This enables me to conclude that "mode of delivery" as a factor type was very strong. All five groups *preferred this type of assessment as compared to written exam only,* and responded very positively to *provides flexible time management.* This tells me that "Time and Structure" as a factor type was also very strong. Finally all

five groups responded positively to "*requires self discipline*", and "*requires active learning and initiative*". Self Discipline as a factor type can be viewed very strongly. Unimportant to all five groups were, *Fewer opportunities to meet new people, less verbal discussion with participants, hard to find quiet time at home and no set class time.* Students were quite content with electronic communication with their peers. I am sure that most students worked on campus and therefore were not concerned if they were not able to work at home. Since students did prefer the flexible time, they preferred not having a set class time.

4.3 Questionnaire Results

Attitude and perception data were obtained through the questionnaire completed in class during the last face-to-face session with the group at the end of the course. The questionnaire was of low objectivity and high focus. There were 27 statements restricting response to a range of 1 to 5 where 1 represented strongly disagree and 5 strongly agree. Mean responses to the statements are shown in Table 3. The lower the mean score the stronger the respondents disagreement with the statement and the higher the mean score the stronger the respondents agreement with the statement. A mean score of 3 indicates a "no opinion" response to the statement. Scores ranged from 1 (strongly disagree) to 5 (strongly agree). Mean scores from Table 3 were compared to statement scores by factor/opinion type from Table 2.

The mean student responses ranged from 1.3 to 4.6. The following statements all had a mean of 4 (agree) and more (strongly agree): statement 5 "Working with classmates and the lecturer through on-line technologies provided exciting experiences"; statement 7 "the instruction was well designed to keep up with the schedule"; statement 10 "Overall, I was satisfied with the class and would recommend on-line mode to my friends"; statement 13 "Course content was interesting because of mode of delivery"; statement 14 "I participated actively in class discussions"; statement 16 "On-line course is more convenient"; statement 21 "VC increases efficiency of education" and statement 24 "I prefer the flexible time management".

TABLE 3: Mean Scores of Student Responses to Statements in Questionnaire

STATEMENT	MEAN
1. I had problems with access to a PC.	1.7
2. I developed new friendships during this course.	3.8
3. I was frustrated sitting alone in front of a computer.	1.4
4. I had more communication with the lecturer compared to FTF	3.2
5. Working with classmates and the lecturer through on-line technologies provided exciting experiences.	4.6
6. Technical problems were barriers when taking this class.	2.9
7. The instruction was well designed to keep up with the schedule.	4.1
8. I believe I have learned in this on-line class as much as I would have learned in a FTF.	3.7
9. If possible, I would prefer taking this course in a FTF mode.	2.9
10. Overall, I was satisfied with the class and would recommend on-line mode to my friends.	4.5
11. It was difficult to maintain self-discipline in learning in this on-line mode.	2.3
12. I could stop VC when I was busy with other things.	3.8
13. Course content was interesting because of mode of delivery.	4.5
14. I participated actively in class discussions.	4.2
15. Course was a waste of time because of mode of delivery.	1.3
16. On-line course is more convenient.	4.2
17. I felt more involved because of mode of delivery.	3.7
18. I was motivated because others read my assignments.	3.5
19. Reading others assignments was very useful.	3.9
20. I did not need to work as hard as FTF.	3
21. VC increases efficiency of Education.	4
22. VC increases the quality of Education.	3.9
23. There was less enrichment from other perspectives.	2.8
24. I prefer the flexible time management	4.3
25. No access at home was problematic.	2.8
26. VC requires basic skills in computer troubleshooting.	3.9
27. On-line mode is what this institution should be focusing on in all subjects.	3

The following statements all had a mean of less than 2 (strongly disagree): statement 1 "I had problems with access to a PC"; statement 3 "I was frustrated sitting alone in front of a computer" and statement 15 "course was a waste of time because of mode of delivery".

When comparing these mean scores from the questionnaire to the statement scores by factor/opinion types from Table 2 we find that the mean scores from the questionnaire do support the factors as a result of the Q study. Factor 1, "Mode of Delivery", is strongly supported by a mean of 4.5 (strongly agree) for the statement "Course content was

interesting because of mode of delivery". Factor 2, "Motivation in Learning", is supported by a mean of 3.5 (agree) for the statement "I was motivated because others read my assignments" and a mean of 4.2 (strongly agree) for the statement " I participated actively in class discussions". Factor 3, "Self Discipline", is supported by a mean of 2.3 (disagree) for the statement "It was difficult to maintain self discipline in learning in this on-line mode". Factor 4, "Efficiency and quality of education", is supported by a mean of 4 (agree) for the statement "VC increases efficiency in education" and a mean of 3.9 (agree) for the statement "VC increases the quality of education". Factor 5, 'Time and structure", is supported strongly by a mean of 4.3 for the statement "I prefer the flexible time management", a mean of 4.2 for the statement "On-line course is more convenient", a mean of 4.5 for the statement "Overall, I was satisfied with the class and would recommend on-line mode to my friends" and a mean of 4.6 for the statement "Working with classmates and the lecturer through on-line technologies provided exciting experiences".

4.4 Comparison of Course Grades

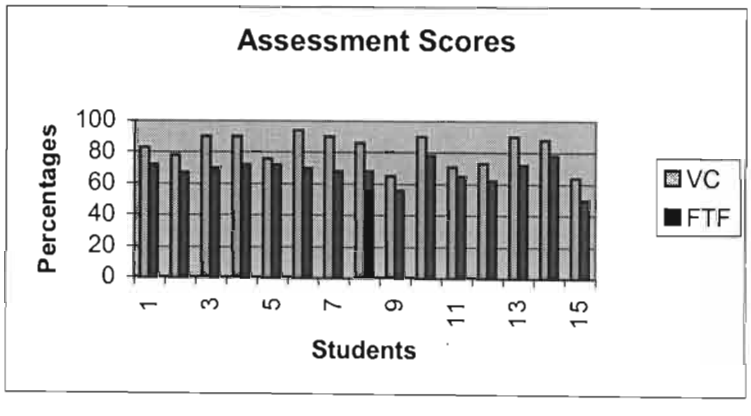
The following table 4 represents student assessment scores for the total face-to-face (FTF) course and the mixed mode course (Virtual Classroom – VC). The same set of students were used in both cases. Students took the FTF course in the first semester of the year. This was offered in the traditional format and totally FTF. They wrote a written examination for which a mark was awarded.

TABLE 4: Comparison of Grades

STUDENTS	ASSESSMENT SCORES	
	VC	FTF
1	83	72
2	78	67
3	90	70
4	90	72
5	76	72
6	94	70
7	90	68
8	86	68
9	65	56
10	90	78
11	71	65
12	73	62
13	90	72
14	88	78
15	64	50
Average	**82**	**68**
Median	**86**	**70**

The following graphs show the comparison of assessment scores for the total FTF course (FTF) and the mixed mode course (VC) .

FIGURE 13



From the above graph (Fig. 13) it is quite evident that the students performed much better in the VC mode of delivery. However, a word of caution since this was a very small sample (15 students). It was felt that the assessment procedures had a profound effect on the way students learnt. In this course the assessment methods used went some ways towards a fair test of constructivist learning. There was no formal written examination, instead there were practical tasks demonstrating competence, an individual essay, a group task and a reflective diary. The sample was too small to do any significant statistical calculations. However, the graph does show a better performance in the VC course.

A discussion of these results follow in the next chapter.

CHAPTER 5

Discussion

5.1 Introduction

To restate the research problem : it is not known how well learners who are used to traditional FTF learning environments will respond to a constructivist learning environment with the use of ALN. The hypotheses tested for this study was that mastery of course material in the VC will be equal or superior to that in the traditional classroom (TC) and that VC students will report a higher subjective satisfaction with VC than the TC on a number of dimensions, including improved overall quality, better use of time and assessing the experience as being better in some way as when compared to TC.

5.2 Five Opinion Types

Five opinion types were identified in the Q study viz: Mode of delivery, Motivation in learning, Self Discipline, Efficiency and Quality of Education and Time and Structure. These opinions can be used to aid educators in reaching their students and increasing the effectiveness of their online courses. At the University of Natal – Edgewood Campus, this insight will have direct impact to the evolution of course materials for offering modules in a mixed mode of delivery. This study was the first to investigate mixed mode learning on this campus. The Department of Computer Science in the Faculty of Education will now use these insights to further develop mixed mode courses.

The five opinion types identified through this study correlate closely with results reported in the literature. All five groups of students, representing the five opinion types (factors) shared in the view that the new mode of delivery was acceptable and beneficial. This was evident in factor one that is "Mode of Delivery". Studies by Maltais and Rondeau (1997) also conclude that "students generally accepted the new format for dissemination and communication of knowledge well".

The Edgewood students also responded positively to the fact that they had more communication with their lecturer as compared to FTF. However it must be noted that much of this communication was electronic. Most students also felt that they learnt better with mixed mode and that VC increased the quality and efficiency of education. This was evident in factor four that is "Efficiency and Quality of Education". The study by Hiltz (1997) also found similar results, "students involved in the mixed modes considered they benefited from better access to their professors and preferred this kind of teaching to the more traditional teaching. Most felt they learned better with mixed mode and that it substantially improved quality of teaching."

The findings of Kapur and Stillman (1997) have a direct bearing on this study. Their conclusion was that, "using the Web as the main source of knowledge communication proved very motivating for students". This ties up with the findings of this study in factor two that is "Motivation in Learning".

All five groups of students, representing the five opinion types, shared in the view that the VC provided flexible time management (factor 5). The studies of Richards and Ridley (1997) and Hiltz (1998) described flexibility and convenience as both reasons students were motivated to enroll in online courses and as the perception of students once enrolled. On the other hand, four of the five groups of students thought the need to pay home phone bills incurred in online education unimportant, whereas Usip and Bee (1998) found that students felt the university should provide financial assistance to offset the associated costs of going online. There is evidence in the literature viz., studies by Guernsey (1998) that support the opinion identified in this study of the need by some students (30%) for face-to-face interaction.

5.3 Positive Aspects

Content analysis of published literature and of websites indicated both positive and negative aspects of the application of technology to online learning. Among the positive aspects documented were that online courses and online education provide greater

flexibility and student convenience; improved access/interaction with the instructor; better grades; and a more positive overall learning experience. The collaborative learning environment seems to better engage students individually in the learning process. Among the negative aspects documented were reduction in face-to-face interaction; concerns over technology and logistics; an increased student workload; and increased costs to the student. The findings of this study through Q methodology and analysis of the completed questionnaires had much bearing on these positive and negative aspects as per the literature.

5.3.1 Flexibility and Convenience

Guernsey (1998) found that a large number of online students were either already registered in regular classes, or were trying to work full- or part-time while earning degrees. Richards and Ridley (1997), found that logistics was the second most common reason for enrolling in online courses. Hiltz (1998), reported that 69% of students felt that the courses in the virtual classroom were "more convenient" than traditional courses. Richards and Ridley (1997), found that online education as the only alternative, and was the third most common reason for enrolling in online courses.

In this study factor 5 (Time and Structure) further confirm the above findings. Participants strongly agreed with statement 18 from the Q-Sample – "Provides flexible time management". Analysis of the questionnaire revealed that 80% of participants agreed with statement 12 : "I could stop VC when I was busy with other things". One hundred percent agreed with statement 16 "On-line course is more convenient". Ninety three percent of participants agreed with statement 24 "I prefer the flexible time management". In this study students were forced into taking the on-line course. However, it is hoped that students will in future be willing to do so on their own because of the above findings.

5.3.2 Access/Interaction with Instructor

Students perceive that they receive more individual attention from instructors (Guernsey, 1998). Studies ("Lucent Technologies Centre for Excellence in Distance Learning" (CEDL), 1999) have shown that student attitudes to
ward online education can be significantly affected by facilitating some degree of interaction among students and teachers. Hiltz (1998), found that 71% of students who had just completed an online course felt that asynchronous learning networks provided better access to their professor.

In this study, four of the five opinion types (factor groups) agreed with statement 5 from Q-sample: "I had more communication with the lecturer than FTF". This statement was repeated in the questionnaire and 80% agreed with it. Even though this communication was electronic, students preferred this rather than FTF.

5.3.3 Better Performance

Students perceive that they would get better grades than in a face-to-face course (Guernsey,1998). Koch (1998) states that online education students earned higher grades than students in conventional versions of the same classes. Usip and Bee (1998) found that students who participated in web-based instruction felt that they improved their course performance.

In this study students agreed with statements 4 and 10 from the Q-Sample : "I learnt more because of the use of VC" and "I prefer this type of assessment as compared to a written exam only. From the response in the questionnaire, 60% responded positively to statement 8 viz. " I believe I have learned in this on-line class as much as I would have learned in a FTF class". Again the mode of delivery and the structure of the course feature strongly. The findings from the questionnaire and the Q-study support each other quite strongly.

5.3.4 Collaborative Learning Environment

Barreau *et al.* (1993) found that students reported they formed good working relationships, felt equality in their contributions and felt that groups enabled them to produce higher quality projects. Students prefer engaging in small group discussion or

interactive question and answer as opposed to viewing lectures (CEDL, 1999). Hiltz (1998), found that only 15% in his study did not "feel more involved in taking an active part" in a virtual class; and that 55% felt more motivated to work hard on their assignments because others would be reading them. Hiltz (1998), also found that only 20% agreed with the statement, "I would not take another online class," while 52% disagreed. Asynchronous learning environments allow more time to compose responses to questions (Jaffee, 1997).

In this study the following statements from the questionnaire have bearing on this positive aspect. "Working with classmates and the lecturer through on-line technologies provided exciting experiences". Most of the participants (74%) strongly supported this statement while 13 % agreed and the other 13% were neutral. "Overall, I was satisfied with this class and would recommend on-line mode to my friends". Eighty percent of participants agreed with this statement. "I participated actively in class discussions". Eighty seven percent of participants agreed with this statement. "I felt more involved because of the mode of delivery". Sixty seven percent of participants agreed with this statement. "I was motivated because others read my assignments". Only 34% agreed with this statement and 33% were neutral while 33% disagreed. Since the course did force students to work together, especially in group work, students seem to have enjoyed working with their peers.

5.3.5 Positive Learning Experience

Barreau *et al.* (1993) state that students found the time spent on class (1-27 hours per week) was worthwhile. Barbrow *et al.* (1996) and Foell and Fritz (1995), found that students overall attitudes toward computers in online education classes were positive. Those who have taken online courses have generally responded positively to the experience and would recommend it to other students (CEDL, 1999). Richards and Ridley (1997) found that 79% of students rated their experience in online courses as "excellent" or "good." Hiltz (1998) reported that 58% of students felt that the virtual classroom increased the quality of education (20% felt it did not).

In this study 80% of students said that they will recommend on-line mode to their friends. Seventy four percent felt that VC increased the quality of education and the balance (26%) was neutral. Three of the five opinion types showed a very strong (+3) belief that VC increased the quality of education. The other two opinion types were neutral.

5.4 Negative Aspects

5.4.1 Limitations on Interactivity

Guernsey (1998) states that younger students had difficulties with online courses and felt that they needed to be with a "live person". Larson (1999) cites some students' need for face-to-face interaction. Hiltz (1998) reported that the majority (59-64%) of students felt that they made new friendships in courses with a face-to-face element, whereas only 33% of the virtual classroom-only students agreed.

Contrary to previous literature, in this study, 87% of students disagreed with the statement " I felt frustrated sitting alone in front of a computer". Sixty seven percent of students felt they had made new friendships during this course. Only 33% felt they would like to take this course in a FTF mode, while 47% disagreed and the balance (20%) were neutral. I think that the fact that these students were exposed to a mixed mode for the first time, does have some bearing on the findings. It will be interesting to find out how they feel after a number of mixed mode courses.

5.4.2 Technological Problems

Students new to a particular technology may initially exhibit some concern about the role of technology in the learning experience. If this occurs, these students typically demonstrate a reluctance to actively participate in the online classroom areas (CEDL). Mastrian and McGonigle (1997) found that the most frequent negative comment related to the overall experience was the early frustration with the use of the computer.

In this study 73% of students felt that they needed some basic skills in computer troubleshooting. This may have been has a result of some frustrations during the course. There were some technical hitches during the course viz. poor radio link between Edgewood and the Durban campus as a result of bad weather. There were times that the server was down.

5.4.3 Increased Workload

Barbrow, Jeong, and Parks (1996) found that students' attitudes were positive with the exception of the amount of time it took to learn new software. Gifford (1998) stated that the majority of students felt that more time was spent on the Internet-based class than in the regular classroom. Hiltz (1998) reported that only 13% of students in the virtual classroom agreed (67% disagreed) with the statement, "I didn't have to work as hard for the online class". Barreau *et al.* (1993) reported that students sometimes felt overloaded with information; Guernsey (1998) found that students felt online courses required more work.

In this study 33.3% of students agreed, 33.3% of students disagreed and 33.3% of students were neutral to the statement " I did not need to work as hard as FTF". In many students reflective journal they felt that they needed more time at the beginning to familiarize themselves with WEBCT. Some students felt they worked harder because of the short space of time as compared to FTF.

5.4.4 Lack of Logistical Support

Larson (1999) has found that lack of availability of course resource materials was a negative aspect of online learning. Hiltz (1998) found that 40-50% of students had difficulty accessing course materials due to busy signals at the dial-in. Hiltz (1998) also reported that 52% of virtual students felt that it was easier to fall behind in virtual classes due to the ease of postponing or procrastinating.

In this study students felt that they needed more technical support at the beginning. This may be as a result of the fact that they were exposed to WEBCT for the first time.

5.4.5 Costs

Usip and Bee (1998) found that students who chose not to take advantage of auxiliary materials placed on the Web felt that the university should provide financial assistance to offset the associated costs of going online. Hiltz (1998) found that 13% of students indicated that access to a PC was a serious problem. In this study 33.3% of students indicated that access to a PC at home was problematic. Only one of the five opinion types indicated that paying home phone bills was a great concern. These students may not have needed to use their computers from home since they had ample time on campus to get online in any of three student LANs. These students had to come to campus for other FTF courses as well.

5.5 Course Management Tips

From my experience with this course I would like to leave course instructors with the following advice; log into your courses on a scheduled basis, especially frequently at the beginning of the semester. Students will be wondering who is out there and the instructor can help by responding right away. This gives students a sense of security and lets them know everything is functioning correctly. Setting and maintaining a regular and consistent log-on schedule is very important and though the instructor's responsiveness is critical, the expectations and workload should be realistic; respond to all student e-mail immediately. E-mail should only be used for private communication between student and instructor. If the message is not private in nature instructors should ask the student to post it in the appropriate place in the course; check for, and respond immediately to, any student queries in the course itself; grade and return evaluated assignments to students as quickly as possible; check to see that students are responding in the appropriate locations in the course and address any problems that may arise immediately. Keeping a course tidy and free from problems, false starts, or empty student documents created by accident

keeps the "classroom" running smoothly, cleanly, and free of potential sources of confusion.

On-line courses are, by nature, learner-centered and can have more active participation by all students in the class than in a traditional classroom. Without the structure of weekly classes, students are generally expected to take a more active role in their own learning. A fundamental difference is that instead of simply showing up to make their presence known, in an on-line class students must do something, for example submit an assignment, ask a question, participate in a discussion, etc. Opportunities for these interactions with the course materials, with the instructor, and with other students must be designed into the on-line classroom.

On-line courses differ from traditional classroom courses in several ways. Since students do not have non-verbal cues or the ability to raise a hand to ask questions, learning activities, instructions, and writing must be clear. One must assume nothing and anticipate and address student questions. Those course designers that are able to assume the perspective of the student as they design their courses and activities are better able to be sensitive to these issues and to create effective on-line learning environments.

An effective learning environment consists of well-organized and complete orientation and syllabus information that begin a course and are essential to help orient the students to the course, the instructor, and to what will be expected. In the design of course materials, one needs to pay special attention to the tone of your writing and consistency in your module structure, document naming conventions, and instructional cues. Explicit orientations to each module with due dates, time frames, and details about what the module contains, as well as redundant, clear, explicit expectations and instructions are necessary to ensure students are at all times well oriented to the content, activities, and tasks in the course. One should design and create as many possibilities for student interaction as possible, both with the instructor and with others in the class.

5.6 Conclusion

The hypothesis "mastery of course material in the virtual classroom will be equal or superior to that in the traditional classroom", tested true for this sample.

The hypothesis, "VC students will report higher subjective satisfaction with the VC than the TC on a number of dimensions, including improved overall quality, better use of time, convenience, and whereby the student assesses the experience as being 'better' than the TC in some way, involving learning more on the whole", has also tested true for this sample. An examination of the factors produced from the Q-study and the analysis of the data from the questionnaires supports this.

Based on the student responses to the statements in the questionnaire, the results of the Q study and the reports in their reflective journals this study can be considered as a success. All of the fifteen students achieved higher scores in the VC as compared to the total FTF. However, one must take note that the sample was quite small and the form of assessment was different. It may be that many students do not perform well in a formal written examination because of the stress that formal examinations bring with it. Students did report higher subjective satisfaction with the VC on a number of dimensions viz. improved overall quality, better use of time, convenience and on-line technologies provided exciting experiences.

Despite the small sample size this study has provided valuable information about mixed mode delivery. All of these will be considered when converting existing total FTF modules to mixed mode modules in the Department of Computer Science. It is quite apparent that students do find the course material interesting because of the mode of delivery. Many are also motivated to work hard because of the mode of delivery and structure of the course. It was pleasing to note that students felt that the overall quality and efficiency of education had improved because of the mixed mode delivery. It was also very pleasing to note that the findings of this study was very much in-keeping with existing literature.

If mixed mode delivery in a constructivist environment can ensure that students are motivated to work, then we as educators must try to provide this type of environment for learning. One of the major concerns of educators today is the lack of self-motivation from students. It may be that students are tired of the old traditional way of doing things. It seems that the answer lies with technology and constructivism.

Instruction on-line accentuates the "student as a worker" and the "teacher as a coach" paradigms. The role of the instructor/facilitator becomes one of preparing the instructional environment and anticipating needs of students in advance and providing contingencies. Instructors respond to and accommodate learners in assisting them to develop their own meaning for the material rather than interpreting it for them. This poses a real challenge to traditional practice. If on-line learning (mixed-mode) is to be successful, it is a paradigm shift that must be made.

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APPENDIX A

PARTICIPANTS' Q-SAMPLE STATEMENTS

VC – Virtual Classroom ; FTF – Face-to-Face

1. Course content was interesting because of mode of delivery.
2. VC increased the quality of education.
3. VC increased the efficiency of education.
4. I learnt more because of the use of VC.
5. I had more communication with the lecturer compared to FTF.
6. There was no need to work as hard as in a FTF mode.
7. I was motivated to work harder because others read my assignments.
8. Reading others assignments was very useful.
9. Less sense of self-assessment in comparison to others.
10. I preferred this type of assessment as compared to a written exam only.
11. Fewer subtleties in teaching - instructor observation, speech, inflection, and immediate feedback.
12. Fewer opportunities to meet new people - social interaction.
13. Less enrichment from other perspectives.
14. Less informal learning - side comments by teacher and students.
15. Less discussion with participants.
16. Sometimes hard to find quiet time at home.
17. Sometimes computer time hard to get at home.
18. Provides flexible time management.
19. Potential interference with other obligations.
20. If all courses were online, saves travel time.

21. Can work at home when I want.

22. Trouble getting access to Internet at home.

23. Requires basic skills in computer troubleshooting.

24. Must pay home phone line costs.

25. Access to Internet only through campus was problematic.

26. No set class time was problematic.

27. Requires self-discipline.

28. Requires active learning and initiative.

29. You'll sure learn to use the Internet.

30. Can learn at my own pace.

Example of final Q-Sort

26	13	19	12	3	30	21
9	14	6	17	4	29	28
11	15	7	20	5	1	18
X	16	25	22	8	2	X
X	X	27	23	10	X	X
X	X	X	24	X	X	X

APPENDIX B

CONDITIONING OF INSTRUCTION

You are required to read through the Q-SAMPLE statements.
Which issues are important or not so important to you when thinking about the online mode of delivery as compared to a total face-to-face mode of delivery of your course?
The goal of this study is to help us understand and incorporate your needs and concerns into the planning and implementation of new ways of delivering education to you.
The objective here is to sort the statements along the continuum from the ones that are *Most Important* to the ones that are *Least Important* to you.

1. Look at all the opinion statements to familiarize yourself with the range of issues.

2. Sort the issues into 2 piles. One should contain the statements that you find *Important* in one way or another - for any reason. The other pile contains those statements that you find *Not Important* for any reason. The piles do not have to contain equal number of statements.

3. From the pile of statements you find *Important,* select the three items (only 3) that you *find Most Important.* Place them in a three-item column at the extreme right hand side of your workspace.

4. From the remaining *Important* pile, select four (4) more issues that are now more important to you than the others in the pile. Place these 4 statements in another column just to the left of the three already selected in step 3 above.

5. Next, select from the remaining *Important* pile the five (5) statements that you now feel are *Most Important.* Place these 5 statements in another column just to the left of the four already selected in step 4 above.

6. Next, select from the remainder of the *Important* pile the six (6) statements that you now feel are *Most Important.* Place these 6 statements in another column just to the left of the five already selected in step 5 above.

If you have run out of statements in the *Important* pile and cannot finish step 6, proceed immediately to the next step.

If you have extra unsorted statements at the end of this step, combine the extras with the *Not Important* pile and go on to the next step.

7. Now, work with the pile of statements you feel are *Not Important.* Begin by selecting the three (3) statements you find *Least Important.* Place them in a three-item column on the far-left side of your work area.

8. From the remaining *Not Important* pile, select four (4) more issues that are now less important to you than any others in the pile. Place these 4 statements in another column just to the right of the three already selected in step 7 above.

9. Next, select from the remaining *Not Important* pile the five (5) statements that you feel are *Least Important*. Place these 5 statements in another column just to the right of the four already selected in step 8 above.

10. Place the remaining 6 issues in the middle of your grid. (They may already be there)

11. Now, look at your arrangement. Feel free to move issues around to make sure that your opinion is reflected correctly.

12. When everything is sorted as you want it to be, write the statement numbers in the blank boxes in the grid on your answer sheet and answer the remaining questions on the form.

APPENDIX C

Questionnaire for on-line course in Data Communication

For each statement, please fill in ONE response that indicates the extent to which you agree or disagree with the statement. The scale ranges from :
1 = STRONGLY DISAGREE to 5 = STRONGLY AGREE.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

NB: All statements relate to the on-line mode of delivery of the course.
VC- Virtual Classroom FTF – Face-to-Face

STATEMENT	RESPONSE
1) I had problems with access to a PC.	
2) I developed new friendships during this course.	
3) I was frustrated sitting alone in front of a computer.	
4) I had more communication with the lecturer compared to FTF.	
5) Working with classmates and the lecturer through on-line technologies provided exciting experiences.	
6) Technical problems were barriers when taking this class.	
7) The instruction was well designed to keep up with the schedule.	
8) I believe I have learned in this on-line class as much as I would have learned in a FTF.	
9) If possible, I would prefer taking this course in a FTF mode.	
10) Overall, I was satisfied with the class and would recommend on-line mode to my friends.	
11) It was difficult to maintain self-discipline in learning in this on-line mode.	
12) I could stop VC when I was busy with other things.	
13) Course content was interesting because of mode of delivery.	
14) I participated actively in class discussions.	
15) Course was a waste of time because of mode of delivery.	
16) On-line course is more convenient.	
17) I felt more involved because of mode of delivery.	
18) I was motivated because others read my assignments.	
19) Reading others assignments was very useful.	
20) I did not need to work as hard as FTF.	
21) VC increases efficiency of Education.	
22) VC increases the quality of Education.	
23) There was less enrichment from other perspectives.	
24) I prefer the flexible time management	

25) No access at home was problematic.	
26) VC requires basic skills in computer troubleshooting.	
27) On-line mode is what this institution should be focusing on in all subjects.	

For each technology/tool listed below, please fill in ONE response that indicates the frequency with which you used them before taking this class. The scale ranges from 1 = NEVER to 5 = DAILY

Never	Few times	Monthly	Weekly	Daily
1	2	3	4	5

TECHNOLOGY	**RESPONSE**
1) E-mail	
2) WWW	
3) Newsgroups	
4) On-line Text Chat	
5) WEBCT	
6) Mind-map	

Please indicate your gender. Tick the appropriate block.

MALE	FEMALE

Thank you for your participation in this research. You will be given an opportunity to read the findings/results of this research.