RESEARCH REPORT

INVESTIGATION OF VIRTUAL LEARNING BEHAVIOUR IN AN EASTERN CAPE HIGH SCHOOL BIOLOGY COURSE

by

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DECLARATION

I declare that I have properly edited this manuscript for grammatical and spelling errors as well as all other aspects pertaining to language usage.

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INVESTIGATION OF VIRTUAL LEARNING BEHAVIOUR IN AN EASTERN CAPE HIGH SCHOOL BIOLOGY COURSE

ABSTRACT

Transformation in education over the decades has failed to keep abreast of the rapidly advancing technological environment of modern society. This implies that curricula, learning paradigms and tools employed by educational institutions are not in sync with the technologically oriented lifestyle of modern society. Learners are therefore unable to apply and assimilate their daily life experiences into the learning process.

This disparity warrants radical transformation in education, so as to furnish the appropriate education system where learners are able to construct their knowledge on the basis of pre-existing ideas and experiences.

However, any transformation in the education approach should essentially be complemented by the adoption of appropriate learning environments and paradigms that can capitalize on learners' life experiences as well as elicit the appropriate learning behaviour and attitudes for effective and life-long learning.

Much of the literature reviewed affirms the efficacy of virtual learning environments as mediums that can facilitate effective learner-centred electronic-learning suitable for modern society. They are asserted as liberators of learning in respect of instructivist ideals, information access and the confines of the physical classroom. This is confirmed by findings of this research, which are generally in favour of the virtual learning environment's ability to enhance the learning experiences of learners but remained inconclusive on their learning outcomes.

CHAPTER 1: INTRODUCTION

1.1 <u>Motivation</u>

The technology revolution has transformed every aspect of our society, especially the control of and access to information. However, the education system seems to have remained oblivious to the technological transformation evolving outside the classroom. This has opened a conspicuous gap between the process of learning and teaching in schools and the modern ways of obtaining knowledge in society (Strommen, 1992).

This disparity has limited the learners' ability to apply and assimilate their daily life experiences into the learning process. Students therefore perceive school as rigid, boring and estranged institutions oblivious to attributes of their personal significance. Strommen (1992) proposes that what is needed is a guiding philosophy that suggests principled changes in the curriculum, and effective uses of technology as part of these changes.

Many educators are products and disciples of the instructivist learning approach and still employ the same teaching-learning paradigms used on them decades ago. It is therefore imperative that an appropriate educational approach be sought, where the curricula advocate for a shift from instructivist to constructivist learning paradigms.

Constructivism advocates for a learner-centred approach where a learner actively constructs knowledge and creates new ideas based on pre-existing knowledge and experiences, by assimilating them into the new learning experience. The educational

application of this philosophy requires curricula that match the learners' understanding, fostering growth and development. This involves play and exploration, which are self-structured and self-motivated processes of learning and encourage children to reflect on their ideas (Strommen, 1992).

1.2 **Background**

Society has relentlessly pursued technological tools that can facilitate learning relevant to its ever-changing lifestyle. This has involved the quest for electronic learning tools that can exploit learners' collaborative potential as well as life experiences. Gilbert et al (2000) contends that technology offers opportunities for learner-control, increased motivation and connections to the real world.

Ideal learning environments must provide learning tools that can simulate and exploit learners' social experiences in the learning process. Previous attempts to exploit electronic mediums such as the television yielded minimal success. Owston (1997) contends that it was initially envisaged that educational television would possess the necessary characteristics that would lead to improved student learning, but has unfortunately proven to be marginal.

The stand-alone computer also encountered the same fate due to its inability to support collaborative learning, which according to Strommen (1992) enables students to share the process of constructing their ideas, instead of simply labouring individually. He further contends that the collective effort enables learners to reflect on and elaborate

not just their own ideas, but also those of their peers hence shifting their perception of peers as competitors to that of resources.

The integration of telecommunication and the computer generated the networked-computer, which greatly enhanced its potential as an interactive and resourceful learning medium. This notion is also supported by Berge and Collins (1995a: 6 -12) who contend that the active environment provided by a computer with access to local, national and international resources and networks increases interaction and communication among students, their teachers, peers, parents and other members of the world community.

1.3 Research Problem

The objectives of learning paradigms based on the constructivist philosophy can amicably be realized through the use of virtual learning environments, which can capitalize on learners' life experiences.

Virtual learning environments are replicas of classroom environments but with the added advantages of computer-mediated communication tools that enhance interactive and collaborative learning by promulgating a collection of cognitively oriented learning paradigms. "Sandy and Oleg (1999) define virtual learning environments as learning management software systems that synthesize the functionality of computer-mediated communications" like e-mail, bulletin boards, chats and on-line methods of delivering course materials.

Virtual learning environments are capable of nurturing learners' active cognitive abilities by providing a supportive environment in which they can individually and collaboratively create their own ideas. They are asserted to engross learners through their multi-media facets that induce the learners' use of multi-sensory attributes as well as encourage them to seek for new knowledge and skills on the basis of pre-existing knowledge.

Many pre-tertiary institutions (K-12) have the capacity to adopt virtual online-learning as a complementary learning paradigm, but are still skeptical and reluctant to embrace this innovative paradigm despite its asserted aptness to educating modern society. This reluctance can be attributed to factors such as the incompatible education curricula, which are difficult to implement via the computer-based learning paradigm. Other factors could be the affordability and lack of relevant technical personnel as well as knowledge to maintain a computer-based learning infrastructure.

Educationists are also finding increasing difficulty in considering the adoption of virtual online learning due to the sparse research-based data on its viability. Owston (1997) concedes that evidence of how web-based classrooms can promote learning is not forthcoming. This is supported by Gilbert et al (2000) who contends that research on technology's effectiveness and educational uses is sparse and in some cases disappointing in quality.

1.4 <u>Research Objective</u>

The objective of this research project is to provide data on the viability of virtual learning environments as mediums that induce learning behaviour appropriate for a

learner-centred e-learning approach, suited to the lifestyle and aspirations of modern society. Gilbert et al (2000) contend that research-based data helps to inform educators, policymakers, school administrators, school technical coordinators, and researchers about making research-based decisions regarding the most beneficial approaches to technology use in K-12 educational settings in the 21st century.

Previous research studies into students' perspectives of web-based learning environment have yielded mixed results with some aspects of the virtual learning environment remaining inconclusive. Chin (1999) asserts that web-based learning environments enhance the students' learning experiences but not learning outcomes. He further concludes that much research is still needed to extend the capabilities of the Internet and its use in enhancing students' learning.

CHAPTER 2: THEORY SECTION

2.1 <u>Introduction to Theoretical Principles</u>

Effective learning paradigms must be grounded on sound educational theories, whose principles form the basis of learning in the designing and implementation process. This ensures that the learning process is guided as well as applying that which is scientifically known and proven of how people learn most effectively.

Learning theories provide information on what should be done as well as how it can be achieved, hence annihilating the process of trial and error experimentation in learning and teaching. It is therefore imperative that a learning environment assimilates and exploits pertinent principles of education theories, which can facilitate the realization of learners' full potential.

Many educational theories outline how effective learning can be achieved, mainly on the basis of human physiology, disposition and lifestyle (culture). Accommodation of such diverse foundations can holistically be achieved through the use of technology, which has the capacity to captivate learners through rich and real multi-faceted interactive learning experiences. McManus (1996) contends that the desire for multiple perspectives and knowledge crisscrossing is well supported in the Internet environment, especially using the hypermedia of the World Wide Web.

2.2 <u>Education Theories</u>

According to McManus (1996) there are two main theoretical disciplines of educational theories. The first is the objectivists' (instruction) theoretical discipline, which unfortunately disregards the influence of individual learners' disposition and prior knowledge on their learning experiences and outcomes. This discipline is educator-based, whereby the educator initiates teaching and drills the learner. The second is the constructivists (construction) principle represented by the Hypermedia Design Model, which is based on Spiro's Cognitive Flexibility Theory.

Virtual learning environments are grounded in constructivist principles of (Bruner, 1973), whose ideologies are based on learning theories of such authors/educationists as Spiro et al (1988), Pask (1975) and Salomon (1991). These theories advocate a learning environment that facilitates the learner's construction of new knowledge by assimilating new information to simple, pre-existing notions, and modify their understanding in light of new data. Conway (1997) contends that this ideology emphasizes the significance of encouraging learners to discover principles by themselves through active engagement and interaction within a social learning environment.

Learning occurs in a social context, which Vygotsky (1978b) supports by asserting that cognitive development results from a dialectical process whereby a child learns through problem-solving experiences shared with someone else, usually a parent or teacher and sometimes a sibling or peer. He further contends that interactions with surrounding culture and social agents, such as parents and more competent peers, contribute

significantly to a child's intellectual development (social constructivism). This is quite evident in the way juveniles' vocabulary and accent reflects the influence of their rearing environment.

In Vygotsky's social cognition model (1978a), he contends that "culture is the prime determinant of individual development hence children develop in the context of a culture". This is also supported by Gardner (1993) who emphasizes the cultural context of multiple intelligences by asserting that "each culture tends to emphasize particular intelligences". Therefore, this implies that any paradigm that disregards the influence of culture and material relevance on the learning process, limits the learners' ability to integrate real-world social experiences into their learning, hence suppressing their development of logical insight into how they think as well as their capability to fit real world issues and new knowledge into perspective.

2.3 Application of Theories

Technology has provided computer-based learning paradigms grounded on constructivist ideologies in which learners are able to actively construct their knowledge, rather than simply absorbing ideas transmitted by educators or by memorizing them. This notion is consistent with Piaget's theory of cognitive development (Piaget, 1980), which contends that humans cannot be given information, which they immediately understand and use, but must instead construct their own knowledge on the basis of what they already know. It would be very presumptuous of an educator to expect students to effectively learn how to read without prior knowledge of the alphabet and basic vocabulary.

The principles of constructivism have a direct bearing on all forms of learner-centred paradigms and can be simulated by virtual learning environments, due to their ability to provide real-life learning opportunities via co-operative and individualized environments. In addition to simulations, virtual learning environments have the ability to facilitate advanced knowledge acquisition, while communicative tools like e-mail, chat and bulletin boards enhance social interaction and collaborative learning. Knowledge is asserted to be constructed through our own understanding of our experiences of the world we live in, hence learning takes place through active participation and is a social, collaborative activity.

Therefore, effective learning involves the reorganization of knowledge to accommodate new learning experiences. This notion is supported by the ideology fostered by the cognitive flexibility theory, which supports the use of interactive technology especially in its application in biology studies (Spiro et al., 1988). The multi-media facet of virtual learning environments enables learners to exploit differing forms of intelligence for their learning through the utilization of words (linguistic intelligence), numbers (logical-mathematical intelligence), graphics (spatial intelligence), sound (musical intelligence), self-reflection (intra-personal intelligence) and social experience (interpersonal intelligence).

According to Gardner (1993), the implication of the multiple intelligence theory is that learning and teaching should focus on the particular intelligences of each learner. This probably explains why students tend to excel in learning areas where they are greatly endowed with specific intelligences. Conway (1997) also contends that giving students

a chance to share a wide range of intelligences adds to their confidence and belief in themselves as intelligent and competent learners.

Curricula, learning paradigms and tools should be aimed at facilitating interaction between learners and learning tasks because complete cognitive development requires social interaction. The Internet and WWW are tools potentially endowed with rich multi-sensory interactive features, which can be exploited to facilitate effective social interaction within a learning environment. Social (collaborative) learning through educator guidance or peer collaboration promotes the development of a wider scope of skills than can be attained through individual learning, since peers are utilized as resources rather than perceived as competition to the learner.

Vygostsky (1978b) further contends that children develop in the context of culture, hence schools should reflect the cultural aspects and aspirations of communities in which students live. This notion is quite evident in the new South African curriculum 2005, where fundamental social aspects of South African culture such as the national languages, national constitution and HIV/AIDS awareness have been incorporated. It is therefore imperative that schools adopt learning paradigms such as virtual on-line learning, which can accommodate the cultural diversity of learners.

CHAPTER 3: LITERATURE REVIEW

The indifference and mediocre performance of many high school learners as well as their lack of basic life skills reflects an anomaly in the current education system. This has formed the focus of inquisition for many research studies in an effort to expose the underlying causes as well as formulate solutions to the current adverse educational situation.

Most of the current literature advocates for education reform especially in pre-tertiary institutions (K-12), which constitute the foundation of formal learning as well as the phase at which children build cognitive structures for understanding and responding to physical experiences within their environment (Piaget, 1980).

3.1 Necessity of Education Reform

Technological innovation is accountable for much of the demand for education reform, which Strommen (1992) contends has left educators rushing to catch up. Conway (1997) also concedes that the major problem is that schools have not kept pace with society's expectations and needs for the rapidly changing world of the 21st century.

It is therefore deplorable that current education curricula and paradigms do not exploit, reflect or accommodate learners' modern lifestyle (culture), hence depriving them of the ability to assimilate their life experiences into the learning process as well as relating learning to real-life situations. This cultural and social exclusion is contrary to the

advocacy of learning theories of authors/educationists such as Vygotsky (1978a), Bruner (1973) and Gardner (1993) who advocate for the critical role that experiences or interactions with the surrounding environment play in student learning. According to Vygotsky, culture gives the child the cognitive tools needed for development and these include cultural history, social context and language as well as the modern electronic forms of information access.

The use of networked computers, which do not only deliver content but also facilitate learning, has provided a means of applying principles of learning theories that were previously inapplicable in the traditional classroom. This has induced a shift from the previously instructivist educator-centred to constructivist learner-centred learning paradigms, where learners are acknowledged as not just passive recipients of knowledge but active participants, who are capable of constructing their own knowledge. Berge and Collins (1995a: 6 -12) contend that 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 learning tasks, students have no incentive to construct their own knowledge and little motivation to retain information or transfer its use to novel situations.

The instructivist learning paradigms, which are prevalent in most pre-tertiary (K-12) institutions employ a teacher-centred approach where teachers have control over information, which they disseminate at the time and in the manner, they deem most appropriate to the learning situation. Berryman (1993) contends that objectivists' learning paradigms prompt students to reproduce the right answers to teacher's or test questions but often without real learning. He further contends that control over learning

in the hands of the teacher undercuts the student's development of cognitive management skills, including goal setting, strategic planning, monitoring, evaluating and revising capabilities critical for effective learning. Students develop no confidence in their own ability to learn or in their own sense making abilities and their opportunities to learn from experience are highly constrained.

3.2 Adoption of Constructivism in Education

The constructivist learning approach encourages students to be actively engaged and responsible for their own learning. This ideology also advocates for the inducement of students' ability to solve real-life, practical problems, which requires educators to structure learning around real problems. This encourages students to learn in settings outside the classroom and the school building.

The adoption of constructivism in the new South African Curriculum 2005 implemented through the Outcomes-Based Education (OBE) in pre-tertiary (K-12) institutions has introduced a learner-centred approach, where ideas and interests of learners drive the learning process (Strommen, 1992). Glasser (1990) also affirms that students' basic needs should literally determine how and what they are taught.

University of Pretoria (2003) contends that the main principles underlying an outcomes-based approach to education are "lifelong learning, flexible education and training structures, the integration and transfer of learning and the need to teach towards critical, cross-field and specific outcomes." He further contends that the cross-field outcomes would "promote the development of basic skills such as communication, critical thinking,

problem solving and team work skills, which are necessary for functioning in a changing modern society."

Heinemann (2000) also affirms that the outcomes-based education approach is envisaged to impart and equip scholars with the necessary life-skills for the creation of lifelong learners. It is also quite suitable for accommodating the highly diverse South African society as well as creates a skilled human resource that can sustain a strong South African economy.

3.3 The Quest for Educational Technology

Mathew and Maryanne (2000) contend that the most important factor in any learning environment is to focus on how individuals learn, and then use technology to create that learning. Modern technology has the ability to provide information in interactive, hypertext, and hypermedia formats. These features provide access to the vast Internet and WWW (virtual learning) resources as well as the multimedia presentation capabilities of computers, thus enhancing its potential use in education (Gilbert et al., 2000).

The interactive capabilities of the networked-computer can effectively facilitate learning characterized by active-learner engagement, intensive resourcing and collaboration. Riel and Harasim (1994) also concede that telecommunication and the Internet provide access to a wealth of current information, learner resources and social communities. The ability of learners to access and search for learning resources (information) enhances their understanding as well as interests and also imparts qualities of

efficiency and organization. These attitudes as well as autonomy increase learners' self-confidence, which incites their spontaneous receptiveness towards learning activities and are more active in directing their own learning.

It is therefore regrettable that many wealthy schools with the necessary virtual online learning infrastructure still use computers for only resourcing and execution of projects. They are disregarding their exhilarating capabilities in facilitating a learner-centred education as well as the sharing of knowledge and expertise collaboratively among learners. Gilbert et al (2000) also confirm that many schools use computers merely as tools for learner-centered practices rather than content delivery systems, which cannot help teachers in moving from largely isolated learning activities to applications that involved working in groups. This notion is also affirmed by Owston (1997) who contends that although the emphasis in K-12 education is more on use of the Web for project-based work and resource access than content delivery, the Web's influence on making learning more flexible is not lost in K-12 schools.

3.4 Potential of Virtual Learning Environments

Peat (2000) describes virtual learning environments as "online domains that permit synchronous, collaborative interaction among teachers and students while also providing asynchronous learning resources for individual use by students any time." She further contends that they posses all the advantages of computer-based learning but with the added advantage of access and use over the Internet.

The efficacy of a virtual learning environment hinges on its overwhelming interactive and resourcing capabilities via the Internet and World Wide Web (WWW), which are coupled with an advanced assemblage of interfacing features like text, video, sound and graphics, through which information is presented to and from the learner. Owston (1997) contends that the Web is a tool that fits well with the new virtual learning environment because it empowers students to become part of the Internet community and to take advantage of the wealth of learning opportunities available through the Internet. Berge and Collins (1995a: 6 -12) also affirm that this innovative learning tool encourages students to explore their own interests and become active educational workers, with opportunities to solve some authentic problems.

The Internet and the World Wide Web tools enhance students' learning experiences as well as support both individual and collaborative learning processes, which fosters cooperative effort among learners, active participation and interaction between learners and the facilitator in the virtual classroom.

Murray (1995) defines the virtual classroom as a teaching-learning environment located within a computer-mediated communication system. These virtual classrooms are endowed with and exploit the interactive and repository capabilities for information distribution hence improving the quality and effectiveness of learning. McManus (1996) contends that the two real advantages of a web-based classroom over other media, are its ability to combine the advantages of other media and the Internet's ability to also serve as a content provider, other than just a delivery system.

3.5 <u>Limitations to Virtual Learning Environments</u>

One of the main problems facing many pre-tertiary (K-12) institutions is their inability to afford or sustain the necessary virtual online learning infrastructure. The insurmountable costs of computers, servers, intranet cabling, Internet subscription, software and maintenance leave many underprivileged schools without this learning option. Gilbert et al (2000) also concede that access to the global network of multimedia information and online learning communities require building and maintaining an expensive technology infrastructure.

Mathew and Maryanne (2000) attribute the lack of widespread use of computer-based learning by institutions to:

- Lack of knowledge and skills in creating and maintaining a web-based learning website.

- Reluctance of educators in adopting new paradigms of learning and teaching.

- Lack of resources in terms of time, support, training, and recognition for teachers who wish to pursue new methods of learning.

- Lack of funds and other resources necessary for the development and maintenance of large computer infrastructures.

3.6 Impact of Virtual Learning Environments on Educators

Many educators are skeptical of adopting virtual learning environments for fear of being left redundant and also feel that the instructivist approach still delivers the learning objectives as it did decades ago. They are also reluctant to relinquish their role as the sole owners and controllers of knowledge in the classroom.

Computer-based learning merely transforms the role of the teacher into that of a facilitator, who guides and directs students to appropriate resources, which enables students to develop cognitive management skills, like goal setting, strategic planning, monitoring, evaluating and revising capabilities critical for effective learning. Roblyer et al (1997) contends that the job of the teacher in constructivist models is to arrange for required resources and act as a guide to students while they set their own goals and 'teach themselves'. Berge and Collins (1995a: 6 -12) also affirm that computers are not a threat to teachers but merely change their role to that of providing guidance to help students develop meaningful ways to construct their own knowledge. Computers may however threaten the continued existence of the chalkboard.

CHAPTER 4: THE STUDY METHODOLOGY

4.1 <u>Intervention</u>

This Research study involved the development of a virtual learning environment designed to suit Grade 11 High School Biology students (Appendix C). Available online: http://www.dalecollege.co.za/cyber_classroom/Biology.html

The virtual classroom design was equipped with the relevant qualities necessary for facilitating a learner-centred, self-directed learning approach.

- It provided supportive mechanisms like readings, references and communication tools.

- It gave students ownership in terms of pace, sequence, choice of subtopics and information sources.

- It provided mechanism for follow up through email, discussion and critique activities.

- It provided targets e.g. course and individual objectives

- It was understandable due to the availability of guidelines, explanations and examples.

- It enhanced students' self-confidence by making students accountable for their work and performance.

4.2 <u>Target Population</u>

The target student population consisted of a single group of thirty-two (32) Grade 11

Biology learners, who possessed the following qualities:

- Male of different race groups;

- Relatively the same level of computer literacy;

- Residing in urban areas or school hostel;

- Same age group (16 to 20 years);

- Attending the same school;

- From middle to high-income backgrounds.

This study sample provided the appropriate blend of learner capabilities, disposition,

attitudes, learning styles, culture, social and economic background as well as races.

4.3 <u>Data Collection and Evaluation Methodology</u>

The effective use of the virtual classroom involved more than just executing learning

activities hence its appraisal necessitated an evaluation approach that could provide a

comprehensive understanding of the context in which students operated.

The research study evaluation process therefore employed a mixed method data

collection and analysis procedure (triangulation), which provided a holistic perspective

of the research objectives by eliciting richer, more compelling and reliable findings

primarily based on qualitative and quantitative evaluation methods. The qualitative data supported and explained the underlying meaning of quantitative.

4.3.1 Quantitative Data Collection and Evaluation Methods

This process provided statistically valid generalizations of students' perceptions of the virtual classroom and learning experiences. It also provided a more appropriate way of evaluating the magnitude and frequency of behavioural and descriptive aspects of the research objectives, as well as validating and refuting data pertinent to the influence of the virtual classroom on students' learning experiences and outcomes.

Quantitative Data collection

This involved the collection of data using closed-question questionnaires (appendix A), which students completed at the end of the course to furnish their perceptions of the virtual classroom as well as its impact on their learning experiences and outcomes.

The questionnaire primarily solicited quantitative data with minimal qualitative responses and was constituted of the following nine sections:

Section A was soliciting information regarding the demography of the student population.

Section B was aimed at soliciting students' opinions regarding the virtual classroom's alluring capabilities and usefulness in enhancing learning.

Section C was intended to evaluate the accessibility of computer-based learning facilities.

Section D solicited students' perceptions regarding the usefulness of the Internet and WWW as learning tools.

Section E requested students to evaluate the quality and design (usability) of the virtual classroom (website) as well as its effectiveness in delivering the learning material.

Section F solicited students' opinion regarding the usefulness of the computer-mediated communication tools in the learning process.

Section G was aimed at ascertaining whether students experienced any change in their learning behaviour during the virtual online learning process.

Section H was aimed at probing the influence of students' general demographic profile and disposition on their learning process.

Section I was aimed at ascertaining whether the course facilitator and subject topic had any influence on the learning process.

Section J was aimed at ascertaining whether students experienced learning differently at different stages of the learning process.

Quantitative Data processing

The raw data was checked and found to be devoid of inconsistencies as well as incomplete responses. It was then coded into an analyzable format and entered into the computer for processing.

Quantitative Data analysis

All the quantitative data was then analysed using the SPSS 9.0 (1998) software package by applying a variety of analytical techniques to compare means, test associations, as well as ascertain the strength of relationships between different variables. This involved the use of statistical tests like descriptive frequency tables, cross-tabulation with or without Chi-square, ANOVA, Independent sample T-test. However, the underlying explanations of the significance of the relationships between the virtual classroom attributes and students' learning experiences were provided by qualitative methods.

Analysis of the following general aspects of the research objectives was executed using the following SPSS statistical tests:

Students' demography and capacity to use the virtual classroom as a learning medium

This was determined through descriptive statistical analysis of frequencies with bar chart percentages to ascertain the proportion of students resident in the school-hostel as opposed to home, as well as the magnitude of their perceived interest and capabilities in using computers. Students' ability to access networked computers was also explored using tables of frequencies.

Students' perceptions of the virtual classroom and its attributes

This was explored through descriptive statistical analysis of frequencies of students' perceptions of the appeal and superiority of the virtual classroom, as well as the usefulness of the Internet in the learning process.

The mean, median and maximum of the virtual classroom usability satisfaction was measured through descriptive statistics, in order to ascertain students' perception of its usability in the learning process. Descriptive statistical analysis of frequencies of students' opinions on virtual classroom attributes such as on-screen reading, expressive features and computer-mediated communication were also executed to ascertain their impact on students' learning.

The utilization and usefulness of CMC tools such as email, chat and discussion forum were explored by means of multiple response statistical analysis of frequencies, in order to ascertain their influence on the learning process. A multiple response cross-tabulation analysis without chi-square was also executed to show students' preferences as well as identify any significant relationship between their preferred communication methods and most helpful feature of the virtual classroom.

The relationship between students' preferred communication method and the usefulness of collaboration was investigated by means of a cross-tabulation chi-square test to explore the statistical significant of the relationship.

Students' opinion on their acquired learning behaviour, understanding and recollection

A multiple response cross-tabulation analysis was conducted to ascertain whether students acquired any new learning behaviour as well as the forms of new learning behaviour they developed.

A cross-tabulation with chi-square test was conducted to explore whether there was any statistically significant association between collaborative learning and understanding of the subject matter. It also provided frequencies of students who perceived collaborative learning as useful in their learning process.

The association between understanding and recollection of acquired knowledge was investigated using a cross-tabulation with chi-square test, to ascertain whether the association was statistical significant. It also provided frequencies of students who perceived the virtual classroom as influential in enhancing their understanding and recollection of new knowledge.

Two cross-tabulation tests without chi-square were independently conducted to explore whether there was any statistically significant relationships between acquired behaviour and perceived understanding, as well as recollection.

Students' perception of their satisfaction and achievement in the virtual classroom were explored via descriptive statistical analysis of frequencies. Cross-tabulation tests without chi-square were also independently conducted to explore any statistically significant

relationships between the students' perceived level of computer literacy and acquired behaviour as well as better understanding.

Students' academic performance in the virtual classroom

A descriptive statistical test was conducted to measure the mean, median and maximum of students' performance scores in the experimental course. The difference between the mean marks of hostel and home dwelling students was investigated by means of an Independent sample T-test to ascertain whether it was statistically significant. This provided some insight on whether the residential mode had any influence on students' learning.

A One-way between groups analysis of variance (ANOVA) was conducted to explore differences in mean marks between groups ("No", "Very few" and "Many") of students in respect to their acquisition of new learning behaviour.

The relationship between students' performance groups and their acquired behaviour was measured using a Chi-square, to test whether students' performance and acquired behaviour were independent. Students' opinions on acquired behaviour and understanding as well as recollection were also independently measured using the Chi-square technique, to test whether there was any significant association between these variables. This was aimed at shedding some light on whether students' acquired behaviour had any influence on their understanding and recollection.

The relationship between the usefulness of the Internet and students' performance groups was measured using the Chi-square technique, to test their whether they were

independent in a cross-tabulation. Students' performance scores in the virtual classroom and traditional classroom were also tested using a correlation bivariate test with a scatter plot graph to ascertain whether these two sets of scores were significantly different. This was aimed at determining whether the virtual classroom enhanced students' performance as compared to the traditional classroom.

Students' opinion on general aspects pertinent to virtual online learning

Students' perception of their learning at different stages of the experimental course was analysed through descriptive statistical frequency tests. Cross-tabulation with Chi-square tests were independently executed to establish any significant relationships as well as impact of students' learning styles on their understanding, recollection and performance.

Students' acquisition of new knowledge and retention in the virtual classroom was reflected through their performance score, which were envisaged to be reciprocal to students' understanding and knowledge retention.

4.3.2 Qualitative Data Collection and Evaluation Methods

The qualitative method provided a better understanding of the context in which the research study operated, hence providing insight into students' perceptions of the virtual classroom. The qualitative analytical methods furnished means of discerning, examining, comparing and contrasting as well as interpreting meaningful patterns and themes with respect to the efficacy of the virtual learning environment as well as

students' learning behaviour associated with a learner-centred virtual learning paradigm.

This process entailed the use of in-depth interviews (appendix B) of individual and groups (focus groups) of students as well as structured interviews using open-question questionnaires. Group interviews (focus groups) constituted two to four students synchronously responding to a limited set of pre-established questions in a social context. More qualitative data was furnished through participatory observation by the facilitator.

The use of individual or group interviews was determined by the availability of students, social groupings as well as individual students' disposition such as speech impediments and shyness. The small size (2 to 4) of students' groups was aimed at making the data recording process more manageable through the use of note taking, which was backed up by a tape recording of the interview.

The qualitative data collected through questionnaires (structured interviews) and the oral in-depth interviews was analysed using the QSR NVivo software package. Various analytical techniques were used to explore the following aspects:

- The patterns and common themes, which emerged in responses dealing with specific aspects of the virtual online learning process and students' learning experiences;
- Ways in which the patterns provided insight into students' learning behaviour;

- Deviations from common patterns as well as the causal factors of these response anomalies;

- Interesting accounts that emerged from responses and their implication on virtual online learning;

- Whether displayed patterns necessitated the collection of additional data or revision of study questions; and

- Whether emerging patterns collaborated results of previous studies as well as endeavored to explain the inconsistencies.

Systematic explication of the qualitative data involved the following procedures:

Data Reduction: This entailed the organization and meaningful rearrangement of the data by:

- Examining of data to elicit its general meaning;

- Summarizing, coding and disintegrating of data to isolate and determine sections that are pertinent to students learning experiences;

- Examining data within the context of the research process by considering the intentions, processes and events surrounding the students' use of the virtual classroom, hence eliciting the meaning behind the data;

- Grouping of information relevant to the research according to its meaning, hence creating new logically arranged information pertinent to students' learning behaviour.

The data coded into various nodes was then queried using QSR NVivo to elicit meaning and explanations to students' perceptions of virtual online learning.

The data queries involved node lookups to identify text patterns in students' perception of their learning experiences such as changes in their learning behaviour, perceived achievements. Virtual classroom attributes such as the usefulness of the Internet as a learning tool, computer mediated communication and usability were also queried.

Boolean searches were also employed to elicit logical associations between the coded data and students' demography. This involved determining whether and how students' perceptions of their acquired learning behaviour, achievements, performance, understanding and learning styles were applicable to all students or confined to specific groups of students.

Determination of whether and how students' perceptions of virtual learning attributes like active engagement, Internet, WWW, computer-mediated communications (CMC), collaborative learning, flexibility, independence and computer learning tools varied among students.

Data Display: The data was displayed using text, matrix tables and flow charts to outline critical paths, decision points and supporting evidence that emerged from the data queries.

Participant Observation

The facilitator provided data through direct observation of students' trends, behavioural patterns, performance, collaboration and interaction within the virtual classroom. This provided a holistic perspective of students' behavioural changes as well as peer-to-peer interaction. It also provided the facilitator with direct information, which provided insight and understand of students' limitations as well as frustrations in the virtual classroom.

Display of Qualitative and Quantitative Results

Summaries of data analysis procedures of both quantitative and qualitative (triangulation) methods on specific research question were presented in a format which complements, consolidates and explains opinions expressed by students on that specific subject.

4.4 Subject Content

The subject matter covered by the course was a component of the Grade 11 Biology syllabus hence suiting their level of understanding as well as constituting part of the learners' final examination and continuous assessment.

Due to technical problems and restricted access to the few networked-computers, the stipulated due-dates were not strictly adhered to, hence causing the extension of the experimental course to 7 weeks commencing from the 9th April to the 28th May 2003.

The utilization of the virtual classroom gave the learners an opportunity to experience the qualities of a learner-centred, virtual online learning environment, hence providing them with a foundation on which to base their perceptions and opinions of the paradigm with regards to its influence on their learning behaviour, experiences and outcomes.

CHAPTER 5: RESEARCH STUDY RESULTS

5.1 Inquest Objective

The objective of this inquest was to collect data about students' virtual learning behaviour by soliciting their perceptions and opinions regarding their learning experiences and outcomes in the virtual classroom.

A total of 30 students out of the 32 participants provided responses to the questionnaires and interviews. The quality of the data was examined to ensure that it was devoid of any significant errors that could directly influence the results. This involved checking for extreme values, duplicate cases and missing values. The data was then coded and entered into the computer, where it was analysed using SPSS and QSR NVivo software. The findings from the various sections of the questionnaire, interviews and observation are summarized as follows:

5.2 Students' Demography and Capacity to Use the Virtual Classroom

Age Group

All students were of the same age group of 16 – 20 years

Residence

According to Table 1, only a third (33.3%) of the respondents resided in the school hostel, while the other two thirds (66.7%) resided at home.

Table 1: Where students resided after school

Options	Frequency Count	Percent
Home	20	66.7
School Hostel	10	33.3
Total	30	100.0

Computer Interest and Capability

Figure 1 indicates that all students possessed sufficient interest and capability to use computers although this ranged from moderate (43%), high (33%) to very high (23%).

Figure 1: Students' interest and capability to use computers.
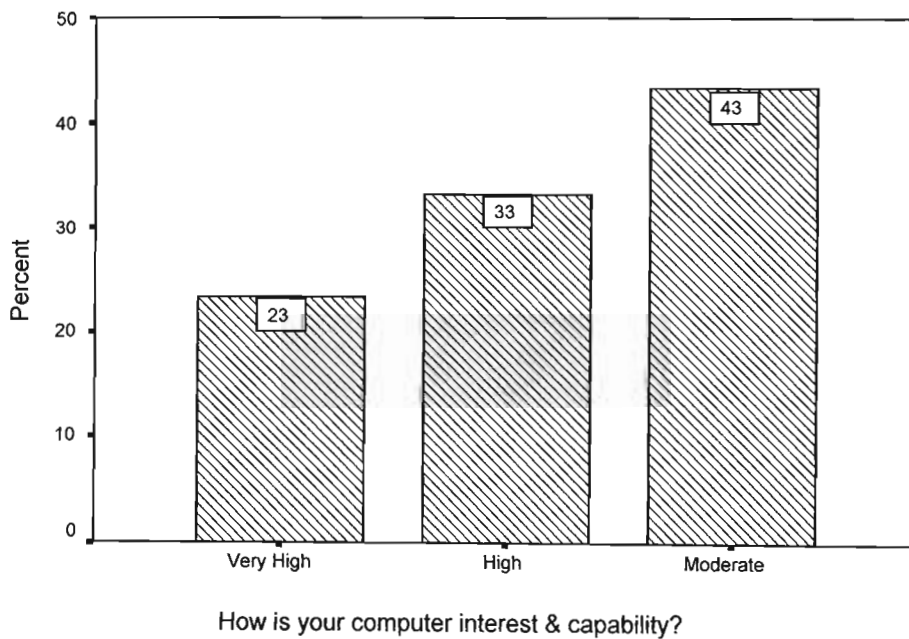
How is your computer interest & capability?

A Chi-square test was conducted to explore any association between frequencies of students who perceived virtual online learning as suited to their learning styles and their perception of the virtual classroom as more interesting.

The Chi square results could not be used because 50% of the cells had expected count less than 5, suggesting that the sample size was too small to report significance. The results also yielded a minimum expected count of 0.87 and a high significance value of 0.104. However results of a cross-tabulation without Chi square showed that among the 17 students who did not perceive virtual online learning to be suited to their learning style, 47.1% perceived it to be more interesting, while 52.9% did not. 84.6% of 13 students who perceived virtual online learning as suited to their learning style also found it interesting.

Another Chi-square test was conducted to explore any association between frequencies of students who perceived virtual online learning as suited to their learning styles and their perception of its superiority over the traditional learning paradigm.

The results indicate a statistically significant Chi-square [x^2 (1, N=30) =6.266, p= 0.012] The frequency (count) of students' perceptions of the virtual classroom's suitability to their learning styles and superiority is shown in Figure 2, which illustrates the statistically significant large proportion of students (13 out of 30) who refuted the virtual classroom's suitability to their learning styles and superiority, than would have been expected had learning styles and superiority perceptions not been associated.

A Phi-coefficient test yielded a relatively median value of 0.457, which signified that the relationship between frequencies of students who perceived the virtual online learning as suited to their learning styles and superior was medially strong.

Figure 2: Frequencies of students' perceptions of virtual online learning's suitability to their learning styles and superiority over the traditional teacher-centred learning paradigm
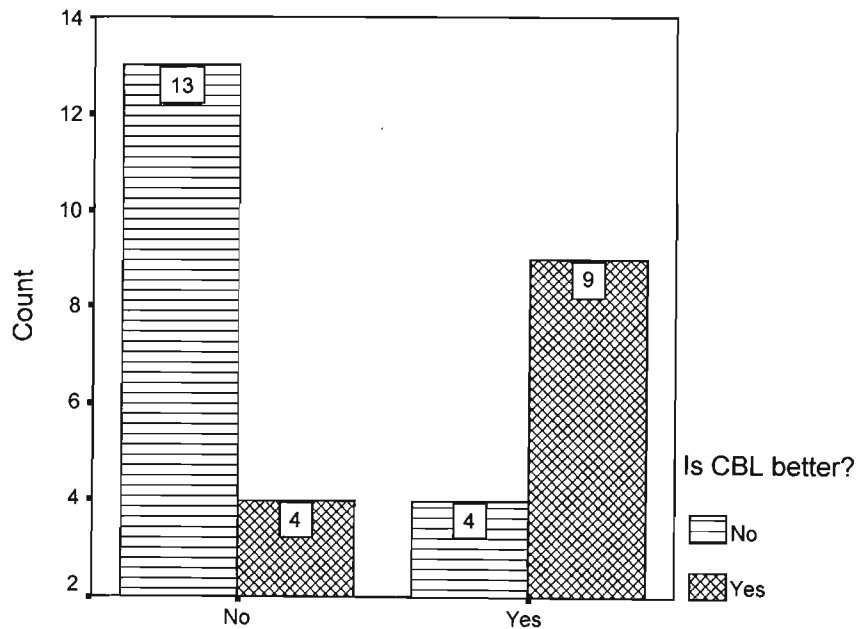
Was virtual online learning suited to your learning style?

(CBL – Computer-Based Learning)

Accessibility of the Virtual Classroom

Table 2 indicates that 40% of the students experienced difficulty in accessing networked-computers, while 60% had easy access to the networked-computers at school or home.

Table 2: Accessibility of networked-computers to students

Options	Frequency Count	Percent
No	12	40
Yes	18	60
Total	30	100.0

Boolean intersection (And) searches showed that home-dwelling students with networked-computers constituted the 'high' performance group and acknowledged the usefulness of accessing the virtual classroom at home.

5.3 Students' Perception of the Appeal and Superiority of the Virtual Classroom

According to Table 3, approximately two thirds of the students (63.3%) conceded that learning via the virtual learning environment (VLE) was more interesting than the traditional classroom. Only about a third (36.7%) disagreed, with none (0%) strongly disagreeing.

Table 3: Students' opinion on whether learning via a VLE is more interesting

Options	Frequency Count	Percent
Strongly Agree	2	6.7
Agree	17	56.7
Disagree	11	36.7
Total	30	100.0

Table 4 indicates that 43.3% of the students did not perceive virtual online learning as superior to the traditional teacher-centred learning paradigm, while 56.7% conceded to its preeminence.

Table 4: Students' opinion on whether learning via the virtual learning environment (VLE) is better than that of the conventional classroom.

Options	Frequency Count	Percent
Yes	13	43.3
No	17	56.7
Total	30	100.0

5.4 <u>Students' Perception of the Internet's Value as a Learning Tool</u>

Figure 3 indicates that the majority of students (97%) conceded to the usefulness of the Internet in the virtual classroom, although to varying degrees. Only 1 (3%) out of the 30 students refuted its usefulness as a learning tool.

Figure 3: Students' opinions regarding the usefulness of the Internet towards their learning

Was Internet linkage useful?
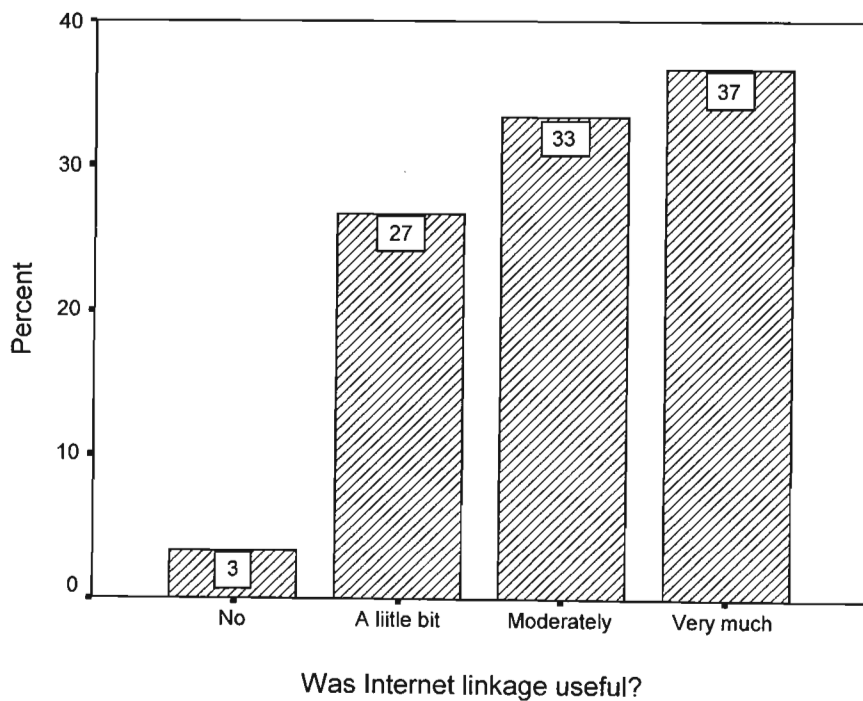
According to Table 5, all the students conceded that it was easier to access information via the Internet than the school library, with two thirds of the students (66,7%) strongly approving.

Table 5: Students' opinions regarding the ease of information access via the Internet

Options	Frequency Count	Percent
Strongly agree	20	66.7
Agree	10	33.3
Total	30	100.0

Table 6, shows that the majority of the students (96.7%) agreed that searching for information via the Internet imparted new skills. The consensus ranged from just agreeing (70%) to strongly agreeing (26.7%) and only one student (3.3%) disagreed with this notion.

Table 6: Students' opinions regarding the acquisition of new skills through information searching via the Internet

Options	Frequency Count	Percent
Strongly agree	8	26.7
Agree	21	70.0
Disagree	1	3.3
Total	30	100.0

A node look-up search revealed that most students perceived the Internet as a very useful source of information but hardly acknowledged its capability as an effective deliverer of learning or facilitator of communication for collaborative learning. A Boolean

intersection (And) search showed that only the few students in possession of home networked-computers experienced the Internet's ability to facilitate learning anytime/anywhere, since they could also access the virtual classroom at home.

Figure 4: Perceived role of the Internet as a learning tool
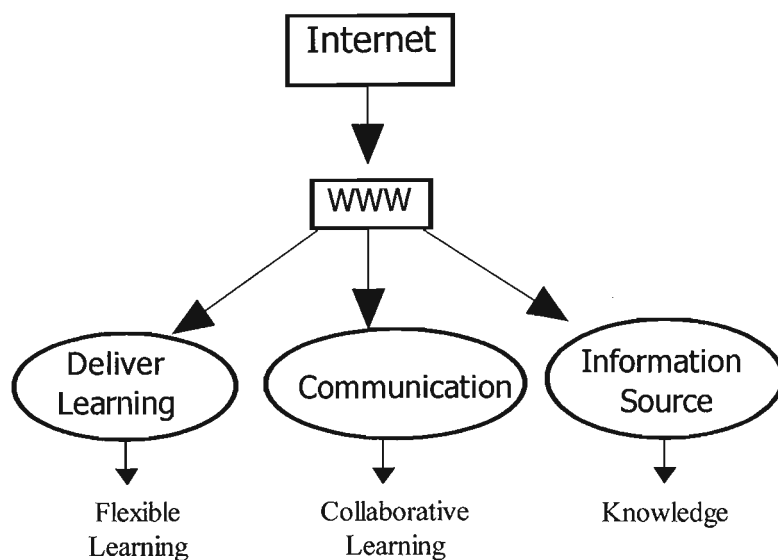
5.5 Students' Perception of the Usability of the Virtual Learning Environment

The results displayed a general approval of the adequacy of the virtual classroom's design and delivery capabilities in facilitating learning. Table 7 indicates that the Total Usability Satisfaction expressed by students ranged from 14 to 20 with a mean of 16.5, which was quite high, since according to the code-key score the minimum was 5 and maximum 20.

Table 7: Descriptive Statistics on the Total Usability Satisfaction

	Total Usability Satisfaction
Maximum	20
Minimum	14
Mean	16.5

5.6 Students' Perception of the Virtual Learning Environment's Features/Tools

Table 8 shows that almost two thirds (63.3%) of the 30 students preferred reading from the computer screen, unlike the 5 students (16.7%) who perceive it to be worse than chalkboard reading. However, 6 (20%) out of the 30 students expressed no preference.

Table 8: Comparison between screen and chalkboard reading

Options	Frequency Count	Percent
Better	19	63.3
Similar	6	20.0
Worse	5	16.7
Total	30	100.0

5.7 Students' Perception of Computer-Mediated Communication and Collaboration in the Virtual Classroom

Computer-Mediated Communication

Table 10 reveals that almost half of the students (43.3%) perceived computer-mediated communication (CMC) as difficult. 11, (36.7) found it easier, while 6, (20%) found it similar to their conventional modes of communication in the traditional classroom.

Table 10: Students' impression of computer-mediated communication (CMC).

Impression	Frequency Count	Percent
Easier	11	36.7
Same	6	20.0
More difficult	13	43.3
Total	30	100.0

According to Table 11, the majority of students (86.7%) used email to submit their assignments, while 14, (46.7%) utilized it to contact their facilitator. Only 7 students (23.3%) used it as a medium for discussing problems with peers.

Table 11: Multiple response statistical analysis of conditions in which students utilized email communication.

Purpose for which Email was Used	Frequency Count	Percent
Contact the facilitator	14	46.7
Submit assignments	26	86.7
Discuss with classmates	7	23.3

Figure 5 indicates that the majority of students found the discussion forum useful towards their learning. These perceptions ranged from very useful (40%), moderate (46.7%) to marginal (10%). Only 1 student (3.3%) refuted the usefulness of the discussion forum towards learning.

Figure 5: Students' perception on the usefulness of the discussion forum towards their learning

Was the discussion forum useful to your learning?
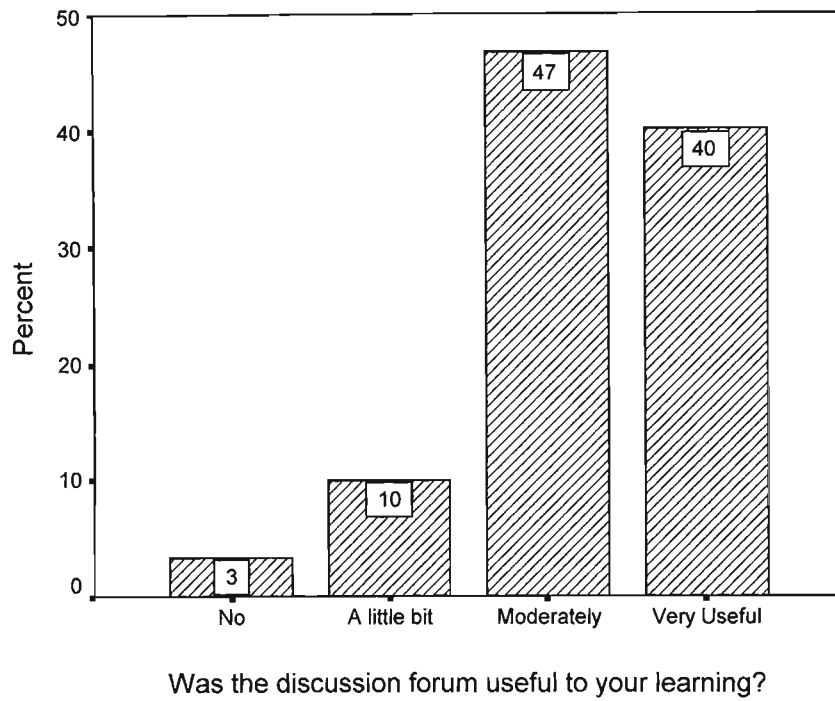
A multiple response cross-tabulation analysis was executed to show students' communication method preferences as well as relationship between their preferred communication methods and most helpful feature of the virtual classroom. Table 12 indicates that 23, (76.7%) of the 30 students conceded that the discussion forum was the most helpful feature towards their learning, while 13, (43.3%) and 15, (50%) identified the email and revising readings, activities and messages respectively. Only 3, (10%) students cited the chat as having been most helpful in their learning.

The table also shows that there were equal proportions of students who prefer email communication (50%) and those who preferred the discussion forum (50%). Only 2, (6.7) out of the 30 students preferred the chat as a communication tool.

The majority of students (12 out of 23) identified the discussion forum as their mode of communication and most helpful feature. While 11 out of 23 students found the discussion forum to be very helpful but preferred the email as their communication tool. The chat was the least popular both as a communication method and helpful feature.

Table 12: A Multiple Response Cross-tabulation of preferred communication method and most helpful virtual learning environment (VLE) feature

Most helpful VLE feature	Preferred communication method			Total	Percent
	Email	Chat	Discussion forum		
Email	10	1	2	13	43.3%
Discussion forum	11	2	12	23	76.7%
Chat	0	1	2	3	10%
Revision of text	7	0	10	15	50%
Total	15	2	15		
Percent	50%	6.7%	50%		

A node look up search revealed that students' perceptions of communication were overwhelmingly positive with emphasis on its facilitation of learning in a social context, where learners were able to share resources, expertise, and knowledge as well as compare their work with that of their peers. One student applauded its usefulness to students with speech impediments e.g. stuttering, eloquence and shyness.

Boolean intersection (And) searches revealed that students who preferred communicating via the chat perceived other communication modes as slow in comparison to the chat's synchronous nature. Those who favoured email communication were lured by its ease and common use as well as its one-to-one communicative capabilities, while the students who preferred the discussion forum was enticed by its ability to support collaborative learning and self-introspection since students could access peers' messages and work. The use of email and discussion forum communication was observably intense in the virtual classroom.

Table 13: Data matrix for students' preferred communication modes.

Preferred communication mode	Reasons given
Chat	Synchronous (instant response)
Email	Easy, familiar and private
Discussion forum	Enables collaborative learning and introspection

However, an intersection (And) search revealed that the majority of students, who expressed their objection to the virtual classroom's usefulness to their understanding, also preferred face-to-face communication, which they cited as being more convenient, easier and yields instantaneous responses.

Collaboration

Figure 6 indicates that almost half (46.7%) of the 30 students found collaborative learning just marginally useful in their learning. 8 students (26.7%) found it reasonably useful, while 6, (20%) found it very useful. Only 2 students (6.7%) refuted its usefulness in learning. A cross-tabulation with Chi-square showed no significant relationship between collaborative learning and understanding. It however showed that 11 of the 14 students, who found collaborative learning to be marginally useful, also found it unhelpful towards their understanding. Strangely, one student found collaboration among peers useless but helpful towards understanding of the subject matter.

Figure 6: Frequencies of students' impression of the usefulness of collaborative learning and its ability to enhance understanding.

Was collaboration among peers usefull?
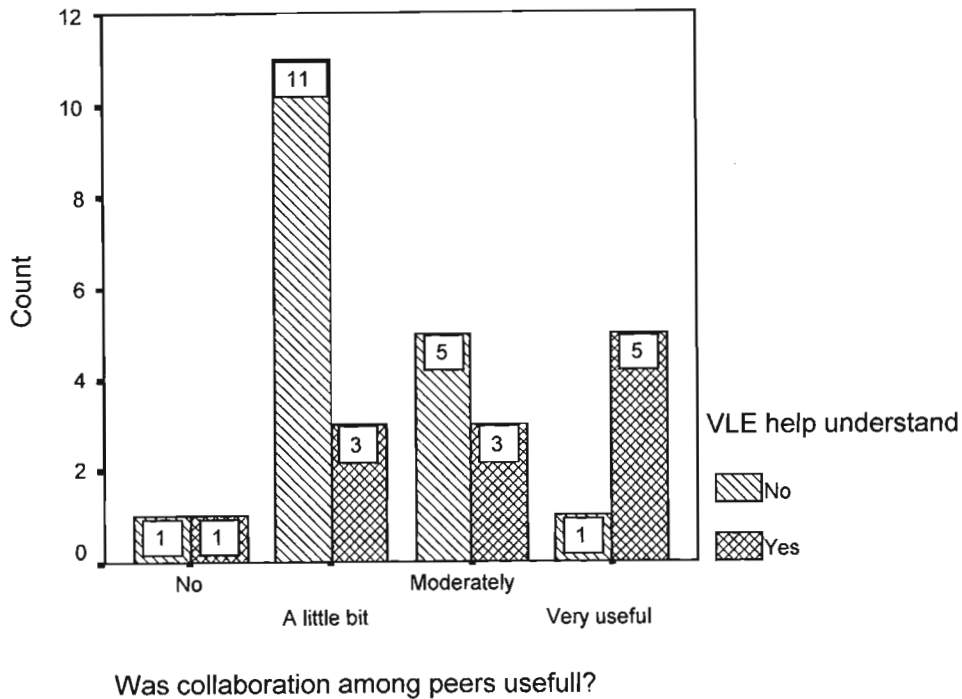
5.8 Students' Perception of Learning Behaviour and Experiences.

Learning Behaviour

Table 14 indicates the results of a multiple response cross-tabulation analysis of whether students acquired any new learning behavior and the forms of new learning behaviour they developed. 24, (80%) out of the 30 students acquired new learning behaviour, of which 15, (50%) acquired many new study habits, while 9, (30%) acquired very few. Students who did not acquire any new learning behaviour constituted 20% of the class. None (0%) of the students conceded to acquiring very many new study habits.

The table also shows that an overwhelmingly high number of students (66.7% to 96.7%) acquired various learning behaviour. Nearly all the students (96.7%) developed an attitude of personal responsibility towards their learning. Punctuality was the least (66.7%) acquired learning behaviour.

It is however interesting to note that even the 6 students (20%) who denied acquiring any new learning behaviour conceded to having developed a variety of behavioural skills. The high percentage of students (50%) who acquired many new study habits correlates with the high number of students who developed various forms of new learning behaviour.

Table 14: A Multiple Response Cross-tabulation of whether students acquired new

learning behaviour and the new learning behaviour they developed.

Forms of new Learning behaviour developed by students	Whether student acquired new learning behaviour			Total	Percent
	No	Very few	Many		
Offering assistance to classmate	4	7	10	21	70.0
Sharing Knowledge and expertise	4	8	11	23	76.7
Responsibility for own learning	6	9	14	29	96.7
Setting own learning pace	6	8	13	27	90.0
Time management	6	8	13	27	90.0
Punctuality	3	5	12	20	66.7
Creating own understanding	6	8	14	28	93.3
Total	6	9	15		
Percent	20	30	50		

Table 15 indicates that the Total Developed Behaviour Index perceived by students

ranged from 4 to 7 with a mean of 5.8, which was quite high, since according to the

code-key score the minimum was 0 and maximum 7.

Table 15: Descriptive Statistics on the Total Developed Behaviour Index

	Total Developed Behaviour Index
Maximum	7.0
Minimum	4.0
Mean	5.8

A node lookup search revealed that students adopted a variety of learning behaviour ranging from taking responsibility for their own learning, self-pacing and collaboration to time management skills. This was quite evident in the virtual classroom, as students gradually posted fewer queries and exhibited more proficiency in using the virtual classroom. According to a matrix intersection, attitudes of self-pacing and self-discipline (responsibility) featured quite prominently among home-dwelling students. There was however minimal reference to creation of own knowledge and punctuality, which were evidently marginal in the virtual classroom.

Boolean intersection (And) searches between students who perceived that they had acquired any new ways of learning and their perception of the virtual classroom's usefulness to their understanding revealed minimal reference to affirm this notion. There was no reference to the virtual classroom's ability to enhance students' recollection, which was observably marginal in the summative evaluation results. There was also evidence of acquired learning attitudes of self-pacing and independent learning skills among students who refuted acquiring any new ways of learning.

Matrix intersection searches revealed that most home-dwelling students perceived self-discipline, responsibility and time management skills quite prominently, especially among students in the 'high' performance group. Hostel-dwelling students seemed to have perceived time-management as the most difficult behavioural quality to implement, which was also evident in the virtual classroom. However, home-dwelling students merely perceived it as an acquired skill, which they observably achieved over time.

Although peer-to-peer collaboration was observably marginal in the virtual classroom, students conceded to have collaborated face to face outside the virtual classroom. Many behavioural aspects were interlinked hence many students failed to observe punctuality because they did not acquire some or any of the complementary behavioural attitudes as illustrated by Figure 7 below;

Figure 7: Interconnection between behavioural attitudes
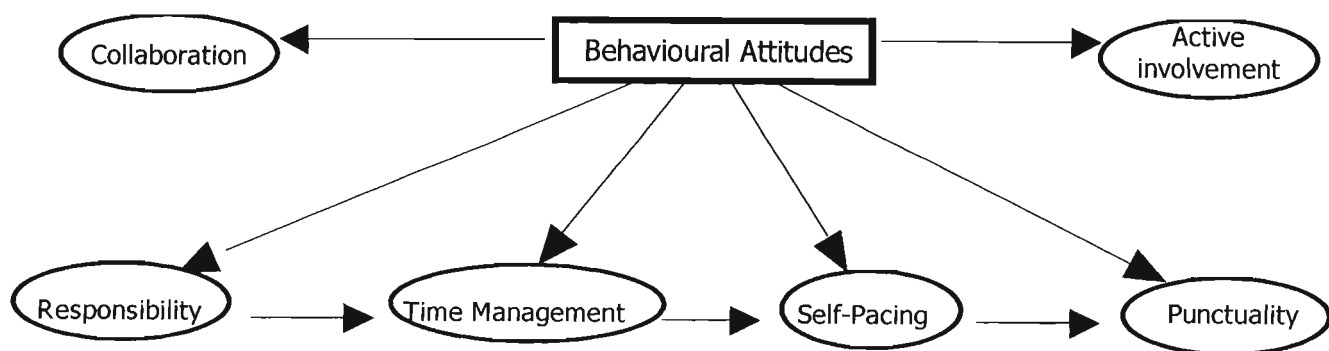
Learning Experiences

A node lookup search showed that students' learning experiences were mainly induced or associated with the self-directed learning approach, which one student referred to as "having to figure things out for your self". They expressed their autonomous experiences

as self-paced, challenging (engaging), more flexible, relaxing, convenient and resourceful. There were profound perceptions of enjoyment in most of the students' learning experiences, exhibited through their description of virtual online learning as interesting, social, relaxing and demanding.

However, a Boolean intersection (And) search revealed preferences of varying individual learning styles especially among students who were accustomed and exploitive of a teacher-centred approach. One student insisted, "I personally learn more by listening than by being on the computer". Some students felt that they needed the physical presence of a teacher to complement the virtual classroom for reasons such as explicit verbal explanations and enforcement of discipline.

Boolean intersection (And) searches revealed that students who conceded to the virtual classroom's suitability to their learning styles also perceived it as a better learning paradigm. However, coded perceptions of students in the 'high' performance group revealed that they did not regard this paradigm as superior but more suited for tertiary institutions or specific subjects.

5.9 Students' Perception of the Virtual Classroom's Usefulness to their Understanding and Recollection

A Chi-square test was conducted to explore any association between frequencies of students who perceived the virtual classroom as useful to their understanding and recollection of the subject matter. The results indicate a statistically significant Chi-square [x^2 (2, N=30) =13.032, p= 0.00].

The frequency (count) of students' perceptions of the virtual classroom's helpfulness in understanding and remembering is shown in Figure 8, which illustrates the statistically significant large proportion of students (15 out of 30) who refuted the virtual classroom's usefulness towards their understanding and recollection than would have been expected had understanding and recollection not been associated.

Figure 8: Frequency of students' perception of the virtual classroom's usefulness towards understanding and recollection of subject matter (CBL - Computer-based Learning)
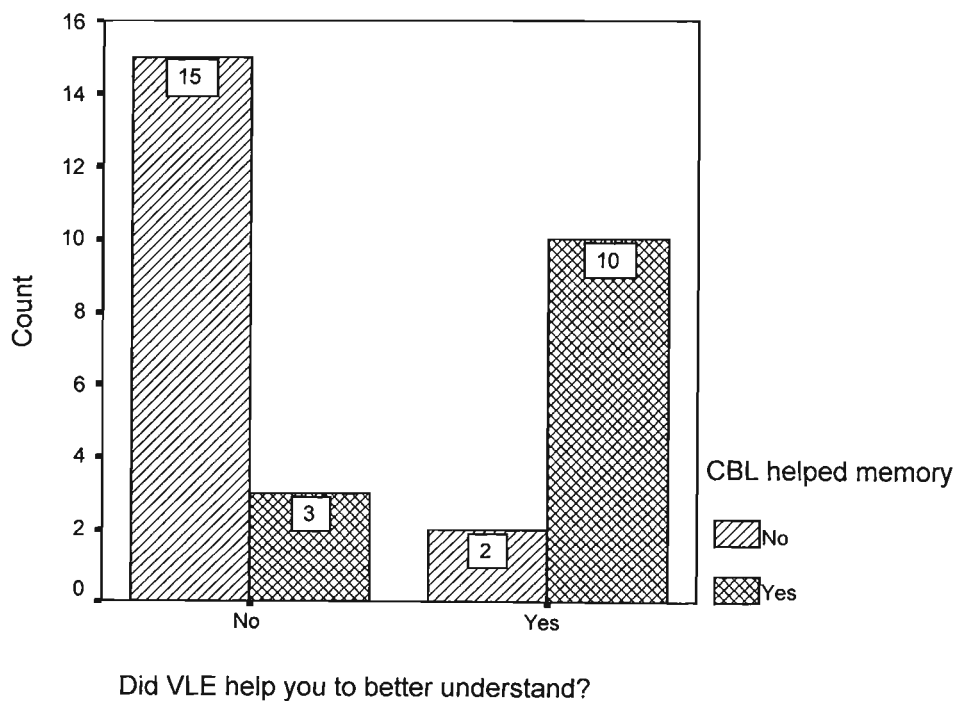
A Chi-square test was conducted to explore any association between frequencies of students who perceived that they had acquired any new ways of learning and their perception of the virtual classroom's usefulness to their understanding. However, the Chi square results could not be used because 50% of the cells had expected count less

than 5, suggesting that the sample size was too small to report significance. The results also yielded a minimum expected count of 2.4 and a high significance value of 0.912, which implied that the differences between the two variables were greater.

Figure 9 indicates that 9, (60%) out of the 15 students who acquired many new study habits refuted the virtual classroom's usefulness to their understanding, while the remaining 6 (40%) concede to its usefulness. Out of the 24 students who acquired some sort of new learning habits (very few to many), over half (14) of them refuted the virtual classrooms' ability to enhance understanding.

Figure 9: Frequency of students' perceptions of acquired behaviour and the virtual classroom's usefulness towards understanding.

Did you acquire any new ways of learning (study habits)?

A node lookup search revealed marginal perceptions supporting the virtual classroom's usefulness to students' understanding. Boolean intersection (And) searches however revealed that most positive perceptions were confined to students in the 'high' performance group, whose contentions were also quite evident in their work. The only perception revealed among students in the 'mediocre' performance group was negative while none was available in the 'low' performance group. No conclusive trend could be established on the basis of learning styles.
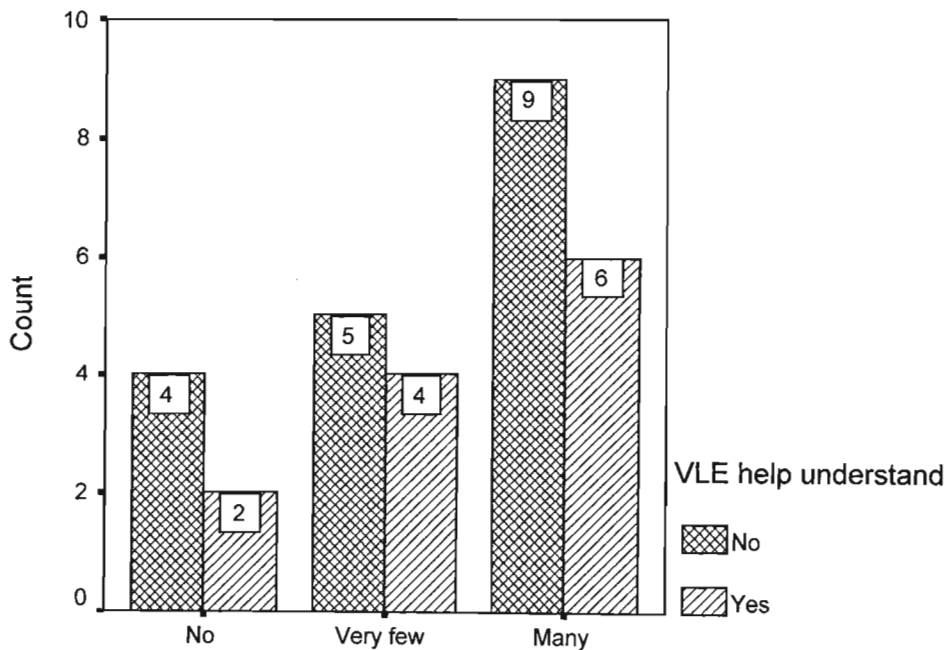
A Chi-square test was conducted to explore any association between frequencies of students who perceived that they had acquired any new ways of learning and their perception of the virtual learning environment's (VLE) usefulness to their recollection. The Chi square results could not be used because 50% of the cells had expected count less than 5, suggesting that the sample size was too small to report significance.

However, Figure 10 indicates that of the 24 students who acquired new learning behaviour (very few to many), half (12) conceded to the virtual classroom's ability to enhance their recollection. Only one student did not acquire any new ways of learning but conceded to the virtual classroom's ability to enhance recollection.

Figure 10: Frequency of students' perception of acquired new ways of learning and the virtual classroom's usefulness to their recollection.
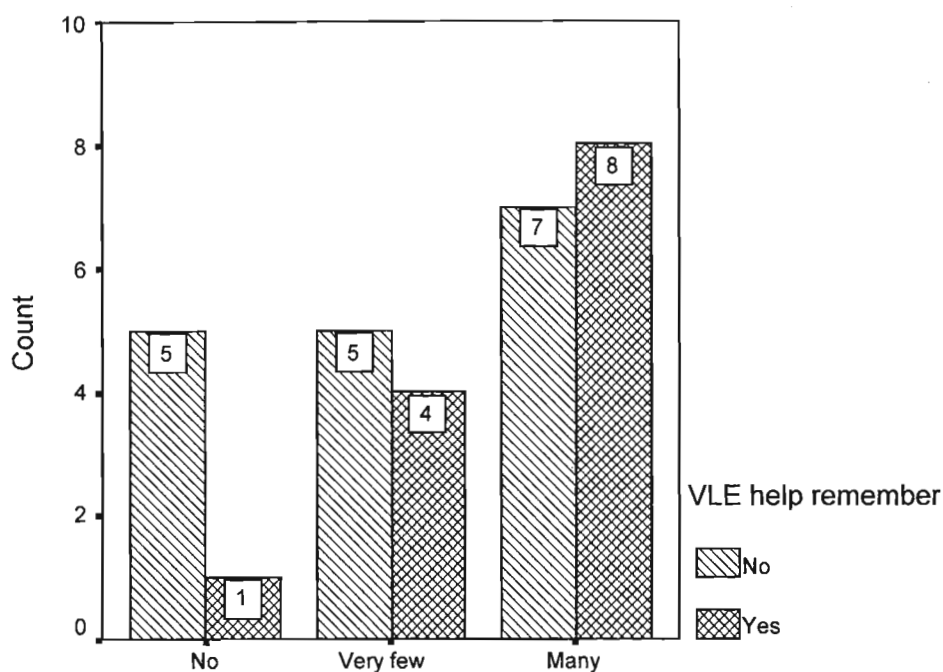
Did you acquire any new ways of learning (study habits)?

Table 16 shows that only 5, (16.7%) out of 30 students found the time allocated for the work sufficient. 12, (40%) perceived the time allocation as completely inadequate.

Table 16: Adequacy of time allocated

Options	Frequency	Percent
No	12	40.0
A little bit	4	13.3
Moderately	9	30.0
Sufficient	5	16.7
Total	30	100.0

5.10 Students' Perceived Achievement and Satisfaction in the Virtual Classroom

Achievement

Table 17 indicates that all students except one experienced some level of achievement from using the virtual classroom. Over half (16) of the 30 students felt marginal achievement, while the rest of the students' (13) achievement was moderate to a lot.

Table 17: Feeling of Achievement from the VLE

Options	Frequency Count	Percent
No	1	3.3
A little bit	16	53.3
Moderately	8	26.7
A lot	5	16.7
Total	30	100.0

A node lookup search revealed that students' perceived achievements in the virtual classroom were mainly associated with acquisition of behavioural attitudes such as time management, active involvement, collaboration and self-discipline (responsibility). There was minimal achievement with regards to the subject matter.

Satisfaction

Table 18 shows that the majority of students (76.6%) perceived marginal to moderate satisfaction. Only two students (6.7%) experienced no satisfaction from the virtual classroom, while 5, (16.7%) felt completely satisfied.

Table 18: Students' perceived satisfaction from the VLE

Options	Frequency Count	Percent
No	2	6.7
A little bit	10	33.3
Moderately	13	43.3
Satisfied	5	16.7
Total	30	100.0

Independent Chi-square tests were conducted to explore any association between frequencies of students who perceived that they had acquired any new ways of learning and their perception of achievement as well as satisfaction in the virtual classroom. The Chi square results could not be reported because the percentage of cells that had expected count less than 5 were 91.7% and 83.3% respectively, indicating that the sample size was too small to report significance.

However, Figure 11 shows that those students who acquired no new ways of learning also perceived no feeling of satisfaction at all. Most of the students (8 out of 15) who acquired many study habits felt moderately satisfied with the virtual classroom.

This group also constituted the highest number of students (3 out of 15) who felt

satisfied with virtual online learning.

Figure 11: Students' perception of acquired study habits and satisfaction with virtual

online learning.
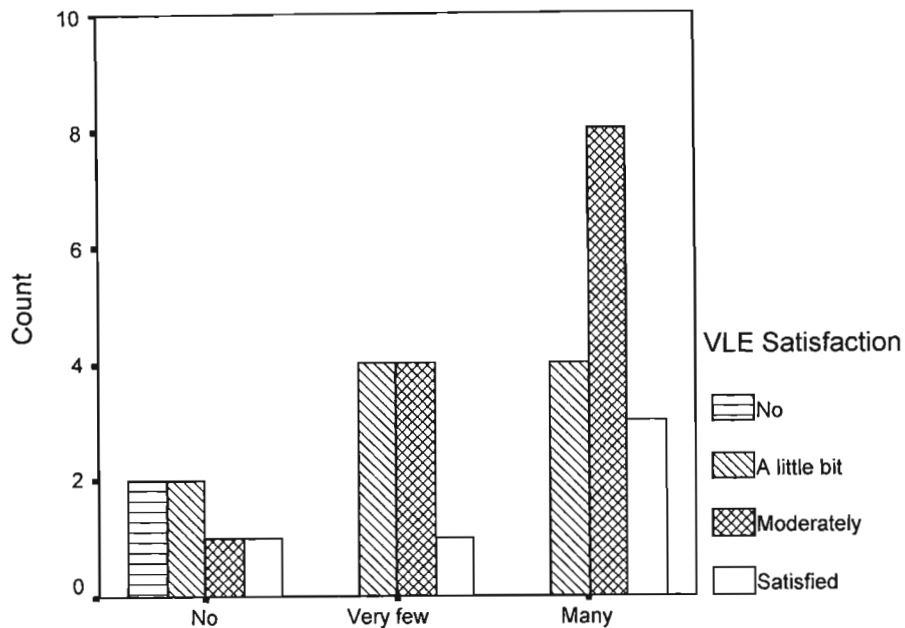
Did you acquire any new ways of learning (study habits)?

5.11 Students' Opinions on General Aspects Pertinent to Virtual Online Learning

Computer Literacy

Chi-square tests were independently conducted to explore any association between

frequencies of students' perceptions between the variables tested below. However, the

Chi square test results in all the cases could not be used because the percentage of

cells that had expected count less than 5 were above 20%, hence indicating that the

sample size was too small to report significance.

- A cross-tabulation without Chi-square test between students' perceived usefulness of their computer literacy level and acquired behaviour, showed that almost half (12) out of the 25 students who perceived their computer literacy level to be sufficient for their learning in the virtual classroom also acquired many study habits, while 7, (28%) acquired very few and 6, (20%) none.

- A cross-tabulation without Chi-square test between students' perceived usefulness of their computer literacy level and understanding revealed that 15, (60%) of the 25 students who perceived their computer literacy level to be useful, refuted the virtual classroom's ability to enhance their understanding, while 10, (40%) conceded.

Learning Styles

Table 19 indicates that slightly over half of the students (56.7%) refute the suitability of their learning styles to virtual online learning.

Table 19: Students' perceived suitability of virtual online learning to their learning style

Options	Frequency Count	Percent
No	17	56.7
Yes	13	43.3
Total	30	100.0

A Chi-square test was conducted to explore any association between frequencies of students who perceived virtual online learning as suited to their learning styles and their

perception of the virtual classroom's usefulness to their understanding. The results indicate a statistically significant Chi-square [x^2 (2, N=30) =8.167, p=0.004]. The number of "Yes" and "No" respondents in respect to understanding in each "Yes" and "No" category of learning style aptness are shown in Figure 12. The figure shows that a statistically significantly large proportion of students (14 out of 17) perceived the virtual online learning as neither suited to their learning style nor helpful in enhancing their understanding, and a fairly large number of students (9 out of 13) perceive the contrary.

A Phi-coefficient test yielded a medium value of 0.522, which signified that the relationship between frequencies of students who perceived that virtual online learning was suited to their learning styles and their perception of the virtual classroom's usefulness to their understanding was medially strong.

Figure 12: Students' perceived suitability of virtual online learning to their learning style and its helpfulness in enhancing their understanding

Did CBL suit your learning style?
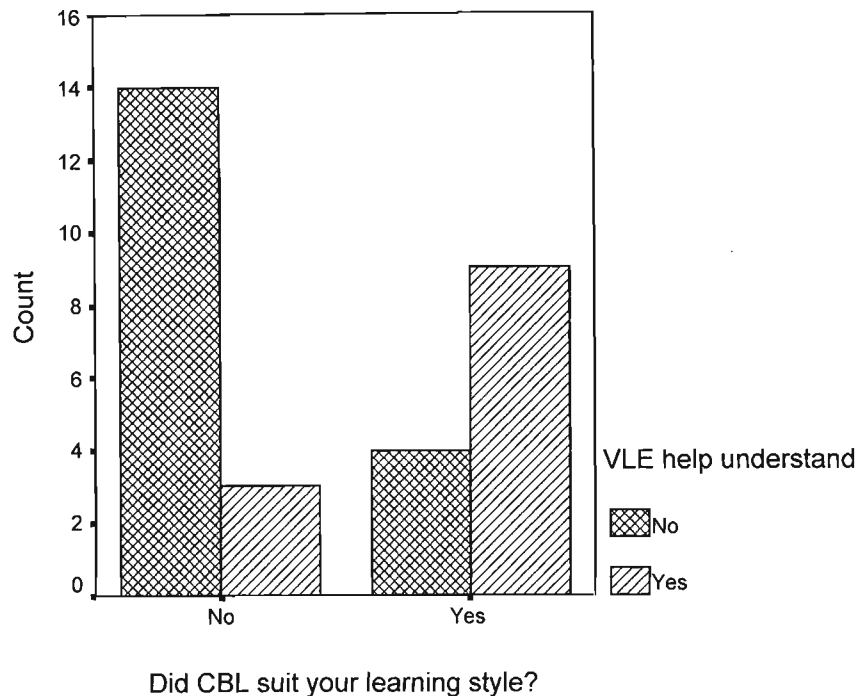
Boolean intersection (And) searches showed that students' perceptions of the virtual classroom were consistent with their learning styles. Students who refuted the virtual classroom's suitability to their learning style vehemently expressed their preference for a teacher-centred learning approach with face-to-face communication, citing their disinterest in computers. A similar pattern was also evident among students who refuted the virtual classroom's superiority over the traditional classroom.

Students' negative perceptions and indifference to virtual online learning was also observable during their execution of learning activities in the virtual classroom, especially among students in the 'low' performance group.

A Chi-square test was conducted to explore any association between frequencies of students who perceived that they had acquired new ways of learning and their perception of the virtual classroom's suitability to their learning style. The Chi square results could not be reported because 50% of the cells had expected count less than 5, suggesting that the sample size was too small to report significance. The results also yielded a minimum expected count of 2.6 and a high significance value of 0.854, which indicated a trend of greater differences between the two variables.

However, Figure 13 shows that the number of students in the "Many", "Very few" and "No" categories of acquired learning behaviour among students who refuted virtual online learning as suited to their learning style as well as those who conceded, was relatively the same. The acquisition of learning behaviour therefore seemed independent of learning style.

Figure 13: Students' perceived suitability of virtual online learning to their learning style and acquired learning behaviour

Did CBL suit your learning style?
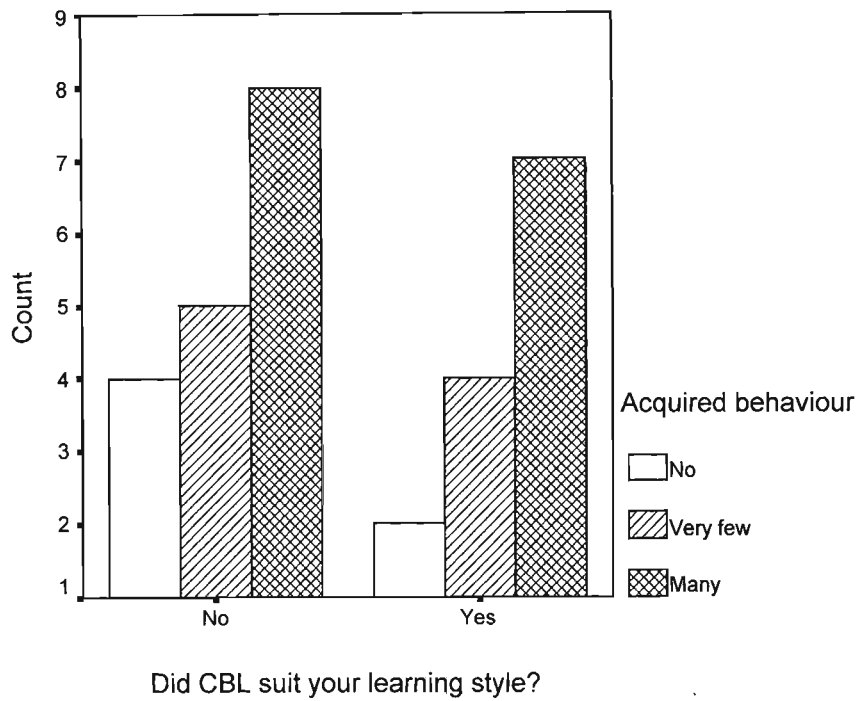
Active Engagement

A Chi-square test was conducted to explore any association between frequencies of students who perceived active engagement and their perception of the virtual classroom's usefulness to their understanding. The Chi square results could not be used because 70% of the cells had expected count less than 5, suggesting that the sample size was too small to report significance. The results also yielded a minimum expected count of 0.4 and a high significance value of 0.62.

However, the results of a cross tabulation without Chi-square showed that almost half of the students (14 out of 30) perceived the level of active engagement as moderate, of whom the majority (71.4%) refuted the virtual classroom's ability to enhance understanding. 9 out the 30 students perceived the level of active engagement as high, while 4 perceived it as very high and the rest (3) as low.

A node lookup search revealed a general perception that virtual online learning was very engaging and many students referred to it as hard and challenging work. Boolean intersection (And) searches revealed that this experience was most prominent among students who conceded to the virtual classroom's usefulness to their understanding and those in the mediocre performance group, but minimal in both low and high performance groups.

Differences in Learning at Different Stages

Figure 14 indicates that two thirds of the students (67%) experienced learning differently at different stages of the experimental course, while a third (33%) did not.

Figure 14: Students' opinion on whether they experienced learning differently at different stages of their learning process.

Did you experience learning differently at different stages?
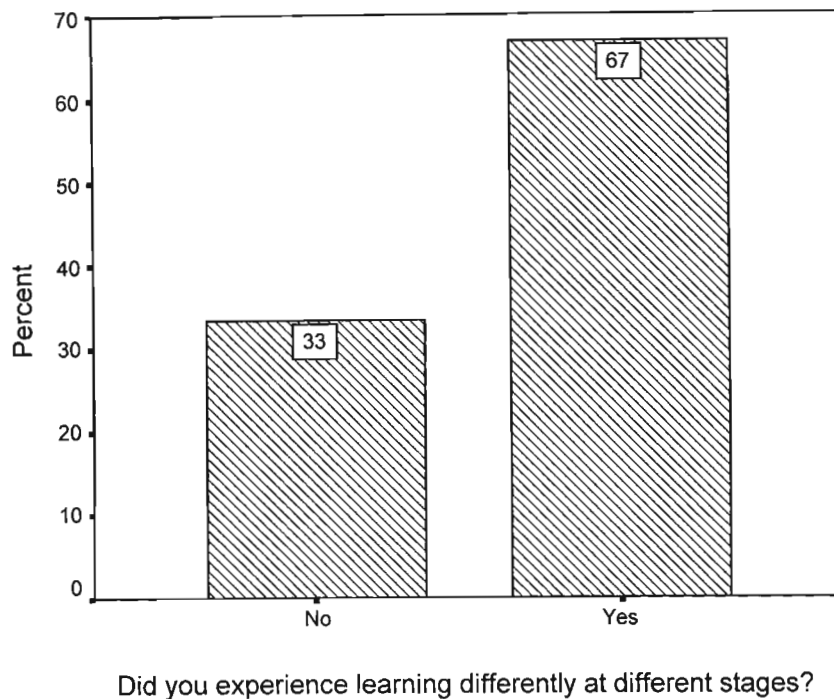
A node lookup search showed that some students perceived learning differently at different stages of their learning. One student stated, "As I progressed with the work, I found that I was getting more confident".

Virtual Learning Problems

A node lookup search revealed that the most pronounced problems perceived by students in the virtual classroom were time inadequacy and restricted access to networked-computers especially since only six computers were networked. A Boolean intersection (And) search revealed that both hostel and home dwelling students equally

experienced the same problems, which observably influenced students' performance and attitude towards the virtual classroom. However, most students in the 'high' performance group had ample access to networked-computers at home and perceived the allocated time as adequate.

5.12 Students' Academic Performance in the Virtual Classroom

Table 20 shows that the majority of students (70%) were generally mediocre. Only 4 students (13.3%) out of the 30 excelled in their performance, while the rest (16.7%) performed poorly.

Table 20: Students' performance groups in the virtual classroom

Performance Groups	Frequency Count	Percent
Low	5	16.7
Mediocre	21	70.0
High	4	13.3
Total	30	100.0

Table 21 indicates that the marks obtained by students in the virtual classroom ranged from 15% to 84% with a mean of 52.2%. The students' general performance in the

virtual classroom is slightly above average considering that the total assessment mark was 100%.

Table 21: Descriptive Statistics of students' marks obtained in the virtual classroom

	Marks Obtained by students
Maximum	84
Minimum	15
Mean	52.2

Table 22 shows the mean marks of school-hostel and home dwelling students An analysis test using the independent sample T-test revealed that there was no statistically significant difference between the mean marks of hostel and home-dwelling students since the significance value for T-test was 0.331 (above 0.05)

Table 22: Descriptive Statistics of mean marks of school Hostel and Home dwelling students

	After-school Dwelling	
	Home	School Hostel
Mean	54.5	47.8
Standard Deviation	18.7	13.9
Number	20	10

A One-way between groups analysis of variance (ANOVA) was conducted to explore differences in mean marks between groups ("No", "Very few" and "Many") of students in respect to their acquisition of new learning behaviour. The results indicate no statistically significant difference between any of the three groups.

Post-hoc comparisons using the LSD (Least Squares Difference) multiple comparison tests indicated that the mean marks of students for "No" (Mean =49.2, SD =11.1), "Very few" (Mean =50.1, SD =20.2) and "Many" (Mean =54.7, SD =18.2) was not significantly different from each other. The mean marks however seemed to increase with increase in number of study habits acquired by students.

Figure 15: The mean marks plot of students' acquisition of new learning behaviour

Did you acquire any new ways of learning (study habits)?
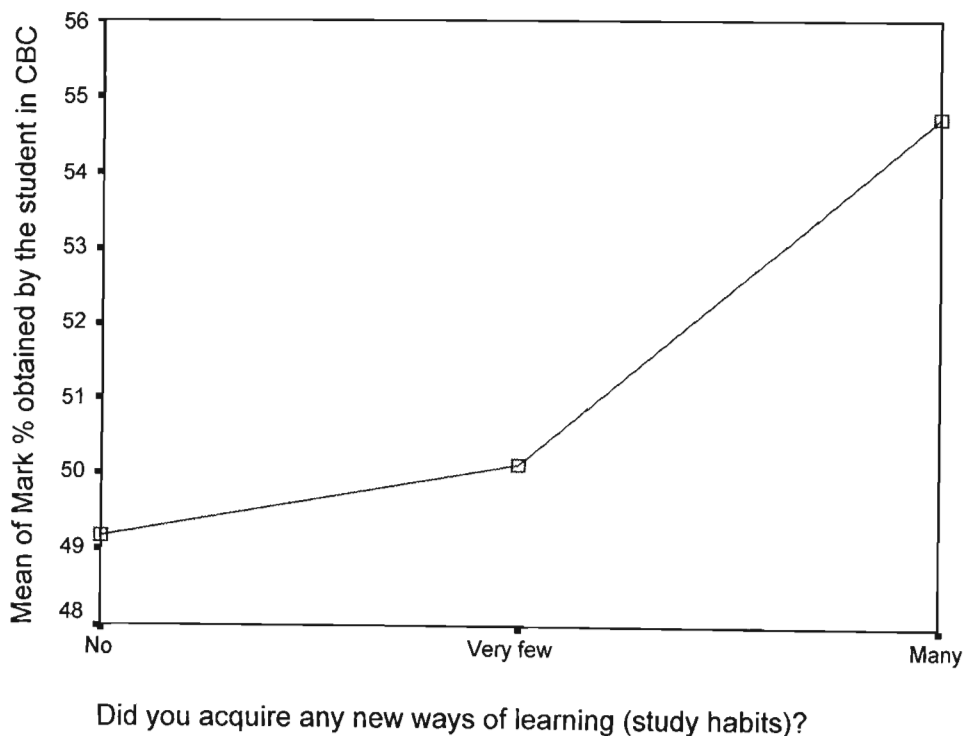
Exploration of associations between frequencies of students' academic performance groups in the virtual classroom and their perceptions of various virtual classroom attributes were independently conducted using a Chi-square test. However the Chi square results could not be reported because the percentage of cells that had expected count less than 5 were above 20% in each of the cases, hence indicating that the sample size was too small to report significance.

However, a cross-tabulation descriptive analysis without Chi-square, revealed the following in each of the cases below:

- A Cross-tabulation descriptive analysis test between students' academic performance groups (Low, Mediocre & High) and perception of the virtual classroom's usefulness to their understanding revealed that 12, (57.1%) out of the 21 'Mediocre' students, as well as 3, (75%) of the 4 'high' performance students refute the virtual classrooms ability to enhance understanding.

- A Cross-tabulation descriptive analysis test between students' academic performance groups (Low, Mediocre & High) and suitability of virtual online learning to their learning styles showed that 14, (66.7%) out of the 21 'mediocre' students, as well as 2 (50%) of the 4 'high' performance students refuted the suitability of virtual online learning to their learning styles. However, 4 (80%) of the 5 'low' performance students conceded to its suitability to their learning styles.

- A Cross-tabulation descriptive analysis test between students' academic performance groups (Low, Mediocre & High) and students' perceived achievement in the virtual classroom revealed that all students in the 'low' and 'high' performance groups felt some form of achievement although at varying degrees. None (0%) of the 'low' performance group students felt much achievement. Only one student (4.8%) in the 'mediocre' performance group felt no achievement in the virtual classroom.

- A Cross-tabulation descriptive analysis test between students' academic performance groups (Low, Mediocre & High) and students' perceived acquired learning behaviour revealed that all students in the 'high' performance groups acquired new study habits of which 3, (75%) acquired many. 76.2% of the 'mediocre' performance group acquired new study habits ranging from very few to many.

The relationship between students' performance marks in the virtual classroom and traditional classroom was tested using the Pearson product-moment correlation coefficient. The results revealed no significant correlation between the two variables. However, Figure 16 reveals that there was a slight association with increase in marks.

Figure 16: Scatter-plot to show the relationship between students' marks in the virtual

and traditional classroom

Mark % obtained by the student in CBC

(CBC – Computer-based Classroom)
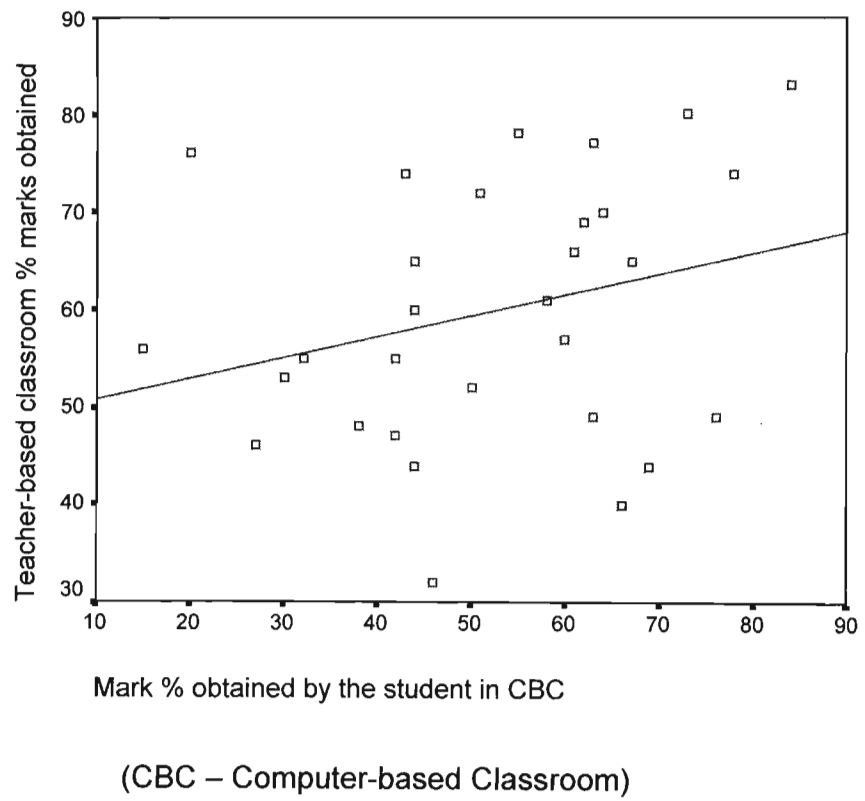
CHAPTER 6: FINDINGS / INTERPRETATION OF RESULTS

6.1 Students' Demography and Capacity to Use the Virtual Classroom

Students' Residence

The majority of students (66.7%) resided at home, while only a third were resident in the school-hostel. Although all students used the same virtual classroom, only a few students could access the virtual classroom after school.

Students' Computer Interest and Capability

Students' interest and capability to use computers ranged from moderate to very high. Therefore, all students possessed the necessary computer skills for virtual online learning.

6.2 Students' Learning Experiences and Perception of the Virtual Classroom

Students' Learning Experiences

Many students felt that their virtual learning experience was interesting, challenging, self-directed, self-paced, collaborative and flexible. Gilbert et al (2000) contends that technology makes learning more interactive, enjoyable, and customizable, which improves students' attitudes toward the subject and their interest in learning. Students also felt that control over their own pace, independence and flexibility of subject matter presentation enhanced their learning experience. On the other hand students may have found virtual online learning challenging because they were unaccustomed to self-directed learning and lacked the necessary independent learning skills.

Students' dissatisfaction with their learning experience can be attributed to their accustomed teacher-dependence and lack of self-discipline. Berge and Collins (1995b: 6 -12) contend that since students must manage their own learning in the virtual classroom, this newfound independence may be a hindrance to those students who need more structure. This finding is consistent with that of Chin (1999) who found that although students felt positive and successful about their experience in using the Web, they did not wish to see web-based teaching replace classroom teaching.

Oliver and Omari (1996) also found that students cherished the teacher's contribution and regarded it as a fundamental component of their learning process. Frustration created by students' limited access to networked-computers may also have contributed towards their dissatisfaction.

Interest in the Virtual Classroom

The two thirds of students (63.3%) who found virtual online learning more interesting than the conventional teacher-based learning, was relatively proportional to that of students who perceived it as a better learning paradigm. This can be attributed to students' interest in using computers. Owston (1997) contends that the virtual classroom appeals very much to the way our students now prefer to learn because their world is rich in visual stimuli. It is also common practice these days for most students to play and seek entertainment on computers.

The indifference displayed by over a third of the students can be attributed to their negative attitude towards self-directed learning or contrasting learning styles suited to the instructivist-learning paradigm that they were accustomed to.

Accessibility of the Virtual Classroom

Almost half of students (40%) experienced insufficient access to networked-computers at school and after school. This limited their ability to access the virtual classroom anywhere/anytime, hence affecting their self-pacing and time-management skills. This problem also translated into frustration and indifference towards the virtual classroom. Gilbert et al (2000) contends that research and best practice indicate that one computer for every four to five students is necessary if students are to be able to use technology in a manner that will yield significant improvements in learning.

A few students with home networked-computers had ample access to the virtual classroom and benefits from this online learning quality were evident in their proficiency and punctuality in the virtual classroom.

Role of the Internet and WWW in the Virtual Classroom

Students' acknowledgement of the Internet's pivotal role in the virtual classroom was consistent with findings by Hong et al (2003) and Wise and Hughes (1996) where students generally showed a positive attitude toward the use of the Internet and WWW for learning

Students perceived the Internet as a quick and easy information source, which was consistent with their accustomed use of the Internet. Owston (1997) also concedes that unlike traditional media, the Web can offer information that is instantly available, often very up-to-date, worldwide in scope, and presented in a more motivating format for students to explore. Students' information search via the Internet imparted new skills. This notion is supported by Gilbert et al (2000) who asserts that access to a huge

information resource requires students to develop thinking skills to sort, evaluate and synthesize the information.

However, the conglomeration of students in the school structure and ease with which they could communicate face-to-face with each other limited their ability to appreciate the Internet's ability to facilitate communication and delivery of learning.

Only the few students with networked-computers at home exploited what Hunter and Smith (2001) assert as "anytime/anyplace" learning. Quintana (1996) and Berge and Collins (1995b: 6 -12) also affirm that Internet-based learning allows students to learn at their own pace and access the information at a time that is convenient for them.

Design and Delivery (Usability) of the Virtual classroom

There was an overwhelming approval of the virtual classroom's design and delivery capabilities for effective learning. This was also supported by the high usability mean hence contributing toward the satisfaction and achievement of learners.

Communication in the Virtual Classroom

Students' perceived difficulty in using CMC is attributable to their being unaccustomed to its use in a learning context. It is however puzzling that some students (20%) found CMC similar to the communication modes in the traditional classroom, since even Riel and Harasim (1994) assert that the mode of communication via computer-mediated communication differs from the verbal communication utilized in the conventional classroom.

There was an overwhelming appreciation of the computer-mediated communication's ability to facilitate learning in a social context. Berge and Collins (1995a: 6 -12) contend that computer-mediated communication (CMC) promotes a type of interaction that is often lacking in the traditional teacher-based classroom, since it allows learners the freedom to explore alternative pathways to find and develop their own style of learning because students are able to capitalize on those communication tools that suit and enhance their way of learning.

Students displayed multiple preferences of CMC tools depending on their preferred use for each tool. 50% of the student population showed preference for both the discussion forum and email as their communication methods. Many students (76.7%) were intrigued by the discussion forum's ability to facilitate collaborative learning and conceded to its usefulness towards their learning. Findings by Chin (1999) also revealed that students felt that a discussion group was a good way to discuss problems amongst themselves.

The email was favoured for its ease and familiarity as well as one-to-one communicative capability. Owston (1997) contends that e-mail provides a way for students to contact the instructor directly. The majority of students used the email to submit their assignments and interacting with the facilitator. However, only a few students used it as a medium of collaborating with peers, which corroborated the students' confessed use of face-to-face communication to discuss issues pertinent to the virtual classroom, citing its instantaneous nature. Quintana (1996) contends that e-mail communication helps to reduce students' feeling of isolation from the facilitator but lacks the visual cues and

facial expressions that convey messages of understanding, or lack of comprehension, of questions and responses between the student and instructor.

A few students (6.7%) preferred and acknowledged the chat's usefulness in the virtual classroom due to its synchronous capabilities. Half of the students (50%) found the virtual classroom's capabilities to facilitate revision of readings, learning activities and messages very useful, which are attributed to the computer's ability to preserve and reuse information unlike the chalkboard.

One student's appreciation of the usefulness of CMC to learners with speech impediments (stuttering), eloquence and shyness, was exhibited in the intensity and flow of his dialogue in the virtual classroom. Owston (1997) contends that students who are shy or uncomfortable about participating in class discussions often no longer feel that way in on-line forums. Peat (2000) also contends that CMC empowers students with disabilities, physical impairment, disfigurement, or speech impediments, which hinder their equal participation in face-to-face encounters.

Computer-Tool/Features of the Virtual Classroom

There was a general appreciation of all interfacing features as useful towards students' expression of their understanding. They provided students with an easy, enjoyable and appealing way of expression. More than half of the students favoured and showed keenness in exploiting features such as graphics, text-effects and colour. They however found videos to be the least helpful because of their large file sizes. The spelling checker was most useful to English second language users.

6.3 Students' Perception of Acquired Learning Behaviour, Understanding and Recollection

Behavioural Attitudes / New Way of Learning

It was not surprising that the majority of students (80%) acquired new ways of learning since they were essential for self-directed learning in the virtual classroom. Nearly all students (96.7%) adopted a responsible attitude towards their own learning because all other acquired behavioural attitudes hinged on it. Berge and Collins (1995b: 6 -12) contend that CMC promotes self-discipline and requires students to take more responsibility for their own learning. The adoption of new learning behaviour made students more confident and proficient in the virtual classroom.

Self-pacing and self-discipline attitudes were very prominent among students, because they were necessary for the submission of work timeously. However, time management and punctuality were the most difficult skills to effect due to the limited access to networked-computers and the programmed after-school period for hostel dwellers.

The self-directed learning activities and attributes of the virtual classroom imparted new learning skills through information accessing, exploration, independent inquiry, collaboration, communication, knowledge sharing and co-operative-learning.

Acquisition of new learning behaviour was however limited by the restricted access to networked-computers and short period of the experimental course (7 weeks), which seemed inadequate for students to acclimatization to the new paradigm. It is therefore likely that more students would have acquired more new ways of learning over time.

Understanding and Recollection

Understanding and recollection require students to assimilate new information to prior-experiences, however such an approach was alien to learners hence the negative perception by 60% of the students. This finding is consistent with that of Chin (1999) where students refuted the Web's ability to enhanced their understanding and recollection of subject matter. Vygotsky (1978b) contends that knowledge and understanding are actively constructed by the learner, not passively received from the environment, and socially constructed through experience with the physical world and social interactions leading to new or modified knowledge.

Students' acquisition of new learning behaviour was not significantly influential towards their understanding and recollection of subject matter, which is possibly because many of the independent learning skills acquired by learners were more pertinent to proficiency rather than direct facilitation of understanding and recollection. Berge and Collins (1995a: 6 -12) contends that what makes a difference in content retention and transfer is not so much what is done by the teacher, but what students as learners can be encouraged to do themselves.

The acknowledged ability of the virtual classroom to enhance understanding and recollection was evident among a few actively involved, self-disciplined students. Berge and Collins (1995b: 6 -12) contends that effective learning hinges on active engagement by students and the construction of knowledge on their own leads to understanding.

Achievements and Satisfaction

Learners' active engagement in the virtual classroom induced a sense of achievement and satisfaction for the majority of students (80%). Many research studies found that students expressed satisfaction with their web-based learning experience (Chin, 1999: , Berge and Collins, 1995a: 6 -12). Students' perceived achievements were mainly pertinent to acquired behavioural attitudes such as self-discipline, time management, active-engagement and collaboration as well as enhanced computer skills. Gilbert et al (2000) contends that when technology is systematically implemented, it offers opportunities for learner-control, increased motivation and connections to the real world, which enhance student achievement.

Students' acquisition of new learning behaviour seems to have contributed towards their sense of achievement and satisfaction, since students who did not acquire any new ways of learning also felt no sense of satisfaction at all.

Collaboration

Social (collaborative) learning through educator guidance or peer collaboration promotes the development of a wider scope of skills than can be attained through individual learning, hence the overwhelming students' support for the usefulness of collaboration among peers. Berge and Collins (1995a: 6 -12) contend that the virtual learning environment is able to provide an environment in which collaborative efforts are rewarded by fostering a view of knowledge in which expertise is distributed and created among the different participants. Collaborative methods develop critical thinking through directing learners towards discussion, clarification of their own ideas and evaluation of others' ideas (University of Pretoria, 2003).

However, students' minimal peer-to-peer collaboration in the virtual classroom was possibly induced by their confessed use of face-to-face interaction since they could intimately interact with each other within the school confines. Despite the high number of students who conceded to the usefulness of peer collaboration, only 39% regarded it as helpful towards their understanding.

Difference in Learning at Different Stages

Two thirds of the students (67%) initially experience problems, which could be attributed to their unaccustomed use of the virtual classroom, but their confidence and proficiency increased as they progressed with their learning. Jones (1996) also found that students struggled with the new learning approach, which was attributed to their lack of familiarity with independent learning. These results were also consistent with earlier findings which according to Berge and Collins (1995a: 6 -12) found that students were highly satisfied with this mode of learning once they got past initial difficulties with technology.

6.4 Students' Performance in the Learning Activities of the Virtual Classroom

Performance Marks

Students' performance was reciprocal to their application of independent learning skills such as self-discipline, self-motivation, active involvement and time management. Therefore, the mediocre performance of the majority of students (70%) can be attributed to a deficiency in such learning skills. The excellent performance of the minority of students (13%) is attributable to their positive attitude, strict application of independent learning skills and good computer skills as well as easy access to networked-computers.

These findings were consistent with Hong et al (2003) and Wise and Hughes (1996) where students who were better acquainted with the Internet had more positive attitudes toward the use of the Internet for learning purposes. Jones (1996) and Murray (1995) also contend that computer-based learning can be more interactive and more effective for mature, motivated learners comfortable with independent learning and computers.

Students' poor performance despite their matching learning style could have emanated from a lack of independent learning skills or insufficient access to networked-computers, which reciprocated a lack of motivation and indifference. Students' form of residence was not influential towards their performance since both hostel and home dwellers' performance was relatively the same.

There was no significant difference in performances between students who acquired varying quantities of learning behaviour, although there was a slight increase in performance marks with increase in quantity of learning behaviour acquired. It is therefore possible that the quality rather than the quantity of acquired learning attitudes influenced students' performances.

The lack of significant correlation between students' performance marks in the virtual classroom and traditional classroom could be attributed to their lack of appropriate attitudes, independent learning skills and active involvement in the virtual classroom.

6.5 Students' Opinions on General Aspects Pertinent to Virtual Online Learning

Learning Styles

The unsuitability of virtual online learning to over half (57%) of the students' learning styles and their preference for the instructivist teacher-centred learning paradigm with face-to-face interaction can be attributed to their lack and dislike of responsibilities attached to self-directed learning since they were accustomed to teacher-dependence. Berge and Collins (1995b: 6 -12) also concede that some students prefer the social aspects of the classroom and are unsettled by the lack of face-to-face interaction in computer-mediated communication. However, students' acquisition of new learning behaviour was independent of their learning styles.

Active Engagement

The findings of this study where the majority of students felt actively engaged in the learning process are supportive of Gilbert et al (2000) who contend that effective or engaged learning means students are responsible for their own learning, they take charge and are self-regulated. Active engagement and engrossment of students is the essence of the learner-centred learning approach applied in the virtual classroom, where students were engaged in the mental process of synthesizing meaning through reflection and abstraction.

Virtual Classroom Problems

The most pronounced problems experienced by the majority of the students, irrespective of their form of residence were the limited accessibility of networked computers and time. These problems translated into frustration and indifference to

virtual online learning, which ultimately adversely influences students' performance. Students in the 'high' performance group hardly experienced any of these problems, which was reflected in the high quality of their work.

CHAPTER 7: CONCLUSION

The findings of this research study are generally in favour of the virtual learning environment's ability to enhance the learning experiences of learners. They are however inconclusive regarding its ability to enhance students' learning outcomes. This can be attributed to the lack of a predetermined benchmark on which research findings on learning outcomes can be gauged. Dusick (1998) suggests that the definition of outcomes must be carefully examined before condemning a method as not a significant improvement. The answers provided by this research can be summarized as follows:

Has the virtual learning environment induced change in learning behaviour?
According to the overwhelming positive responses furnished by students, it is apparent that the virtual learning environment induced change in students' learning behaviour, the magnitude of which depended on individual student's self-discipline, self-motivation and active involvement in the virtual classroom. Without adopting the appropriate learning behaviour many students would have been unable to effectively execute self-directed learning in the virtual classroom.

Has the learning behaviour acquired enhanced the learning experiences and outcomes of students?
Judging from students' perceptions it is clear that their learning experiences were favourable and rewarding, especially among students whose learning styles were adequately accommodated by the online learning paradigm. However, this cannot be entirely attributed to acquired learning behaviour but also to virtual classroom attributes

such as the Internet and WWW. Students whose attitude and learning style clashed with the self-directed learning paradigm failed to adopt the necessary learning behaviour and were therefore dissatisfied with their learning experiences.

Students' overwhelming disapproval of the virtual classroom's usefulness towards their understanding and recollection of the subject matter, despite their acquisition of new learning behaviour indicates that students did not perceive the virtual classroom or acquired learning behaviour as influential towards the enhancement of their learning outcomes. Only the few students who exhibited the appropriate cocktail of independent learning skills achieved enhanced learning outcomes.

Did learners experience behavioural changes differently and why?

It was evident from the students' perceptions that they experienced behavioural changes differently, which was exhibited by their gradual improvement in proficiency and quality of work. This is attributable to differences in students' learning styles, attitude towards computers, level of computer literacy, the subject topic, the Internet experience, self-discipline, academic and social background as well as attitude towards the new learning paradigm. There was even evidence of inadvertent acquisition of new learning behaviour.

Did students experience their learning differently at different stages of learning?

The answer to this is 'yes' for many of the learners, especially since they were utilizing a new and different learning paradigm. Students attributed it to initial difficulties in acclimatizing to the virtual classroom attributes such as CMC tools, navigation, Internet, resourcing and a lack of independent learning skills.

These research findings provide some insight into the viability of virtual learning environments in pre-tertiary institutions (K-12) for the future, which Gilbert et al (2000) affirm as having an important role to play in K-12 education.

Owston (1997) contends that the key to promoting improved learning with the Web appears to lie within how effectively the medium is exploited in the teaching-learning situation. It is therefore logical that the designing and creation of an effective learning environment, which is in sync with the lifestyle of modern society is likely to induce the appropriate learning skills (behaviour) for enhanced learning experiences and outcomes.

REFERENCES

Berge, Z. and Collins, M. 1995a Computer-Mediated Communication and the Online Classroom in Distance Learning. In *Computer-Mediated Communication and the Online Classroom*, Vol. 2 Hampton Press, Cresskill, NJ, pp. 6 -12.

Berge, Z. and Collins, M. 1995b Computer-Mediated Communication and the Online Classroom: Overview and Perspectives. In *Computer-Mediated Communication and Online Classroom*, Vol. 1 Hampton Press, Cresskill, NJ, pp. 6 -12.

Berryman, S. E. 1993. Designing Effective Learning Environments: Cognitive Apprenticeship Models. http://www.ilt.columbia.edu/publications/papers/berry1.html. Accessed: 8 July 2002

Bruner, J. 1973. Constructivist Theory http://tip.psychology.org/bruner.html. Accessed: 24 July 2002

Chin, K. L. 1999. A study into students' perceptions of Web-based learning environment http://www.herdsa.org.au/vic/cornerstones/pdf/Chin.PDF. Accessed: 13 July 2002

Conway, J. 1997. Educational Technology's Effect on Models of Instruction http://udel.edu/~jconway/EDST666.htm. Accessed: 14 April 2002

Dusick, M. D. 1998. The Learning Effectiveness of Educational Technology: What Does That Really Mean? http://learnonline.sbccd.cc.ca.us/~ddusick/lib130/effectiveness.htm. Accessed: 10 March 2002

Gardner, H. 1993. Multiple Intelligences http://tip.psychology.org/gardner.html. Accessed: 24 July 2002

Gilbert, V., Mary, M., Mary, F., Mary, A., Mark, H. and Lenaya, R. 2000. Computer-Based Technology and Learning: Evolving Uses and Expectations http://www.ncrel.org/tplan/cbtl/toc.htm. Accessed: 8 November 2002

Glasser, W. 1990. Control Theory http://www.funderstanding.com/control_theory.cfm. Accessed: 12 April 2002

Heinemann 2000. Outcomes Based Education http://www.heinemann.co.za/Schools/TeachingTips/OBE2.asp. Accessed: 12 November 2002

Hong, K. S., Ridzuan, A. A. and Kuek, M. K. 2003. Students' attitudes toward the use of the Internet for learning: A study at a university in Malaysia http://ifets.ieee.org/periodical/6-2/5.html. Accessed: 21 June 2003.

Hunter, W. J. and Smith, R., 2001. Virtual schooling: Integrating schooling into technology. http://ucalgary.ca/~hunter/Hunter&Smith.html. Accessed: 21 May 2003.

Jones, D. 1996. Solving some problems of University Education: A Case Study http://elmo.scu.edu.au/sponsored/ausweb/ausweb96/educn/jones/. Accessed: 2 April 2002.

Mathew, N. and Maryanne, D. P. 2000. Using the World Wide Web to Enhance Classroom Instruction http://www.firstmonday.dk/issues/issue5_3/mathew/#m6. Accessed: 24 July 2002.

McManus, T. F. 1996. Delivering Instruction on the World Wide Web http://www.svsu.edu/~mcmanus/papers/wbi.html. Accessed: 22 July 2002.

Murray, T. 1995. Designing a Virtual Classroom http://www.njit.edu/njlT/Department/CCCC/VC/Papers/Design.html. Accessed: 13 April 2002

Oliver, R. and Omari, A. 1996. The place of the WWW in an undergraduate multimedia degree program. http://elmo.scu.edu.au/sponsored/ausweb/ausweb96/educn/omari/. Accessed: 23 May 2002

Owston, R. D. 1997. The World Wide Web: A Technology to Enhance Teaching and Learning? http://www.edu.yorku.ca/~rowston/article.html. Accessed: 20 July 2002

Pask, G. 1975. Conversation Theory http://tip.psychology.org/pask.html. Accessed: 23 July 2002

Peat, M. 2000. Towards First Year Biology online: a virtual learning environment http://ifets.ieee.org/periodical/vol_3_2000/b06.pdf. Accessed: 5 November 2002

Piaget, J. 1980. Genetic Epistemology http://tip.psychology.org/piaget.html. Accessed: 24 July 2002

Quintana, Y. 1996. Evaluating the Value and Effectiveness of Internet-Based Learning http://www.isoc.org/inet96/proceedings/cl/cl 4.htm. Accessed: 12 April 2002

Riel, M. and Harasim, L. 1994. Research Perspective on Network Learning Environments: In *Journal of Man-Machine Learning*, 4 (2 & 3), pp. 91-114.

Roblyer, E., Havriluk, M. D., Edwards, Jack, and Havriluk, M. A. 1997. *Integrating Educational Technology into Teaching*, Merrill, Upper Saddle river, NJ.

Salomon, G. 1991. Symbol Systems http://tip.psychology.org/salomon.html. Accessed: 24 July 2002

Sandy, B. and Oleg, L. 1999. A Framework for Pedagogical Evaluation of Virtual Learning Environments http://www.jtap.ac.uk/reports/htm/jtap-041.html# Toc463843827. Accessed: 24 April 2002

Spiro, R., Feltovitch, P. and Coulson, R. 1988. Cognitive Flexibility Theory http://tip.psychology.org/spiro.html. Accessed: 24 July 2002

Strommen, E. F. 1992. Constructivism, Technology, and the Future of Classroom Learning http://www.ilt.columbia.edu/publications/papers/construct.html. Accessed: 07 March 2003

University of Pretoria; 2003. Telematic Learning and Education Innovation. "Virtual Campus; Constructivism and virtual learning environments": http://www.up.ac.za/telematic/virtual/construc.htm. Accessed: 20 August 2003

Vygotsky, L. S. 1978a. Mind in society; the development of higher psychological processes, (Cole, M., John-Steiner, V., Scribner, S. and Souberman, E., eds.). Cambridge MA, Harvard University Press.

Vygotsky, L. S. 1978b. Social Development Theory http://tip.psychology.org/vygotsky.html. Accessed: 24 July 2002

Wise, L. and Hughes, C. 1996. Integrating WWW into an on-campus laboratory-based teaching program http://elmo.scu.edu.au/sponsored/ausweb/ausweb96/educn/wise/. Accessed: 12 May 2002

APPENDICES

Appendix A: <u>The On-line Questionnaire</u>

UNIVERSITY OF NATAL
DURBAN, EDGEWOOD, MEDICAL SCHOOL AND PIETERMARITZBURG

As part of the computer-based learning project conducted at Dale College, it is imperative that the learning process be evaluated through feedback from the participants of the project. You are therefore kindly requested to answer the following questions and send the questionnaire as an email attachment to kavumahk@webmail.co.za   Thank *you!*

EVALUATION QUESTIONNAIRE

Indicate your choice of **answer** with a **cross (x) by clicking** on the relevant answer box or **writing** in the **spaces provided**.

SECTION A
AIM: To solicit information regarding the demography of the target student population.

QUESTIONS
1. To which age group do you belong?

   ☐ Under 15   ☐ 16 – 20   ☐ 21 – 25   ☐ Over 25

2. Do you reside in the school hostel?   ☐ Yes   ☐ No

3. How do you rate your interest and capability in using computers?

   ☐ Very high   ☐ High   ☐ Moderate   ☐ Poor

SECTION B
AIM: To solicit students' opinions regarding the use of **computer-based learning** in the execution of learning activities in terms of its **enticing or alluring** capabilities as well as **motivational** potential and **usefulness** in enhancing learning.

QUESTIONS
4. The use of computer-based learning is more **interesting** than the normal teacher-based classroom learning and should therefore be encouraged in schools.

   ☐ Strongly agree   ☐ Agree   ☐ Disagree   ☐ Strongly disagree

Give reasons why:

_____

_____

_____

5. Do you think that learning through the use of a computer-based classroom is a **better** way of learning than the normal teacher-based classroom learning and why?

☐ Yes ☐ No

Give reasons why: _____

_____

_____

SECTION C

AIM: To evaluate the **accessibility** of computer-based learning facilities.

QUESTIONS

6. Did you experience any problems in getting access to a computer to carry out your learning activities? (Were networked-computers easily available whenever you wanted to do your class exercises?)

☐ Yes ☐ No

Give reasons why: _____

_____

_____

SECTION D

AIM: To solicit the perceptions of students with regards to the **usefulness** and influence of the **Internet and WWW** in the execution of learning activities.

QUESTIONS

7. Was the linking of the computer-based classroom to the Internet useful towards your learning and why?

☐ No ☐ A little bit ☐ Moderately ☐ Very much

Give reasons why: _____

_____

8. It was easier to get information that you needed to use for your assignments from the Internet than from the school library.

☐ Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree

9. Searching (resourcing) for information using the Internet helped students to develop new skills of evaluating important material found on the World Wide Web (WWW) as well as gave them a better understanding of the subject matter.

☐ Strongly agree   ☐ Agree   ☐ Disagree   ☐ Strongly disagree

SECTION E

AIM: To evaluate the **quality** and **design** of the computer-based classroom (website) as well as its **effectiveness** in delivering the learning material.

QUESTIONS

10. Indicate your opinion regarding the following aspects (usability) of the Computer-based classroom (website) by putting a cross in the relevant box:

	Strongly agree	Agree	Disagree	Strongly disagree
10.1 the design was effective for learning.	☐	☐	☐	☐
10.2 the general appearance was appealing.	☐	☐	☐	☐
10.3 the presentation of learning material and activities was clear and understandable.	☐	☐	☐	☐
10.4 the linkage of web pages gave you more control over your learning.	☐	☐	☐	☐
10.5.the web-classroom (web site) was easy to use.	☐	☐	☐	☐

11. What is your opinion regarding the **reading** of learning material from a computer screen rather than the chalkboard or books?

☐ Better   ☐ Similar   ☐ Worse

12. Which of the following features of the computer-based classroom were more helpful towards your learning? (You can select more than one feature)

☐ Email
☐ Discussion Forum
☐ Chat
☐ Revising readings, activities and messages on the discussion forum

13. Which of the following computer generated features did you find most useful in expressing your understanding in the assignments? (You can select more than one).

☐ Text   ☐ Colours   ☐ Graphics (pictures)   ☐ Video   ☐ None

SECTION F

AIM: To solicit students' opinion with regards to the effectiveness of the **communication paradigms** as well as their **influence** on the learning process.

QUESTIONS

14. Under which of the following conditions did you use email communication in your learning process? (You can select more than one condition):

☐ To contact the facilitator when I encountered problems.
☐ To submit my assignments
☐ To discuss problems with my classmates

15. Did you find the discussion forum useful towards your learning?

☐ No   ☐ A little bit ☐ Moderately   ☐ Very useful

16. How did you find the method of communication in the computer-based classroom as compared to the way you normally communicate in the real classroom at school?

☐ Easier   ☐ Same (no difference)   ☐ More difficult

17. Which one of the following communication methods did you mainly prefer to use in the computer-based classroom and why?

☐ Email   ☐ Chat   ☐ Discussion forum

Give reasons why: _____

_____

SECTION G

AIM: To ascertain whether students experienced any change in learning behaviour induced by the computer-based learning process.

QUESTIONS

18. Did you develop (acquire) any new ways of learning (learning or study habits) as a result of using the computer-based learning method?

☐No   ☐Very few   ☐Many   ☐Very many

19. Did the computer-based classroom help you to develop any of the following learning behaviour?

	Yes	No
19.1 Offering assistance to your classmates	☐	☐
19.2 Sharing of your knowledge and expertise.	☐	☐
19.3 Responsibility for your own learning.	☐	☐
19.4 Set your own learning pace (Self-paced learning)	☐	☐
19.5 Applying proper time management	☐	☐
19.6 Punctuality in handing in assignments.	☐	☐
19.7 Creating your own understanding of the topic.	☐	☐

20. Was the method of working together (collaboration) in the computer-based classroom useful in your learning?

☐ No ☐ A little bit ☐ Moderately ☐ Very useful

21. Did the use of computer-based learning help you to understand the subject matter (Bacteria & Fungi) better than if it were taught by a teacher?

☐ Yes ☐ No

22. Did the use of computer-based learning help you to remember (keep the knowledge) of the subject matter (Bacteria) better than if you learnt it in the real classroom at school?

☐ Yes ☐ No

23. Was the time allocated and used for the computer-based learning activities sufficient?

☐ No ☐ A little bit ☐ Moderately ☐ Sufficient

24. Do you feel satisfied with the learning process of using the computer-based classroom in this project?

☐ No ☐ A little bit ☐ Moderately ☐ Satisfied

25. Do you feel that you have achieved something useful from using computer-based learning and why?

☐ No ☐ A little bit ☐ Moderately ☐ A lot

Give reasons why:

26. Did the experience of using computer-based learning make you more enthusiastic and interested in using this method of learning and why?

☐ No ☐ A little bit ☐ Moderately ☐ Very much

Give reasons why:

SECTION H

AIM: To probe the general demographic profile and disposition of the students with regards to their level of computer literacy, perspective on technical assistance and attitude towards computers.

QUESTIONS

27. Was your level of computer knowledge (literacy) enough in enabling you to carry out all the learning activities in the computer-based classroom?

☐ Yes   ☐ No

28. Did learning through the computer-based classroom suit your style (way) of learning?

☐ Yes   ☐ No

29. How do you rate your active participation (engagement) in the learning process of the computer-based classroom?

☐ Very low   ☐ Slightly low   ☐ Moderate   ☐ High   ☐ Very high

30. Would you have preferred to remain anonymous (unknown) when using the computer-mediated communication like email and discussion forum during the learning activities?

☐ Yes   ☐ No

Give a reason why:

_____

_____

_____

SECTION I

AIM: To ascertain whether the course facilitator and subject topic had any influence on the learning process.

QUESTIONS

31. Did the facilitator have any influence on your learning in the computer-based classroom? If so, how?

☐ No   ☐ A little bit   ☐ Moderately   ☐ Very much

How?

_____

_____

_____

SECTION J
AIM: To ascertain whether students experienced change in learning behaviour at differing stages of their learning.

QUESTIONS
32. Did you experience any differences in your learning at the different stages of your learning in this course? [Was your way of learning at the beginning (exercise 1) different from that at the end (exercise 6) of this course?]

☐ No   ☐ Yes

Give reasons why:

_____

_____

_____

N.B: SAVE THIS QUESTIONNAIRE!!!!

*Do not forget to **SAVE** this document as **QUESTIONNAIRE.doc** and then email it to me as an attachment at **kavumahk@webmail.co.za***

Thank you for participating in this project.

Appendix B: The In-depth Oral Interview Questions

1. How was the **learning experience** in the virtual classroom different from that which you are accustomed to in the traditional classroom? In terms of:

   - Active involvement (engagement) in the learning process.
   - Independence (autonomy)
   - Searching for information and compiling your own work.
   - Setting your own learning pace.
   - Taking responsibility for your own learning
   - Collaborative learning
     - Peer to peer interaction (sharing & assisting each other on discussion forum) through reading and responding to peers' messages on discussion forum

2. Did you acquire any **new learning behaviour** (study habits) with regards to:
   - Taking responsibility for your own learning.
   - Controlling your own learning pace.
   - Promptness
   - Self-motivation.

3. Did the following factors help you to better **understand and learn** the subject?

   - Active engagement (involved) in the learning process.
   - Creating your own understanding of the subject content (matter) through learning activities (resource collection, article review, compiling reports).
   - Applying what you already knew to understand new information.

4. Did your **Independence** affect your learning positively or negatively? How?

5. Did you experience any **difference in learning** during the initial stages of learning as compared to the final stages of the learning process? How? (Difficult at first and easier with time). Explain why?

6. What is your general opinion regarding the use of the **virtual online classroom** as a medium of learning in high schools.

7. What is your opinion regarding the usefulness of the **Internet and WWW** in terms of:
   - Providing a source of learning information – rather than a library
   - Delivering learning (anytime and anywhere) – rather than a teacher (physical classroom).
   - Providing communication medium (CMC) – rather than verbal face-to-face dialogue.

8. What is your opinion regarding the accessibility of the virtual classroom **anytime, anywhere**?

9. How do your compare the computer **learning tools** (text, screen, video, and graphics) with tools in the traditional classroom (chalkboard, chalk, pen, paper, text-books).

10. What is your opinion regarding the mode of **communication** in the virtual classroom compared to the traditional classroom? (Easy/ Fun/ Better/ Quicker/more convenient/No face-to-face).

11. What were the **main problems** you experienced when using the virtual online learning process?

Appendix C: <u>Screen Capture of Virtual Classroom</u>