LEARNING AT A DISTANCE: THE EXPERIENCES AND ATTRIBUTIONAL STYLE OF SECONDARY STUDENTS IN AN AUDIOGRAPHICS TELECONFERENCE CHEMISTRY COURSE

KIMBERLY ANN MADORE

LEARNING AT A DISTANCE: THE EXPERIENCES AND ATTRIBUTIONAL STYLE OF SECONDARY STUDENTS IN AN AUDIOGRAPHICS TELECONFERENCE CHEMISTRY COURSE

By

Kimberly Ann Madore, B.Sc., B.Ed.

A thesis submitted to the School of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Education

Faculty of Education

Memorial University of Newfoundland

April 1998

St. John's Newfoundland

Abstract

This study investigated the experiences of secondary students in an audio-graphics teleconference chemistry program from the students' perspective. Two theoretical perspectives were used to guide the study. The first was based on the ideas of Moore and Garrison who highlighted the importance of interactions to students' learning. Garrsion argues that these interactions are supported by the interactive capability of teleconference technology. The second was derived from the literature on motivation, in particular Weiner's attribution theory. From this perspective, students' motivation to persist and succeed in distance education was studied and the attributional style of both distance and non-distance students was compared.

Data collection included diary entries, telephone interviews, a questionnaire, an Attributional Style Questionnaire, and a Causal Dimension Scale. The data provide insight into students' opinions concerning the teleconference technology, their characteristics and motivation, and the distance learning environment (workload, supervision, organization, etc.). The results revealed a character profile of the distance learner. These students reported being organized, responsible, independent, mature individuals. The majority of distance students attributed to their success in distance education chemistry to level of effort. There was a significant difference in the attributional style of the distance and non-distance students. The non-distance students

tended to have a 'pessimistic' attributional style while the distance students had a more 'optimistic' one. The results clearly indicated the importance of the interactions described by Moore. All interactions, except learner-learner between different sites, were supported by the teleconference technology.

Table of Contents

List of Tables and Figures

Chapter 1

Overview of the Study

Distance education is a form of education in which the teacher and the students are separated geographically and there is no face-to-face contact between the participants. This type of education has developed from its origins in correspondence courses based solely on print material to include instructional delivery that utilizes various forms of technology. For example, courses have been offered through videotape, broadcast television, radio, teleconference, and more recently the Internet, including the World Wide Web.

The province of Newfoundland, Canada is largely rural, and its population is scattered over a wide geographical area, with the majority of the population at the geographical extreme. This province has had long experience with distance education at the post-secondary level to increase access in the rural areas. The emphasis on distance education emerged in the 1960's because it was difficult for people located in rural communities to access programs offered by the province's only university. With the major expansion of post-secondary education in the 1960's, distance education was seen by

policy makers as an effective way to serve the local population.

Distance education at the secondary level had its origins in a report on small schools (Riggs, 1987). Many small communities have schools with low student enrollments and few teachers specialized in the mathematics and science curriculum. Distance education was seen as an important element in a strategy to improve educational opportunities for students in these schools.

Improved access to education has been one of the main justifications for developing and implementing distance education. However, some writers have expressed concern with the nature of the interactions between teacher and student and among students, which occur when a distance education format is used. The concern exists that correspondence and other forms of distance education cannot provide for the kinds of interactions necessary for effective learning. Garrison (1990) emphasizes the importance of sustained two-way communication to ensure that the educational experience goes beyond transmitting information. Garrison (1990) argues that audio-teleconferencing can provide interactions that are not possible through more conventional correspondence courses. According to Garrison, a teleconference approach to distance education helps reduce the isolation associated with correspondence. By using teleconferencing as the central feature of course delivery, distance education will approach the interactive ideal of an educational experience (Garrison, 1990).

Moore (1993) has extended this idea, arguing that:

educators need to organize programmes to ensure maximum effectiveness of each

> type of interaction, and ensure they provide the type of interaction that is most suitable for the various teaching tasks of different subject areas, and for learners at different stages of development. (p. 23)

Both Moore and Garrison have highlighted the importance of interactions to the increased motivation of learners and to a higher quality learning experience in distance education. Both have argued that technology is available which optimizes communications between the participants and the instructor of a distance education course. As a result, the experience of learning at a distance need no longer be considered as isolating students and teachers from each other.

Distance education does require that students be capable of working independently and without much supervision. Even though students in classroom instruction must be responsible for completing their work, they have the assurance that a teacher is available on site for assistance both during and after school. The requirement for greater independence in distance education suggests that students with certain personal characteristics associated with independence or internal motivation may be better suited to such courses than students who are more dependent or externally motivated. This presents an interesting dilemma, because if students are selected, or select themselves, for participation in distance education because of these characteristics, then student motivation rather than access, could become a driving force for participation. To the extent that there is such selectivity, one of the main purposes for distance education may be defeated.

There has been no formal evaluation of distance education programs at the high school level in this province. While this study was not designed as a comprehensive evaluation of the program, it should shed some light on matters of distance education policy by focusing on student perceptions, an area which is often neglected in program evaluation research. This study has focused on the chemistry program offered through audio-graphics teleconferencing to high school students in rural Newfoundland.

Purpose

Distance education at the high school level in Newfoundland is relatively new. The first course, in Advanced Mathematics, was offered in 1988. Since then further courses in, Physics, French, and Chemistry have been added. All of these courses are taught via an audio-graphics teleconference network and include support materials such as student handbooks. A concerted effort has been made by course designers to prepare the materials specifically for distance delivery. The audio-graphics approach has been used to overcome some of the limitations of the correspondence format, specifically to provide for more direct learner-instructor interactions.

Although the program has expanded substantially over nearly a decade, few studies have been carried out on its reception or its effectiveness. An early study (Wright, Banfield & Drover, 1989) did conclude that students' grades are comparable in the

distance and non-distance versions of Advanced Mathematics. Beyond this the program has been left to expand without much thought to issues such as student reaction, selectivity, effect of the technology, nature of the interactions occurring, or other matters.

Enrollment data indicate that a much lower proportion of students in small schools take the chemistry courses by distance education than of students in other schools who take the course in the regular classroom format (14% in small schools compared to 31% in other schools). Thus, despite the relatively equal access to the courses, fewer students are opting for chemistry by distance than do so ordinarily. This suggests that some element of selectivity is at play. The question is whether this is a matter of self-selection or of school or teacher selection and, more importantly, whether selectivity is related to student characteristics such as ability to work independently, level of responsibility, or attributional style.

Student perceptions of distance education, their attributional style, and their performance are all key issues which warrant research. Although levels of achievement appear to be comparable, the question of whether there is a matter of selectivity or of other student characteristics requires investigation. What characteristics and/or behaviors are unique to the distance learner? What, if any, obstacles have to be overcome by students to do well? Do distance students have to work harder to achieve at the same level? Could there possibly be a difference in the attributional style of distance learners compared to the non-distance learners? Does attributional style influence the motivation and performance of students in distance education courses?

In summary, the purpose of the study was to investigate several key issues in the distance education program. These are:

1. What are the students' perceptions of the teleconference environment? In particular, does the technology from the students' perspective provide the opportunity for learner-instructor and learner-learner interactions as identified in the work of Moore and Garrison?
2. How do the characteristics of students in distance education chemistry differ from those of students in a classroom course? In particular, are the attributional characteristics of the two groups different?
3. What do the distance students do to perform well? How does the performance of distance students compare to that of students in classroom chemistry?
4. How do students in distance education view the required workload, the ability to interact with teachers, the need for independence, and other aspects of the distance education environment?

Context

The existence of many small schools in rural communities is one of the distinctive features of education in Newfoundland. In 1996-97, for example, about 130 of the 470

schools in the province had enrolments of fewer than 100 students. Despite a major school consolidation effort over the past several decades, the scattered nature of the population, and an overall decline in enrollments, have resulted in a situation in which small schools must be seen as a permanent feature of the system.

At the high school level, one of the consequences of small school size is the inability to offer more than a minimum core program. This problem has been exacerbated since a broadly-based program, with an expectation that students have some choice of courses, was introduced in the 1980's. A particular problem of small schools is the inability to offer Advanced Mathematics and Science courses, and courses in French. These have been the courses targeted through distance education in an attempt to alleviate the problem of accessibility.

The high school distance education program began in September 1988 with 36 students, a half-time teacher, 13 small schools and one course in Advanced Mathematics. In 1995, 97 of the 178 small schools offered the high school program and 78 were classified as distance education sites. In the 1996-97 school year, there were 15 distance education instructors delivering a total of 10 courses including French (2 courses), Mathematics (4 courses), Chemistry (2 courses) and Physics (2 courses) at the high school level. In the chemistry program, for example, there were 30 schools on-line with a total of 156 students enroled.

All the distance education courses use teleconference as the main mode of communication. This method of instruction includes both audio and graphic components

whereby data is transmitted over standard telephone lines. Two-way communications are possible using microphones and an electronic black board. Students may communicate with the instructor and with students at other remote sites. The teleconference classes are supplemented with print material and laboratory videos, as well as, with telephone and facsimile communications.

Significance of the Study

This study provides an in-depth view of the complex interactions in an audio-graphics teleconferencing course, from the perspective of students participation in the course. The focus on the student perspective is consistent with the view that those most directly involved in and affected by a particular innovation are able to shed light on the value of the innovation and on its detailed workings. In particular, this approach is significant because it opens a direct window into matters of pressures, workload, problems with the technology used, selectivity, and other issues important to gaining a full understanding of the program at hand.

The information revealed in this study has intended to provide explanation, insight, and analysis for individuals interested in developing audio-graphics teleconferencing courses at the secondary level. The insights from the participants will contribute to a higher level of understanding of the audio-graphic teleconferencing environment and how

that environment influences students. The results will also serve to benefit distance education instructors as they reflect on and evaluate their teaching techniques, styles, and strategies.

The information revealed by these students has implications for the future organization of courses and for teaching strategies employed in distance education. Quite possibly there exists a gap between theory and practice for effective teaching strategies in distance education. What teachers and students view as effective instructional techniques could be very different, especially in a distance environment. Feedback from the students concerning how a course is delivered would provide instructors with valuable information for future lesson planning.

Morgan (1984) supports the need for considering students' understandings in distance education course design and teaching. The participant perspective offers a valuable contribution to the planning and implementation of such programs. Students have experience with issues concerning workload, deadlines, scheduling laboratory activities, frustrations with the technology, and pressures with this learning environment. Their opinions offer course designers feedback from the ground level.

The students can shed light on the theoretical debate concerning the potential of teleconferencing for two-way communications. It is reasonable to surmise that increased interactions between students and their instructor will reduce the isolation associated with distance education and will make this learning environment more like that in the regular classroom. However, students may not feel that these interactions are necessary. They

could be just as successful in distance courses modeled by the traditional correspondence design as they would be in those incorporating interactions through teleconference or computer conference designs. The description of students' experiences in distance education would justify the mode of instruction employed.

Students' comments, opinions, and ideas may serve as a guide for policy issues in future distance education endeavors. Is distance education actually increasing accessibility to courses as is generally assumed by its supporters? The selective nature of students in taking distance education courses offers a challenge to policy makers. They must re-evaluate the rationale for distance programs and determine how to target a greater percentage of the student population. This is not a concern for just secondary level courses. This challenge exists at every level of distance education programming. Thus, this research has implications on an international level as the global society increases its emphasis on distance education programs.

Overall, the results of this study offer decision makers an elevated level of understanding and thus constitute important contributions to the decisions being made about distance education. The results of students' responses which reference the educational transactions described by Garrison and the types of interactions highlighted by Moore may be used to determine whether or not they influence students' learning at a distance. As well, the importance of such interactions may have many implications for instructors and their approaches to teaching classes at a distance. Finally, a possible connection between attributional style, motivation, and performance could illuminate why

distance education seems to remain a marginal endeavor as a result of students' selectivity Thus, this study is intended to be useful for the improved development of distance education both locally and elsewhere.

Conceptual Framework

This study begins with the idea that our understanding of the teaching and learning process in distance education can be enhanced by examining student perceptions of their experience in this setting. This basic idea has been extended and elaborated through the use of two different theoretical frameworks. The first is derived from the work of Moore (1990) and Garrison (1993) on the nature of the transactions which should be expected to occur in an educational setting. The second is concerned with student motivation. Specifically, the motivational theory referred to as attribution theory (Henry & Campbell, 1995; Seligman & Schulman, 1986; Weiner, 1984, 1985 & 1986; Weiner, Frieze, Kukla, Reed, Rest & Rosenbaum, 1971) has been used as the basis for examining student participation, effort, independence, and other elements which might contribute to success in the program.

Moore (1990) has identified three forms of interaction commonly found in teaching. These are labeled learner-content, learner-instructor, and learner-learner interactions. Obviously, all of these forms of interaction can be found in regular classroom

settings (although the balance among the three may differ substantially from one classroom to another). In distance education, however, these interaction patterns can be altered substantially. For example, conventional correspondence courses involve learner-content interactions almost exclusively, presumably on the assumption that this type of interaction is the crucial one for learning. In fact, correspondence courses would not be sustainable under any other assumption. At the same time, if there is any value in the other forms of interaction, then something important must be missing in distance education through correspondence.

The latter view is the one espoused by Garrison (1993). According to Garrison, the focus for the distance educator should be on what he calls the 'educational transaction' rather than on the acquisition of information. Garrison's notion of the educational transaction parallels that of Moore, in its emphasis on forms of interaction other than learner-content. Garrison thus argues for teleconferencing as a means of overcoming the one-dimensional nature of learner-content interactions.

Obviously, both Moore and Garrison believe that learner-instructor and learner-learner interactions are important for distance education as well as for regular classroom instruction. This view is no doubt shared by most educators, otherwise there would be no point in setting up the elaborate structures required for classroom instruction. It would be sufficient to set students to work with textbooks and other materials which convey the content. It is therefore natural that educators would seek technologies which permit other forms of interaction to occur.

It is interesting from this to speculate why the early expectations about the educational potential of broadcast media such as radio and television have not been realized in practice. The analysis of the different forms of interaction may help explain why this is the case. Although broadcast technology is capable of reaching large numbers of people, and of conveying information in a highly efficient (and even entertaining) manner, this type of communication remains one-dimensional, consisting almost entirely of learner-content interactions. New forms of technology have added possibilities for changing this situation.

Teleconferencing is obviously one form of technology which has some potential for incorporating the other forms of interaction. Using teleconferencing, teachers and students are able to engage in real-time learner-instructor interactions. The particular organization in which students participate in distance education groups within their own schools, and are on-line with the teacher and other students brings the teleconferencing setting much closer to the regular classroom than is the case for other approaches to distance education. At the same time, teleconferencing is somewhat limited in its potential to emulate a normal classroom setting, particularly when based primarily on audio interactions, and where the amount of on-line time is much less than in regular classrooms. The limitations are especially evident when one considers the requirement for access to the technology, the dependency on people actually being able to use the technology, the absence of an on-site teacher, and the reliance on other technologies such as facsimile transmission for some of the interactions which occur.

One of the main purposes of this study is to shed light on the actual interactions which occur in a teleconference-based distance education course, and particularly on student perceptions of these interactions. If good teaching requires the use of all three forms of interaction, then any form of distance education which limits some of the forms is likely to be judged wanting. In particular, success in learning can be expected to be adversely affected by approaches which fail to provide for all forms of interaction. While this study is not primarily about achievement in the course, it is intended to address the strengths and limitations of teleconferencing, in terms of the nature of the interactions which are found to occur.

Turning now to the second theoretical area, this study is also concerned with participation in distance education, and particularly with the attributes of students required for successful participation. Two specific issues are of interest. First, it is clear that the level of participation in the distance education version of the high school chemistry courses is lower than in the same courses taught through regular classroom instruction. This suggests that some form of selectivity (either student self-selection or selection by others) is at play in student decisions to take the course. Related to this is the possibility that students may believe that they should possess particular attributes, such as independence, perseverance, affinity for technology, or other characteristics in order to successfully participate in this type of instruction.

The second issue of interest is whether or not distance students have a different attributional style than their non-distance counterparts. Attribution theory is a particular

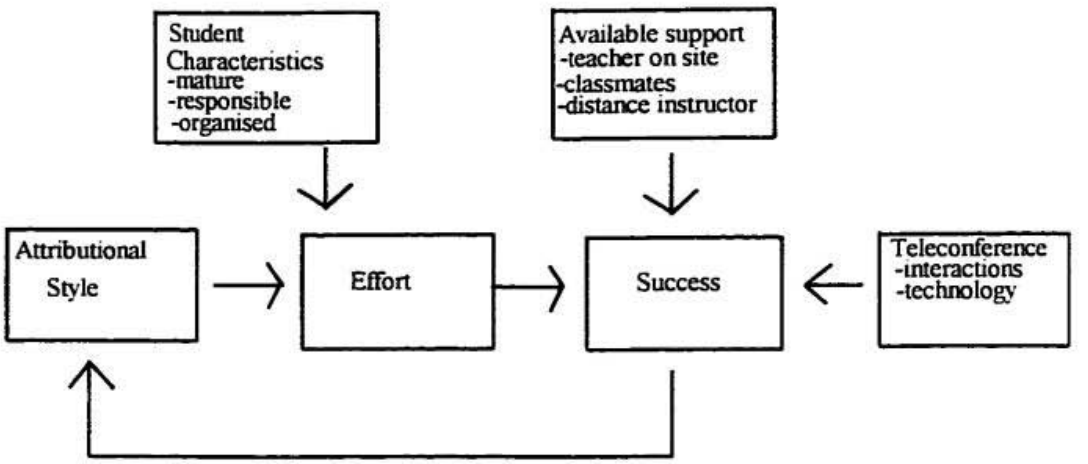
conceptual approach to motivation which deals specifically with the assignment of responsibility for success and failure. This theory had its origins in the work of Weiner (1984) and includes both the cognitive and the affective dimensions. This theory describes how expectancies, emotions, and performance at achievement tasks are determined by the causes that individuals attribute to prior outcomes. The incorporation of the affective domain, outlining specific emotions that are associated with the various attributions, advanced the attribution theory beyond most other cognitive theories. Most theories in the past have focused on either the pleasure/pain principle or the pride versus shame conception for motivation. Attribution theory recognizes a range of emotions that are experienced by students in the classroom such as pride, happiness, hopefulness, positive self-esteem, anger, shame, guilt, hopelessness, etc., and each is associated with a particular attribution. The emotions experienced by a student as a result of the attribution he/she has assigned to a success or failure will determine the motivation level in future endeavors.

Since the nature of distance education involves much independent work, it is anticipated that students possess an internal locus of causality in which learning is perceived to be under their control. This would motivate students to persist in spite of a heavy workload and they would view their level of effort rather than their ability as a predictor of success. Students with an internal locus of causality would be comfortable working independently and would attribute their success or failure to themselves, and not to external factors. Thus, these students would be highly motivated to succeed when faced with a challenge such as taking responsibility for one's own learning.

When students with a particular attributional style enrol in distance education programs, an isolated segment of the population is targeted by this method of instructional delivery. This would in fact narrow the type of students participating in the program which conflicts with the main premise of distance education, accessibility. Thus, this study has approached student characteristics from a motivational perspective to determine if there are particular attributions which separate the distance from the non-distance learners. If, in fact, significant differences are evident between the two groups, the rationale for distance initiatives based on accessibility would need further evaluation.

An overall conceptual framework for this study is represented by Figure 1. Several elements such as effort, attributions, student characteristics, teleconference technology, and available support are linked together and contribute to the level of success perceived by the students.

Figure 1: Conceptual Model



Attributional style is a predictor of the effort level students will employ in their studies as illustrated in Figure 1. The attributional style includes ratings on three dimensions: locus of causality, stability, and globality. When an individual rates the cause of an event as internal, stable, and global his/her attributional style would be categorized as an 'optimistic' one (Seligman & Schulman, 1986). Those who rates the cause of an event as external, unstable, and non-global would be classified as having a 'pessimistic' attributional style (Seligman & Schulman, 1986). According to Seligman and Schulman,

individuals with an optimistic attributional style will be more persistent after failure than those with the opposite style.

Distance education students who have an optimistic attributional style would put more effort into their work, thus increasing the chance of having success in chemistry. The positive emotions associated with their success would continue to motivate students with this attributional style. As well, any disappointments associated with not meeting their expectations would serve to increase the level of effort in these students. Students who believe that success is under their control will continue to be motivated to work to ensure future success.

Proposing that attributional style is the only predictor of success would be an oversimplification of students' behavior. Particular student characteristics such as maturity level, sense of responsibility, and organizational ability may also contribute to the amount of effort students exert. These traits may be perceived by the students as necessary to successfully meet the challenge of a distance education program. This perception would predetermine the students who enrol in the teleconference courses. As a result, only students who are mature, responsible, and organized will be involved. These characteristics would then contribute to the level of effort students employ to be successful in their teleconference course. A student who is determined to succeed under any conditions (optimistic attributional style) may be further motivated by having the ability to work independently, by taking responsibility for ones own learning, and by having good organizational skills.

Another contributing factor to the success of a student in distance education is the amount of support available to the students from a teacher at the site, from their classmates, or from their distance education instructor. Students may avail of the support available to varying degrees. Often the knowledge that help is available is sufficient. However, the opportunity for learner-learner and learner-instructor interactions is present from the help available outside of the teleconference class. For example, students may interact with one another at their site while completing assignments, lessons, or laboratory activities. These interactions may be more important in the distance environment than in the regular classroom environment to compensate for the absence of the instructor at their school. Thus, students form a cohesive network among themselves to increase the chance of success.

The learner-instructor interactions are possible through telephone and facsimile communications outside classtime. There are limitations to both these methods of communication. For example, it is often difficult to explain chemistry concepts in telephone conversations without access to visuals. In facsimile transmissions, the response time and the limited real-time interaction between student and instructor are troublesome.

Of all the possible influences on students' success discussed, the teleconference environment itself would play a major role in students' learning. Not only are learner-instructor interactions possible but also learner-learner interactions. Garrison has extended the concept of learner-learner interactions to include students at different remote locations. It is through teleconferencing that Garrison believes students will achieve these

interactions. The learner-instructor interactions would be most prevalent during the teleconference class. Students, through the incorporation of both audio and graphic components, have two-way real time communications with their instructor. This would simulate the regular classroom teaching environment, providing the greatest amount of interaction between learner and instructor which is argued by Garrison to be imperative for students' learning. Thus, the technology, itself, and the types of interactions it allows contribute directly to students' success.

The technology does have the potential to act as a barrier to students' performance. The comfort level of students with the equipment and the technical problems which could arise from the technology offer the potential for inhibiting student's learning. However, the technical support available during the on-line classes would minimize any problems arising from the technology itself. These students would enjoy the challenge of learning in a different environment if in fact they possess an optimistic attributional style and the previously mentioned personal characteristics.

Overall, this conceptual model has incorporated elements from the theoretical perspectives of Garrison and Moore to assess the audio-graphics teleconference environment. The principles of attribution theory have provided the framework for understanding the motivation of students both in selecting and in completing the course. It is important to note however that a particular attributional style and specific student characteristics thought necessary to be successful would greatly limit the population of students targeted by distance education. In fact, this model does characterize a particular

type of learner who would excel in the distance environment. The rationale for increased accessibility to programming would not be supported with such specific criteria for students enrolling in distance education.

Overview of Methods

This study may be considered an example of action research where the researcher had a dual role of being the researcher and the instructor simultaneously. Adler (1993) supports the notion of the teacher as researcher. She states "teaching and conducting research should be seen, not as conflicting, or even different, but, in fact, as part of the same whole" (p. 160). It is in the role of a researcher that a teacher can reflect upon and evaluate the effectiveness of one's practice. Teachers can use the feedback from the students concerning issues in distance education to assist them in their self-evaluation.

Potentially the researcher as a teacher could bias the results of the study. The students could respond with what they interpret the teacher/researcher is looking for, particularly in the diaries and telephone interviews. A conflict could arise with students interpreting their participation in the study as a component of their evaluation for the course. As well, the researcher could have preconceived notions about the issues investigated in this study.

Every effort was taken to separate the expectations for students participating in the

study from the requirements for their participation in the chemistry program. It was clearly identified in all correspondence between the researcher and the participants that their involvement in the study was voluntary and would have no impact on their performance in the course. Students were assured that they could remove themselves from the study at any time without any repercussions associated with their chemistry performance. There was no reference made to student participation in the study during on-line chemistry classes and all contact was made with the students outside of regular school hours. In any event, the time period (4 months) in which the researcher was instructing students during the data collection was limited. For the remainder of the time, leave was granted from all teaching duties.

In support of the methodology employed, Amundsen (1993) has suggested that the direction of research in distance education should focus more on the learning and the learner. This is consistent with the theoretical framework of this study, which investigates interactions on the one hand and attributional styles and related student characteristics on the other. As well, the majority of data collection was from the participant's perspective.

The students in distance education may be said to construe a setting in terms of their unique experiences and backgrounds. Their performance in this setting reflects their interpretation of the learning environment. Thus, no matter how well intended a particular program such as distance education might be, it cannot succeed if it is not accepted by the participants. For this reason, data collection was conducted from the vantage point of the participants through diaries, telephone interviews and questionnaires. It was the intention

to provide distance education instructors with a rich description of the participant perspective on learning at a distance, which can shed light on the interactions taking place and the student characteristics seen as important for success in this setting.

In the diary entries, students were encouraged to compare their teleconference experiences with those in the classroom on issues of workload, interactions, organization, and participation. The reason why these students enrolled as well as the characteristics they felt were necessary to be successful in distance education were sought to provide a broader description of these students. Through this data, the researcher disclosed the value, meaning, intents, disappointments, and satisfactions associated with distance education chemistry from the student perspective.

A questionnaire was administered to all distance education chemistry students to obtain data from a broader sample than that provided by the diary group. Both descriptive statistics and comparative analyses were completed to evaluate the students' responses on this instrument. A Causal Dimension Scale (CDS) was given to all distance education chemistry students. The results of the CDS were used to assess attributional style of distance learners and were correlated with their performance. The Attributional Style Questionnaire (ASQ) was given to distance education and non-distance education chemistry students to determine the attributional style of both groups.

Overall, qualitative techniques were chosen to best suite the analysis of students' perceptions while quantitative techniques enhanced the comparative component of data analysis. The combination of qualitative and quantitative methodologies were intended to

provide a broad picture of students' experience and performance in distance education chemistry and to offer a comparison in attributional styles between distance and non-distance students.

Structure of the Report

This first chapter has given a statement of the problem, an overview of the context of the study, and an outline of its theoretical and practical basis. The second chapter focuses on the local setting for distance education. The purpose is to provide the reader with a more in depth understanding of the development and implementation of distance education chemistry at the secondary level in Newfoundland. The third chapter consists of a two-part literature review. The first section deals with issues and research in distance education. The second section focuses on the distance learner in terms of students' perceptions of learning and research on motivation. The fourth chapter includes a detailed description of the methodologies employed in this study. The samples, instruments, and data collection procedures are outlined in detail in this chapter. The fifth chapter discusses the analysis of results on the student diaries, telephone interviews, and questionnaires. Finally, the sixth chapter includes a summary of the study and its results, and a discussion of its implications for theory and practice.

Chapter 2

The Context of Distance Education

Accessibility to programs and cost efficiency have been strong rationales for the implementation of distance education. Both at the secondary and the post-secondary level distance education is thought to offer a resolution to the problem of offering a diversified curriculum to students in a wider geographical area. For example, rural schools are often challenged with shortages of teaching personnel or with small numbers of students interested in certain courses. Economically it is difficult to offer courses under these circumstances. However, distance education offers a potential solution to the problem. With distance delivery, several sites that are geographically dispersed can be linked together with an instructor for program delivery. As a result, enough students can be grouped together to form a class. This is in fact the way distance education classes in secondary schools are organized in Newfoundland, Canada.

Origins in Newfoundland

Memorial University of Newfoundland (MUN) became involved with distance education in 1967. A program called FOGO, named after the community Fogo, used videotapes of local experiences to provide access to information from the expertise of locals to other groups in the community. Instructors, generally people in the community, would teach courses during the summer months at sites in Corner Brook, Grand Falls, and Clarenville. The majority of students enrolling in the courses were teachers. Video tapes which simulated a classroom lecture and films were the main mode of instruction. Educational television was also utilized in some courses offered by MUN Extension. Problems arose, however, with the development and structure of such courses which eventually led to their discontinuation.

In 1995, Memorial University's School of Continuing Studies offered first year university courses via broadcast satellite. Two-way communication was optimized with a large screen TV and cameras at the student sites in which students could see the instructor and students at other remote sites. Audio-teleconferencing was established to provide verbal interactions amongst all participants.

Currently at MUN, the main component of distance education courses is print material. The use of teleconference has declined due to cost factors and the nature of the courses being offered via distance education. More recently, the World Wide Web (WWW) has also come into use as a tool in distance courses. The World Wide Web has

become a mandatory component in approximately 10 courses over the last 2 years. Notes are posted on the WWW and links are made to other sites. World Wide Web conferencing is being used to facilitate student interactions.

The use of the WWW has increased accessibility to programs for both instructors and students. MUN has students enrolled from British Columbia, Istanbul, Australia, Norway, and England. As well, instructors are no longer required to be located in Newfoundland. Currently one instructor for MUN is working from Hong Kong.

Distance education initiatives are not limited to the province's University. The Open Learning Information Network (OLIN) was established in 1995, with a mandate to improve access to education in this province. This agency has partnered with MUN, colleges, and the private sector to deliver distance education programs. The programs have included professional development workshops for instructors, instructional designers, and technical specialists. The objectives have included hints for WWW page design, explanations of what is involved with putting a course on the WWW, descriptions of the instructors' changing role, demonstrations of how to incorporate theories of collaborative learning in this type of medium, and information on copyright laws. The programs have generally involved a correspondence design with an audio-teleconferencing component. In 1997, a business course was designed with a multimedia environment philosophy which incorporated CD Rom, WWW, and computer conferencing to promote problem solving and to enhance group learning.

At the college level in Newfoundland, a strategic plan for distance education was

established in 1995. As a result of this plan, the provincial community college, now known as the College of the North Atlantic, has partnered with the private sector to develop distance education initiatives. The College serves the role of content provider and instructional designer, while the private sector is the technology/multimedia provider. The methodologies employed included modular correspondence/learning activity packages, audio-conferencing, videos, texts, and institutes which were supported by telephone tutoring, E-mail correspondence, mail correspondence, and facsimile. The latest program being piloted in September 1997 was delivered fully on the Internet which included computer conferencing and E-mail assignments.

The delivery of distance education programs has varied substantially since its origins. Initially, the main emphasis was on increasing accessibility to programs. Over the years, the method of instructional delivery has varied. Recently, program design has been grounded in learning theory and in promoting interactions among the teachers and students. Course designers have been intentionally developing courses that include elements to reduce the isolation of distance courses. For example, conferences using the World Wide Web and teleconference classes have been designed to facilitate student interaction.

A great deal of effort has also been expended for the development of distance education courses at the secondary level. Teachers were contracted to put together student materials for the distance education chemistry program. A closer examination of the process for implementing high school distance education courses will provide a more

comprehensive picture of its organization in this province.

Distance Education Chemistry in Newfoundland

The Department of Education joined the three other Atlantic provinces in 1995 to develop a common chemistry curriculum. At the same time, it was decided to offer chemistry to rural schools through distance education. The development of the two chemistry courses (2202 and 3202) for implementation in distance education was initiated in January 1995. The course materials included student handbooks, laboratory manuals, laboratory videos, and evaluation instruments.

The student handbooks were designed to supplement the on-line chemistry classes. The intention was to have all the instructional information that a teacher would give in a classroom lesson written in the student handbooks. A handbook was written for each unit in the chemistry program and was subdivided into individual lessons. Each lesson included learning objectives, topic explanations, sample exercises, practice exercises, and textbook references. As the students worked through each lesson they completed the knowledge objectives of the chemistry course. Laboratory activities were also developed to target the skills objectives of the program.

The choice of which laboratory activities to include was a challenge since students and teacher would be separated from one another. Safety was always a concern.

Mandatory supervision by a teacher at each remote site was a condition imposed upon schools that chose to offer distance education chemistry. The activities were developed and field tested by qualified chemistry personnel prior to their inclusion in the program. Video tapes were produced which outlined proper laboratory techniques, disposal techniques, and safety concerns for each activity. The videos also included demonstrations to enhance the exposure of students to chemistry. It was the intention to make the experience of chemistry as realistic but as safe as possible. The program was designed so that the students in distance education were provided the same opportunities as students in classroom chemistry. They completed problem exercises, laboratory activities, and evaluation instruments, just as students in the classroom would.

The evaluation instruments for distance education consisted of assignments, unit tests, midyear, and final exams. Each of these were constructed one year in advance of their utilization and were mailed to each site a couple of months prior to the commencement of the school year. The principal or distance education coordinator in each school was responsible for the security of the instruments. These individuals also served as a liaison between the school and the distance education instructor. Generally, if there were technical problems with the distance education equipment, the coordinator would be available for assistance.

The distance education courses were delivered through an audio-graphics teleconferencing network in which data transfer occurred over standard one-line telephone facilities. The sites were signed on by the teleconferencing operator and generally, there

was a maximum of 15 students from multiple sites on-line at one time for a class. Both the instructor and the students had access to a telewriter (electronic pad) and light pen, monitor, computer, modem, microphone, and speaker box. To further enhance communication a fax machine and a telephone, dedicated to distance education participants, were installed at each remote site and at each teaching site. The classes were scheduled so that fifty percent of instructional time was for teleconferencing (on-line) classes and fifty percent of instructional time was for off-line work sessions. It was during the off-line classes that the students completed assigned work in the handbook and/or textbook or completed laboratory activities. All classes were of forty minutes duration.

During the first week of classes, detailed schedules were faxed to the students. These identified when to complete each lesson in the handbook, when to watch laboratory videos and complete laboratory activities, when to view the video disc segments, when to pick up assignments, and when tests, assignments, and lab reports were required to be submitted. All assignments, lab reports, tests, and exams were faxed to the distance education instructor to be corrected. The instructor faxed to each student a grading sheet which identified where marks were gained or lost, and an answer key which had each question completed in detail so that students could identify their mistakes. The turn around time for feedback was minimal because the fax machine was used for communication.

Differences Between Distance and Classroom Chemistry

There is an inherent challenge for students who choose to take distance education chemistry compared to those students who take classroom chemistry. The distance students must motivate themselves to persist in a learning environment where their teacher is not located in the same school. These students need to be self-disciplined and able to work independently because they do not have their teacher on site. To compensate for the distance delivery a great amount of effort went into the development of the course materials.

The question of why such emphasis was placed on developing curricular materials for these courses compared to regular classroom courses was an appropriate one. The most likely explanation was that the designers wished to offset the effect of not having a classroom teacher present. Learning chemistry was challenging in itself without the added burden of having to learn without the teacher present in the school. Naturally, there was an obvious desire to ensure the success of the distance program. Therefore, extra resources were developed for the distance students that would not have been completed for the classroom teacher. In this sense, the students in distance education may benefit from the extra developmental effort for the teleconference courses.

The extra materials developed for students and the teleconference classes were intended to help students learn at a distance. However, the experience could potentially be an isolated and lonely one. To offset this, the instructors in chemistry made every

effort to promote the social aspect of education. Students and instructors exchanged photographs, faxed student information sheets, attended graduations when geographically possible, wrote letters, or made contact using electronic mail. As well, there was a close relationship between instructors and distance coordinators in the schools, and through this network student work was monitored if problems arose. Like classroom teachers, contact was made with parents to discuss the performance problems of students who were experiencing difficulties. Even though student performance was closely monitored, there was a great deal of responsibility required of students in a distance education course.

In distance education, the students had to follow a specific time line. The students were responsible to have their work faxed according to schedule. They generally had to work independently during their off-line classes to complete the course lessons and assignments. Students often completed lab activities without the assistance of qualified chemistry personnel, and often did so during after school hours. With such responsibility assumed by the student, the selection of students for distance education was sometimes more stringent than for other classroom courses. During the selection process, principals tended to consider the work ethic and responsibility level of students before recommending them for these courses.

Overall, the proportion of students taking distance education chemistry was relatively small. For example, in 1996 - 1997 less than 15% of the high school population in small schools were enrolled in chemistry compared to 31% enrolled in schools with classroom chemistry (Department of Education, 1997). The accessibility rationale used to

justify distance education was not supported by the course enrollments in chemistry

The course offerings in distance education have represented a limited view of accessibility to programming. Only advanced courses such as chemistry, physics, french and advanced mathematics have been developed for distance instruction. This combined with a selection process for students entering the teleconference courses has served to further limit the segment of the population targeted by distance delivery. Thus, the justification for distance education as a viable alternative to classroom teaching is challenged by the program's own design.

As a distance education instructor, I felt the program was worthwhile. The students who were enrolled in chemistry generally had ambitions for future post-secondary studies. It was a great opportunity for them to complete more mathematics, language, and science courses. Even though a small segment of the student population was benefiting from the program, it gave these students in rural communities the opportunity to complete the same programs as their urban counterparts. Hopefully, the experience of completing a teleconference course also developed the students' organizational skills and promoted good study habits. These skills can be generalized across any subject area and should benefit the students regardless of their future educational choices.

Chapter 3

Literature Review

Distance education opportunities at both the secondary and post-secondary levels, have been expanding throughout the world. Universities and schools are offering more distance courses targeting a population of students who, for whatever reason, are unable to enrol in courses offered only on location in the institutions. This expansion is likely driven by several factors, including a desire to improve access to education, the emergence of new technologies for delivery and progress, and the need to find more cost-effective means of providing programs.

A common theme has emerged concerning the reasons why distance education is considered a viable and an important operation. Barker (1991) suggests that

> state-sponsored curriculum reforms, reduced state fiscal revenues, impending teacher shortages, and advances in telecommunications technology have spawned great interest in distance education technologies as an alternative delivery methodology. (p. 204)

The consensus is that distance education provides educational opportunities for students in rural schools where there are low enrollments and a shortage of qualified teachers (Holmberg, 1995; Beckner & Barker, 1994). Since several sites that are geographically dispersed can be linked together for program delivery, distance education appears to be a solution to the problem of offering courses in rural schools with limited enrollments. However, the fact remains that as long as distance education is seen as a means of access for those small numbers of students who have no other access, it is likely to remain a marginal endeavor.

Distance education must go beyond access to disadvantaged groups for this method of instructional delivery to become an integral part of the education system. Ljoså (1992) has identified the following possible functions of distance education:

- ✓ distance education can balance educational inequalities that exist between generations by offering courses for adults.
- ✓ distance education can provide a more flexible opportunity to up-grade education for those individuals who entered the workforce without completing secondary schooling without giving up their employment.
- ✓ distance education can be an effective means of organizing short educational programs whenever an educational campaign is required for large audiences.
- ✓ distance education can be used to offer specific teacher training

programs when curricular changes occur in the school system. There is also the potential to offer programs to groups that have been previously neglected in the school system.

- ✓ distance education can expand the capacity of education in light of new educational needs when the regular school system is overcrowded with a demand for new programs.
- ✓ distance education can extend opportunities to those who live in sparsely populated areas when access to programs is limited due to their geographical isolation.
- ✓ distance education can provide more flexible opportunities for individuals who prefer to continue working while studying.
- ✓ distance education can offer more flexibility to people who are required to develop competence in more than one field or who are required to change their occupation.
- ✓ distance education can offer the possibility of trans-national networks and programs when they are not offered at a local level.

The applications of distance education described by Ljoså are designed mostly for adult education. Even though the role of distance education in post-secondary education appears to be diversifying, the directions that have been taken at the secondary level remain at the level of accessibility. Generally, the courses that are offered through distance education to secondary schools are academic. The proportion of students

interested in taking such courses is limited. The distance education initiatives are targeting a very small segment of the student population, reducing it to the margins.

For distance education to play a greater role in education, initiatives could be developed which link secondary schools with partners in the community. For example, students would have virtual classrooms where the guest speakers were not located in the same community. As a result, the population targeted by distance education would go beyond the academic student and become an integral component of any subject area.

The possible uses of distance education in the curriculum are limited only by one's imagination. However, reality does exist. The cost of implementing distance programs is substantial and must be taken into consideration when planning initiatives. There is evidence in the literature of the discrepancy between perceived benefits of distance education and the reality of implementation.

Challenges with Distance Education Initiatives

Despite the apparent promise, there are many challenges in the global expansion of distance education. It is not an easy endeavor to deliver courses through distance. The enrollment numbers, quality of print materials, associated costs, and technical difficulties are just a few of the inherent problems with distance programs. Arger (1990) argued that "distance education's promise of being able to provide a quality, cost effective education

for the masses of the Third World is not a reality" (p. 17). There is a discrepancy between the perception and the reality of success with distance education. Some examples used by Arger (1990) to illustrate this point follow.

In Papua New Guinea financial and physical constraints have led to very few individuals enrolling in the distance courses. These courses are mostly composed of print material with very little audio material incorporated. Arger (1990) believes that neither goal of quality nor quantity was successfully achieved with this orientation to distance education.

The goal of mass education in Malaysia was also under critical scrutiny as only 15 to 20 percent of Malaysia's university demand was provided for by distance education in Malaysia itself. Even though the quality of the print material in its programs was credible and the established teleconferencing network appeared impressive, the issue of cost effectiveness was not resolved. In Thailand, the Sukhothai Thammathirat Open University (STOU) has had impressive enrollments in its distance education programs and has had a solid reputation for the quality of the print material. However, the incorporation of radio and television programs has caused problems in the organization of courses and has led to a loss of quality. This could be a contributing factor to the high attrition rates exhibited in some of the courses offered by this institution which has challenged the cost effectiveness of the programs (Arger, 1990).

In each of the examples discussed above and in most distance education programs, a major problem exists with low student enrollments or high attrition rates. Only a small

group of individuals are completing these programs. The motivating force that is driving these students was not discussed. Possibly the distance students share common characteristics that distinguish themselves from those who do not enrol in or those who drop out of the programs. For whatever reasons, distance education remains on the margins in most localities.

Outside of the trouble with enrollments and attrition, distance education has many complex technical and organizational issues which need to be addressed to justify its global implementation. For example, the telecommunication and mail systems in Third World countries certainly offer challenges to delivering quality distance education programs. As well, funding is a major issue with any institution offering distance education. The financial commitment for upgrading and maintaining the technology used in distance education is a concern for any institution involved in such endeavors. Technology is advancing at an extremely rapid pace. It is a concern that distance education will become more structured and less available to students as the technological requirements become more advanced. According to Garrison (1990) "if distance education becomes increasingly technologically based, then it will become a privilege of the well-educated who are able to afford the latest technology to access educational programs" (p. 50). The irony of the situation is clear. The more advanced technology and the higher level of technological expertise required for distance education programs would actually limit the students capable of enrolling in the courses. This would defeat one of the main purposes of distance education, that of accessibility.

Some institutions are providing students with the required technology for their distance programs so that any problems associated with access to technology are eliminated. For example, in Newfoundland high schools, the equipment and the technical support is provided by the Department of Education and the Telemedicine Centre. Thus, accessibility to the programs would not be influenced by schools which are not equipped with the necessary technology. However, this could be a significant problem for other institutions implementing distance education initiatives. There is a big range in the technology available for distance education. A brief overview of these technologies is provided in the next section.

Technology in Distance Education

Distance education began with correspondence which consisted mainly of print material mailed to the students. There was very little interaction between the students and their instructor with this type of delivery. As a result of the lack of communication, concerns arose about the quality of these programs. Supporters of distance instruction thus began to place more emphasis on the educational transaction, that is, the communication between the student and the teacher. Teleconference technology offered two-way interactions in real time. The switch to this technology was primarily intended to diversify the nature and frequency of communication between the teacher and the student,

as well as between the student and the student.

There are several types of teleconferencing choices available. Audio-teleconferencing allows voice communications among three or more people who are geographically dispersed. Regular dial-up, long-distance telephone circuits can be used to connect the teleconference participants (Kelleher & Cross, 1985). Audio-graphics teleconferencing involves the inclusion of an interactive visual element to the audio teleconferencing. This may be a facsimile, telewriter, or an electronic blackboard (Kelleher & Cross, 1985). Computer teleconferencing includes the ability to conduct an ongoing meeting with personnel in different geographic locations using video terminals such as CRT (cathode ray tube), or personal computers. Electronic mail (E-mail) systems are generally incorporated into computer teleconferencing systems (Kelleher & Cross, 1985). Video teleconferencing allows the transmission of full-motion live television images from the production site to remote sites. This conferencing can be fully interactive with two-way video/two-way audio or can be in a broadcast mode with one-way video/two-way audio (Kelleher & Cross, 1985).

The use of teleconferencing is not the only method of promoting two-way communications. The advanced technologies have included telephone tutorials, computer conferencing on the World Wide Web, electronic mail, electronic data bases, computer managed learning (CML), computer assisted learning (CAL), and intelligent computer assisted learning (ICAL). These technologies allow for quite a variety in the way courses are designed for distance delivery. Some involve one-way communication with audio

and/or video components, while others involve two-way communications with audio, computer, video, and/or multimedia components (Charron & Obbink, 1993; Garrison, 1990; Wall, 1986). Each of the various media may be used to enhance the learner-learner and learner-instructor interactions in a distance education course.

Educators should not accept technology just because it is available. Distance educators need to be aware of the advantages and disadvantages of the new technologies and determine whether or not they will enhance student learning and motivation. History has shown that not all trends have been successful in distance education, a prime example being broadcast media which lost its popularity as a distance education delivery system.

Just because new technology is becoming available does not mean it will be an effective means for enhancing interactions. Overall, educators must seriously contemplate the costs and benefits of technology, and not feel the necessity to incorporate its use just because it is available. In fact, the rapid advancements in technology may actually limit the expansion of distance education. Technology changes so quickly that there seems to be very little time to conduct research on its impact in education. This can lead to the 'pendulum shifts' that are too often present in education, and which make people wary of the benefits of new technology. Caution must be exercised so that the benefits of new technology in distance education are not overemphasized so that a backlash does not develop when obstacles are encountered. This should contribute to a wider acceptance of distance education as an integral component of mainstream education.

Theoretical Developments

Debate has centered around the role of distance delivery in the education system. It was accepted that the transmission of information constituted learning and correspondence education was successful in disseminating knowledge. More recently, education has been described as a process rather than a product. The ideal educational process was summarized by Shale (1990) as:

- ✓ the teacher and student engaging in initial two-way interaction which provides the teacher with a validation of what the student knows.
- ✓ based on the students' current knowledge, the teacher may provide additional declarative knowledge.
- ✓ through dialogue between the teacher and the student, the student will generate procedural knowledge. The student recognizes what he or she knows through educational exchanges with the teacher, thus validating the knowledge acquired.

Even though present practice in much of education may contradict the idealized education process, this is not a reasonable basis for denying such a definition of education. The delivery systems of distance education have been scrutinized according to the conception of education as a process rather than a product (Garrison, 1990; Garrison & Shale, 1990; Holmberg, 1990; Shale, 1990).

The correspondence model of distance education was justified as a cost effective means to educate mass numbers of students. There were advances made in the quality of course materials (including print, audio-cassettes, and video-tapes) developed for the programs. Technology such as television was incorporated as another means to transmit information. The design of the distance programs utilized one-way communications technologies for the transmission of knowledge. This model did not support the notion of an educational process as described by Shale. There was no way for knowledge to be validated, therefore this type of delivery was not considered educational.

Two-way means of communications technology were proposed by Shale to be the most effective delivery system to support the education process he described. Some examples included teleconferencing (both audio and audio-graphic enhanced), interactive video-conferencing, and possibly computer conferencing. These technologies offered unconstrained two-way, real-time communication between students and teacher (Shale, 1990). Shale (1990) argued that 'teleconferencing and related technologies represent a real opportunity for making learning at a distance more personal and provide a means for "de-massifying" distance education' (p. 340).

Garrison is another strong supporter of two-way communications being the central element of distance education. Garrison (1993) postulated that sustained interaction in a teleconference session would facilitate critical learning. This was considered more important than rote memorization characteristic of correspondence instruction. Sustained two-way communication was thought to be essential for explaining and challenging

perspectives so that students would take responsibility for constructing meaning (Garrison, 1993).

Neither Shale nor Garrison dispute the importance of other technologies such as print to distance learning. However, both individuals have argued that one-way communications technologies do not provide the opportunity to validate knowledge which they consider a critical component of the educational process. Even though the design of print materials and other resources influence the quality of learning, the overriding impact on the quality of an educational experience according to Garrison is the provision of sustained discourse between teacher and student.

The correspondence approach to distance education is still popular. Holmberg has argued that the majority of distance delivery follows the correspondence model in which learning is an individual activity. He sees the distant student, although geographically separated from the instructor, as actually being able to interact in an intense step-by-step manner with the highly structured preproduced text materials developed for the distance course. Holmberg's model calls for telephone interaction with tutors and interaction through written comments via the postal system. It does not provide for the sustained, live interaction of an audio-graphic teleconference. He views the 'new' distance education with its technological enhancements as simply an evolution of the correspondence model which remains as the predominant delivery technique (Holmberg, 1990).

The nature and frequency of communication between teacher and student as well

as between student and student has become a focal point in distance education (Garrison, 1993). Garrison has challenged Holmberg's approach to distance education and proposes that the definition of education at a distance goes beyond the idea of simply sending out prepackaged print material. Garrison and Shale (1990) have argued that education, either face-to-face or at a distance, is more than the uncritical assimilation of prepackaged content. The heart of the educational process is the transaction between the teacher and the student. According to Garrison and Shale, distance educators must be aware of and address this reality to overcome any constraints of distance delivery.

The debate as to whether print material or sustained two-way communication is the central element of distance education continues. The model of distance delivery accepted will depend on the definition of education that one takes. The correspondence model follows an approach whereby information is transmitted to students as the focal point. Supporters of the model that has two-way communications as the main element argue this design provides the opportunity for a more meaningful and effective learning environment through the interaction between student and instructor. However, simply incorporating two-way communications technology in a distance education course does not guarantee more interactions among participants nor does it ensure the educational process will be followed. It is possible that the teleconferencing, for example, would be used only as an enhancement to packaged print materials rather than the print material being an enhancement to the teleconferencing (Garrison, 1993). This would defeat the goal of increasing the interactions among the participants and the instructor in a distance

class.

The model of distance education investigated in this paper corresponds to that proposed by Garrison, in that two-way communication via audio-graphic teleconferencing, telephone, and facsimile was emphasized. The learning environment in distance chemistry had as its focal point the teleconference class which was supplemented with print material. There was a great deal of emphasis on the discourse between student and teacher in the on-line classes to duplicate the interactions that would occur in a classroom context. Overall, the concept of education was viewed as a process involving interactions between the learner and the instructor rather than simply the dissemination of information from instructor to learner.

Research in Distance Education

The literature for distance education contains much advocacy and debate. The amount of empirical research is fairly scant, especially at the secondary level. A literature review by Eiserman and Williams (1987) found very few reports on distance education in the elementary and secondary schools. Articles have been published that describe programs which were implemented at the secondary school level (Barker, 1987; Barker, 1989; Wall, 1986; Withrow, 1990) but these often lack any research methodologies. The suggestion has been made that research should be done on student attitude and

achievement in courses like chemistry and physics because what is published is very limited (Martin & Rainey, 1993).

At the local level, a report (Wright, Banfield & Drover, 1989) was published by the Newfoundland and Labrador Department of Education which evaluated a pilot distance education Advanced Mathematics 1201 course. This was the first course offered to students in rural schools through teleconference in this province. Wright, Banfield and Drover found that the level of achievement and the level of retention were both comparable to that found in the classroom Advanced Mathematics 1201 course.

Overall, the research by the Department of Education in Newfoundland, has focused only on course design and implementation as determined by needs assessments completed by principals of the small schools. There has not been to date a comprehensive study of the participants in the distance education programs, especially the science courses which have the added laboratory component.

Science in Distance Education

An inherent challenge exists in providing science courses through distance education because of the need for laboratory activities. Institutions are dealing with the difficulties of instructing science at a distance, and are developing programs to use in teacher training for science education (Boone & Andersen, 1995; Boone & Andersen, 1994; Boone, 1994). Mugridge (1991) has described some of the approaches to teaching

science courses at a distance. For example, The British Open University began with producing home experiment kits in 1979 to target the problem of completing experiments. Mugridge (1991) reports that other institutes felt it necessary to focus on "issues arising from scientific and technological developments and their impact on society" (p. 318) rather than actual laboratory activities. To target the laboratory problem, the British Columbia Open University divided science courses into theoretical and practical elements where students would complete the required laboratory sessions at a community college (Mugridge, 1991). In Indonesia, the Universitas Terbuka had kits devised that would allow students to construct and use much of their own lab equipment. In Newfoundland, the laboratory components were completed by students in their school with the help of instructional videos and supervising teachers.

In considering various approaches to targeting the problem of completing science laboratories in distance education, it is also necessary to review the literature on the technologies available for the course content delivery. All of the studies which follow had adult participants in the programs. However, the results are applicable to the distance environment at the secondary level.

Delivery Methods in Distance Education

The majority of research in distance education has been completed at the post-secondary level. Much has been published concerning the assessment and evaluation of

various methods of program delivery (Beare, 1989; Burge & Howard, 1990; Eastmond, 1994; Kirby & Boak, 1987; Kirby & Chugh, 1992, 1993; Ritchie & Newby, 1989; Slaton & Lacefield, 1991). The results of these studies offer some insight into the preferences of students taking courses through distance education.

Beare (1989) compared alternative distance education delivery methods offered through a continuing education program for teacher training. The instructional deliveries included lecture, lecture with videotape backup, telelecture, audio assisted independent study, video assisted independent study, and video on campus. The study showed that there were no significant differences on any of the exam items by either instructional format group or academic level. On course evaluations, students who received live instruction appreciated humor which was infused into the course by the instructor. There was a preference for live instruction rather than telelecture as the students preferred an opportunity to ask questions.

Burge and Howard (1990) completed a case study on audio-conferencing (AC) in graduate education. The students reported that continual use of the equipment allowed them to become comfortable with this method of instruction. They also relied on their classmates with prior experience to help them adapt to the new medium. There were some reports of students feeling uncomfortable with using the microphones and suggested a clip-on microphone style. The lack of visual cues in the AC environment presented a challenge for many of the students. There were several student attributes described as being important. For example, speaking slowly and clearly, not rambling or wasting

valuable air time, and being well prepared for class. As for instructor attributes, it was suggested the individual should give time to reflect, use on-line time efficiently, and allow time to work together in groups off-line.

An investigation of adult student perspectives of distance study via computer conferencing was completed by Eastmond (1994). The study revealed that most of the students valued the interactive capability of the computer conferencing. However, its success depended on the students' conceptions of learning, that is, whether they viewed learning as the passive acquisition of facts or as an active effort to know and apply knowledge (Eastmond, 1994). The students in the telecommunications course appreciated the feedback from the instructor's comments which went beyond what they would have received on written assignments in correspondence courses. They enjoyed 'hearing' other students relate their opinions. It was also found that adults developed learning approaches to deal with the new instructional environment. For example, they established study patterns, scheduled effective study time, worked with others, sought specific tasks and structure, and demonstrated competence to the instructor. The study found that in a novel instructional setting the students produced learning approaches that best suited their needs and preferences through trial and error, borrowing, and creative discovery (Eastmond, 1994).

Kirby and Boak (1987) developed a system for audio-teleconferencing analysis which focused mainly on instructor perceptions and the style of instructional approach. The model emphasized the role played by antecedents in shaping instructor perceptions

which in turn determined strategies, instructional processes, and outcomes. Kirby and Boak (1989) developed and tested the model with university level distance education courses. Kirby and Chugh (1992) designed a Q-Sort instrument to investigate instructors' perceptions of elements in the audio-teleconferencing environment. They found that audio-teleconferencing may be a more accessible form of education than the traditional classroom. As well, the analysis revealed two types of instructors who differed in the importance they attached to the practical aspects of audio-teleconferencing. It was found that both clusters thought instructor verbal skills, student's motivation, and ability to interact were very important. Kirby and Chugh (1993) used the same instrument to investigate students' perceptions of elements of the audio-teleconferencing environment and to compare these to the instructors perceptions. The results revealed that students attach great importance to factors in the instructional environment that are closely related to the quality of the learning transaction. The analysis revealed two clusters of students. One group was labeled as student centered who attached importance to student characteristics and another group was labeled instruction-centered who attached more importance to the instructional act. When comparisons were made with instructor's perceptions, notable differences were found. The students attached more importance to student characteristics and to factors relating the availability of courses while the instructors ranked instructor characteristics and goals of education more highly than students.

The influence of the environment in which instruction was delivered on the

frequency and type of interactions, performance, and student attitude was compared in a study by Ritchie and Newby (1989). The types of instructional delivery included a regular classroom condition, a studio classroom with a live instructor, and a studio classroom with a television monitor instructor. The results showed a significant difference in participant achievement for the three groups. The distance group scored significantly higher than the studio group, while the traditional group did not differ from either of the two groups (Ritchie & Newby, 1989). There were more interactions observed in the traditional group than in the other two groups. It was noted that the observed differences could have been due to the novel environment for the distance and the studio groups. The students' attention in the distance and studio groups may have been directed away from the content being delivered as they investigated the new environment. As well, the lower participation rates in these groups may have been due to the inexperience with using a microphone to converse with the instructor (Ritchie & Newby, 1989).

Finally, Slaton and Lacefield (1991) found that an interactive telecommunications network was successful in terms of both technical performance and participant satisfaction for inservice education. The results of this study indicated that the least preferred option for inservice training was non-interactive television programs (Slaton & Lacefield, 1991).

In summary, the research revealed that students generally preferred a learning environment that provided the opportunity for two-way interactions between the students and the instructor. The feedback possible from the instructor in computer conferencing, teleconference, and live television classes was perceived as beneficial. Students generally

preferred this method of instruction over the one-way, non-interactive methods of instructional delivery.

The students also reported that over time their comfort levels with the distance education equipment increased. In fact, a reason cited for the lack of participation by participants in a studio environment was unfamiliarity with the equipment. As well, students also relied on their classmates for help until they felt competent with the technology. Even though the participants were adults in these studies, the results should still apply to a distance learning environment with secondary students.

It is important to note that many of the studies had very low response rates and/or non-random samples (Beare, 1989; Slaton & Lacefield, 1991; Walker & Hackman, 1992). This limits the validity and generalizability of the results and the reader must be cautious when interpreting the results and conclusions.

Students' Perceptions of Learning

A few studies exist which examine students' perceptions of learning at a distance (Anderson, 1994; Boone, Bennett & Ovando, 1995; Figueroa, 1992; MacLaren, 1993; Sponder, 1990; Walker & Hackman, 1992). Anderson (1994) investigated students' experience and perceptions of learning in an audio-teleconferencing context. The methodology included a mail survey, interviews, focus group, and observations. The study found that students placed high value on the learning that resulted from interaction

with students as well as with the instructor. Students also revealed that it was more difficult to develop and maintain support groups with students at other sites. It was concluded that the teleconference provided both a means and a motivation for distance education students to engage in deep levels of meaning and understanding. Anderson reported the need for a more comprehensive understanding of the experience of learning in this environment.

Boone, Bennett and Ovando (1995) used a survey approach to assess teachers' attitudes towards distance education technology in a science and society global issues class. This study found that using two-way audio-video technology did not reduce the quality of the course, did not reduce interactivity, and did not mean teaching strategies for traditional classes were in jeopardy (Boone et al., 1995). The survey results showed that the participants strongly felt that the interactive capability of two-way audio/video technology was necessary for any distance education class. It was suggested that teaching strategies should focus on the interactive capabilities of the technology rather than on delivering a 'lecture and listen' style class.

A study which focused on "how differently students learn in a face-to-face course and in a distance learning situation" (p. 15) was conducted by Figueroa (1992). This study employed a qualitative design to compile a profile of students' learning. The sample for the study was based on individuals who had volunteered to participate. The results did reveal differences between the profiles of the distance and regular classroom students. However, the study found that the profiles of students in both distance and

regular classrooms were complex and suggested that further analysis should be completed to identify the distinct profiles of students in the two different approaches to education (Figueroa, 1992). MacLaren (1993) investigated the opinions of students on the value of interaction in a graduate level distance education course taught mainly by audio-teleconference. The sample consisted of three students and the methodology included observations, questionnaire, interviews, and journal writing. The students' reported that the ability to have one-on-one interaction with the instructor was important because it allowed for the discussion of controversial issues in a non-threatening environment. Students noted that it took time to become comfortable with the teleconference technology and suggested that measures should be introduced to humanize distance education. As well, the results showed that students were not motivated to participate in the teleconference when they did not see the relevance of the topic to their goals or career.

Sponder (1990) completed a qualitative study of students enrolled in audio-conference courses in Western Alaska which incorporated triangulation of various data collection methods. According to Sponder (1990) many students felt that they had little or no control over the educational process when studying at a distance. Sponder concluded that research in distance education should include student motivation from the viewpoint of attribution theory since this theory focuses on the relationship between motivation and individuals' control over life's events.

Walker and Hackman (1992) conducted a study on the predictors of perceived learning and satisfaction of students using a two-way, multi-camera telecommunications

system. Data collection involved a mail-out survey to students who had enrolled in the telecourses between 1988 and 1990. The study investigated which factors of system conveyance and instructor behavior had the greatest impact on interactive communication, measured as perceptions of satisfaction and learning among students (Walker & Hackman, 1992). The results indicated that the amount of information received by the students was the greatest contributor to perceived learning and satisfaction. The non-verbal behaviors of the instructor and the transmissions (both audio and video) also contributed significantly to the students' perception of learning and satisfaction.

Overall, the students valued the interactive capability of distance technology and felt that this was important to their learning. Students reported satisfaction with their learning environment provided they had received sufficient, relevant information. All of these studies, however, dealt with adult learners in either a university or an inservice training environment. These types of courses are much less structured than those for high school students.

In summary, the literature reviewed relating to students' perceptions and attitudes towards distance education is rather limited. Methodological problems include low response rates and small sample sizes. Morgan, Taylor, and Gibbs (1982) have stated that most research and evaluation into student learning has been completed with close-ended questionnaires. They go on to argue that there is a need for an awareness of learning as students experience it so that efforts to improve their learning will be effective. Thus, further research into students' perceptions of the distance environment is certainly needed.

Motivation

Outside of student's perceptions of the distance learning environment, this study has investigated the motivation of distance students. It has been suggested that the selection of students for distance programs at the secondary level should not include only ability level. As reported by Wright, Banfield & Drover (1989) "their [principals and coordinators] future decisions in the selection of students would focus more on criteria that involve motivation and the ability to work independently, than on ability alone" (p. 47). Thus, this section reviews the literature in the area of attribution theory and its application to the distance milieu.

Attribution Theory

The guiding principle of attribution theory is the fact that individuals search for understanding and they seek to discover why an event has occurred (Weiner, 1980a). This theory also incorporates affect, in that certain emotions are associated with particular attributions. A classification scheme was created for the causes given for particular events. The underlying properties of the causes were identified and the similarities and differences were determined. The result was the establishment of several causal dimensions.

Research has supported a three dimensional classification for causal explanations that explain why an event has occurred. The causal dimensions are locus of causality, stability, and controllability (Weiner, 1985; Overwalle, 1989). The locus dimension was proposed by Heider (1958) and distinguishes between factors that are within the person and within the environment. This distinction gained further acceptance with the work of Rotter (1966) who classified individuals as internal or external in locus of control. The dimension is also connected to emotions. For example, a person who attributes success to an internal locus such as ability or effort will experience an increased self-esteem. However, an attribution of failure to internal causes would lead to shame or guilt (Wong & Weiner, 1981). Failure can be attributed to causes outside the individual, such as length of the exam, to avoid feelings of shame or guilt (Weiner, 1984).

The stability dimension was suggested by Weiner, Frieze, Kukla, Reed, Rest and Rosenbaum (1971) because it was felt that some internal causes fluctuate while others remain relatively constant. Thus, students may believe that their ability is a stable factor that does not change, while effort is a variable factor that can change. The third dimension, controllability was included in Weiner's (1979) achievement motivation theory. As well, Weiner (1985) found five empirical studies that identified controllability as a causal dimension. Some of the causes classified in the locus and stability dimensions were perceived to be under volitional control while others were not. For example, effort could be under volitional control while mood or the onset of fatigue could not be willed to change (Weiner, 1985).

A fourth dimension called globality has been suggested by Abramson, Seligman and Teasdale (1978). Abramson et al. (1978) assert that some causes are specific to a situation while others generalize across situations. Thus, an individual with a specific attribution for failure will blame the failure on the specific set of circumstances, while an individual with a global attribution for failure would feel that failure will occur in all similar situations. Criticism of this dimension is evident since some research studies have not revealed empirical evidence of a globality factor (Bar-Tal & Darom, 1979; Meyer & Koelbl, 1982; Weiner, 1985).

In an achievement context, students that consider their success or failure as a result of stable, unchangeable factors such as ability will be less motivated to improve their learning capabilities. They believe that they cannot change the cause of their poor performance. This tends to lead to a sense of learned helplessness by the student and the development of avoidance strategies so that failure is not attributed to an individuals low ability. However, on the other end of the spectrum, there is the mastery student who will attribute both success and failure to internal controllable causes. Seifert (1995) believes that students who have an internal locus of control will be willing to try new things, see difficult problems as a challenge, and will persevere in the face of difficulty.

Attributional style questionnaires have been developed from the learned helplessness theory of depression (Abramson et al., 1978). These questionnaires are concerned with individual differences in people's explanations of success and failure. The individual differences in attributional style are being related to differences in motivation,

performance, and affective reactions (Anderson, Jennings & Arnoult, 1988). The Causal Dimension Scale (CDS) uses a situational approach to measuring attributions (Russell, 1982). Attributions are measured from the responses given on various causal dimensions regarding a single specific situation which is relevant to the individual (Russell, 1991) In contrast using the Attributional Style Questionnaire (ASQ) would be considered a trait approach which suggests that individuals have an 'attributional style' that is consistent across situations (Russell, 1991). The ASQ (Peterson, Semmel, von Baeyer, Abramson, Metalsky & Seligman, 1982) consists of hypothetical events to which respondents must attribute a cause. Then the respondent uses a Likert-type scale to rate the cause on locus of causality (internal versus external), stability, and globality. The idea is that those who tend to blame themselves for negative events, who think the cause will last into the future, and who think that the cause will occur in different contexts will be labeled as having a 'pessimistic' attributional style. However, those with the opposite orientation will be labeled as having an 'optimistic' attributional style (Seligman & Schulman, 1986).

Those students with an optimistic attributional style are motivated to succeed regardless of past experiences. These individuals attribute the cause of their success to internal, controllable causes. The level of effort associated with a task will determine their success in future endeavors. This attributional style could influence students' level of performance, particularly in a novel setting such as distance learning. The students who enrol in distance education find themselves in a challenging environment that requires much self-discipline and a high level of independence. Students with an optimistic

attributional style would be motivated to succeed regardless of the challenges they faced. However, not everyone would be characterized by the same level of motivation. The nature of distance learning may in fact attract students with particular attributional characteristics. This would challenge the main premise of distance education, increased accessibility.

There is very little research available that targets the motivation of distance students, in particular their attributional style. One study by Coldeway, Spencer & Stringer (1980) investigated factors that affect learner motivation in distance education. However, the methodology did not include any standardized measures of learner aptitude nor was there any assessment of learner attributes. Data collection included demographic characteristics of students at the time of enrollment in the University, performance data, and number of credits. There was also uncertainty as to whether or not the sample was representative of the majority of the courses. Coldeway et al. (1980) concluded that "various situational and personal learner 'attributes' do tend to have a relationship to learner behavior in courses" (p. 31). However, there was no further elaboration on how learner attributes were related to learner behavior.

In summary, research which focuses on attributional style of distance learners and its relationship to achievement is novel. Attribution theory predicts, in an achievement context, that individuals with an internal locus of causality with stable, global attributions will persist to ensure their future success. The attributional style of distance learners may illuminate the reasons why these individuals succeed in a challenging learning environment.

Chapter 4

Methodology

As already noted, the focal point of the study was students' perceptions of distance education. Student diaries, telephone interviews, final grades, a questionnaire, a Causal Dimension Scale (CDS), and an Attributional Style Questionnaire (ASQ) were all methods of data collection used to investigate several key issues in the distance education program.

Morgan, Taylor & Gibbs (1982) outline the importance of revealing the complexity of students themselves, and of recognizing the students' ability to reflect upon their experiences. The diaries were selected as a means of data collection so that the complexity of the students' experiences in distance education could be revealed. This data source provided students' opinions concerning the reasons for enrollment in distance education chemistry, the characteristics of a distance learner, the characteristics of a distance instructor, the initial impressions of the program and how their impressions changed over time, the benefits and frustrations of distance education chemistry, the workload associated with the program, their impressions of the technology and how it influenced their learning, the program organization, and the available resources.

The telephone interviews were meant to expand upon key issues targeted by the

diaries and to collect demographic data. Questions were developed to focus on the teleconference technology, in particular how the use of the technology impacted students' learning. The interactions among students were further investigated. Students were probed on the nature of learner-learner interactions (Moore, 1993) and of their importance.

The questionnaire was administered to provide a larger source of data by surveying all students in distance education chemistry. Topics included students' perceptions of the teleconference environment, students' opinion concerning the characteristics necessary to be successful in distance education chemistry, students' views concerning workload, scheduling of off-line and on-line classes, interactions with the teacher and other students, and available help, and students' comparison of distance education classes to regular classroom classes.

The Causal Dimension Scale and the Attributional Style Questionnaire instruments were chosen to measure attributional style. The CDS was used to assess attributional style of distance learners and to correlate it with performance. The ASQ was given to both distance and non-distance learners so that a comparative analysis was possible. This data was intended to shed light on the issue of selectivity of students in distance education and to offer insight into reasons why students were successful in distance education chemistry.

These methods of data collection were all employed to assess the key issues in this study. Both qualitative and quantitative techniques were chosen according to which

would best serve the question being investigated. The researcher felt that the voice of the students should be heard to illuminate their experiences in distance education. Valid answers to many of the research questions could only be obtained from the students themselves. They are the ones who have the ability to reflect upon their experiences and to evaluate their life in distance education chemistry. The students' reflection on their practice will serve to raise educators' awareness of the students' learning experiences and of the factors that motivate these students to achieve. The conclusions reached will then be based in the participants' reality of learning. A more specific breakdown of the key research topics follows.

Research Questions

There were three main issues studied in this research project: the teleconference technology, the characteristics and motivation of students, and the students' assessment of the distance learning environment (workload, need for independence, actions to perform well, etc.). These issues were chosen as a result of a detailed review of the literature. For example, Garrison was found to be a strong supporter of teleconferencing in the distance learning environment. Moore presented interactions that would be sustainable in this instructional medium. Since the distance program for Newfoundland secondary schools has as its main component the teleconference class, the researcher developed the issues

around the ideas of Garrison and Moore.

Another component of the study incorporated the literature on motivation, in particular attribution theory as developed by Weiner. The researcher felt the literature on motivation would offer insight into the type of student taking distance chemistry. This could explain the selective nature, either self-selection or school-directed selection, of students for distance education. This area of research also offers interpretation of students' performance in distance education chemistry.

From the broader areas of research discussed above, the following research questions were developed:

Teleconference environment:

1. Do on-line and off-line classes offer students' the opportunity for learner-instructor, learner-learner, and learner-content interactions as identified by Moore?
2. How does teleconference technology (voice quality, telewriter, microphone) influence students' learning?
3. How much supervision is provided at the site for on-line and off-line classes in distance education chemistry? What level of supervision, conducive to learning, is considered necessary by the students?
4. What level of help is available at the site for the student taking distance education chemistry?

Characteristics and motivation of students:

1. Why do students choose to enroll in a distance education chemistry course?

2. Are there particular types of students who participate in distance education chemistry because of the nature of the course and the level of independent study?
3. Is there a selectivity, either self or school directed, in the type of student chosen to enrol in distance education chemistry?
4. Do students in distance education chemistry have a different attributional style than students not participating in distance education chemistry?
5. Does the attributional style of the distance learner predict their level of success in a distance education chemistry course?

Students' assessment of distance learning environment:

1. Do the students achieve because of a much higher level of effort in a distance education course?
2. What might a student do differently to be successful in distance education chemistry compared to a face-to-face classroom course? Is there more independent work required of the student in distance education chemistry or in a classroom course? Is the student required to be more organized with his/her time and materials in distance education compared to regular classroom courses?
3. How does distance education chemistry require a different amount of work than a course in a traditional classroom?

Population and Samples

Distance education was offered in 30 small schools in rural Newfoundland during the 1996 - 97 school year. One hundred and fifty-six students were enrolled in two courses Chemistry 2202 and 3202. These students were registered for high school in either Level I, II, or III (the equivalent of Grades 10, 11, and 12) and ranged from 15 to 18 years of age. As well, there were 495 students enrolled in Level II who were not taking distance education chemistry in the schools in which distance education chemistry was offered. These students were used as a comparative group to study the attributional styles of distance versus non-distance learners. The population for this study included all distance education chemistry students in Levels I, II, and III (n=156) and all non-distance students in Level II (n=495) in the same schools.

From the population of distance education chemistry students, a random sample of 30 students was selected to complete the student diaries. Twenty-six of the 30 students completed the diary entries. Of the four students who did not finish the diaries, two dropped chemistry and two failed to submit any entries. All of the distance chemistry students were sampled for the questionnaire, ASQ, and CDS. All of the non-distance chemistry students were sampled for the ASQ. Table 1 presents a summary of the number of students who were sampled for each method of data collection.

Table 1: Sample of Students for Each Instrument.

Students	Diary	Telephone Interview	Questionnaire	ASQ	CDS
Distance Education Chemistry	30	26	156	156	156
Non Distance Education Chemistry	n/a	n/a	n/a	495	n/a

There were 26 rather than 30 students who participated in a telephone interview because these interviews were conducted after the diaries had been completed. The response rates for each instrument follow. One hundred and forty-two of the 156 distance education chemistry students returned the questionnaires for a 91% response rate. Three hundred and seventy-one of the 495 ASQ instruments were returned for a 75% response rate. Finally, there was a 74% response rate for the CDS with 115 of the 156 students returning the instrument.

Instruments

Questionnaire

The questionnaire consisted of five sections. It was developed to target the research questions of the study and to provide the researcher with insights from a larger sample of students than the diary group. Section A targeted demographic information,

why students enrolled in distance education chemistry, and what students did differently in distance education compared to a classroom course. Section B consisted of statements to which students responded yes/no to elicit factual information concerning issues in distance education. Items included students' work habits, students' experience with the teleconference equipment and fixing technical problems, on-site supervision and availability of help, and interactions with other students. Section C contained Likert-type scale items so that students could reveal their opinions. Topics included students' work habits, available resources, and supervision. Section D consisted of a variety of items concerning amount of time spent on evaluation instruments for distance education compared to regular classroom courses, students' participation during on-line classes compared to that in regular classroom courses, and supervision of on-line and off-line classes. All items in the questionnaire were reviewed by two experts and revisions were made before administrating to the 156 distance education chemistry students. A copy of the questionnaire is included in Appendix B.

Causal Dimension Scale (CDS)

The Causal Dimension Scale (Russell, 1982) assessed causal attributions for specific events by asking the respondent about an actual situation. Students were asked what would determine their performance in distance education chemistry. The respondent

had to select one of four specific attributions: ability, task difficulty, effort, or luck/chance. These four causes were used so that the respondents would focus on factors directly attributable to them or to the course rather than making excuses for their performance. This question/event was followed by seven items each with a seven point Likert-type scale. Of the seven items, four addressed the locus of causality dimension and three addressed the stability dimension. The Alpha reliabilities were reported by Henry and Campbell (1995) as .90 for locus of causality and .69 for stability. These results have been corroborated by several other studies (Abraham, 1985; Dobbins, 1985; Mark, Mutrie, Brooks & Harris, 1984; McAuley, 1985; Russell, 1982).

The CDS was piloted with a group of chemistry students to ensure there were no problems with understanding the instrument. No revisions were made as a result of the pilot test. The CDS was administered to 156 distance education chemistry students. A copy is included in Appendix B.

Attributional Style Questionnaire (ASQ)

The ASQ (Peterson et al., 1982) represents hypothetical situations to which the respondent must attribute a cause, assuming this situation has happened to him/her. The respondent is asked to rate the cause on a Likert-type scale based on locus of causality (internal versus external), globality, and stability. The ASQ does not create or constrain the causal explanations given by the respondents. "Fundamental attribution researcher

error" (p. 1137) as termed by Russell (1982) was eliminated because the respondents classified the explanations themselves using the Likert-type scales for each dimension. This error is due to discrepancies in the coding of the respondents caused by the researcher. For example, a researcher may code a response as an internal locus of control when the respondent intended it to be an external locus of control. The ASQ instrument was tested for reliability and validity with data presented by Henry and Campbell (1995).

Two of the ten positive and ten negative events as used by Henry and Campbell (1995) were omitted from the ASQ because they did not apply to students in secondary education. The ASQ was piloted with a group of chemistry students to ensure that the directions were clear and to determine the amount of time required to complete the questions. The students did not report any problems with the instrument and as a result, no further modifications were made. A total of 651 instruments were mailed to the 30 distance education chemistry sites. These were administered to both the distance education chemistry students and to the Level II students not taking distance education chemistry. A copy of the ASQ is included in Appendix B.

Diary Entries

The diaries provided the opportunity for students to disclose their personal opinions concerning their thoughts, experiences, and reflections as they completed the high school chemistry course through teleconference. Questions written by the researcher

were also faxed to students towards the end of their diaries. These questions were given to stimulate reflection on specific facets of distance education chemistry which might otherwise have been neglected by the students.

The 30 participants were asked to keep a diary from October, 1996 to February, 1997 to illuminate any transitions in opinions or experiences as the course progressed. Students were instructed to write openly about the work load, teaching techniques, level of communication, study techniques, handbooks, laboratory activities, assignments, laboratory videos, or any other aspect considered worthy of reflection to them. It was the desire of the researcher to obtain some free-response information from the participants and to obtain detailed accounts on certain topics so that the data would illuminate the student's experience in distance education chemistry.

Telephone Interviews

The telephone interviews were designed to supplement the diary entries with a focus on specific questions of interest to the researcher, but which might not have been revealed by the diaries. The participants of the diaries (n=26) were contacted to take part in the telephone interview once the diaries were completed. The telephone interviews were conducted in June, 1997 so that students could reflect upon their experiences over the whole year in the teleconference course. A copy of the telephone interview questions is included in Appendix B.

Other Data Sources

Performance data was collected for distance education chemistry since its inception in 1995. This would include two years for chemistry 2202 and one year for chemistry 3202. The provincial performance data for these years was included for comparison. The distance education marks were included in the provincial data. However, the proportion of students completing distance education (< 2%) was small enough not to significantly indifference the overall result.

Procedure

The principal at each site was contacted, informed about the nature of the study, and asked for his/her consent for students in the school to participate. A consent form describing the study was faxed to all students. Both the parent/guardians and the students signatures were required. The permission forms are included in Appendix A.

The students completing the diary entries were given instructions to make one diary entry per week for the specified time period. It was anticipated that each student would spend approximately fifteen minutes completing an entry. Students were asked to fax their diary entries every three weeks.

In February 1997, permission forms were sent to parents/guardians, all students enrolled in distance chemistry, and all Level II students at the distance sites. Five hundred

and thirty-six of the 651 forms were returned. Upon receipt of the forms, questionnaires were mailed to each of the 30 sites. The ASQ instrument was mailed along with the questionnaires while the CDS was faxed to the distance education chemistry students.

Performance data obtained from the Newfoundland and Labrador Department of Education, Division of Evaluation, Research and Planning included the final grades for each student in distance education chemistry and for classroom chemistry students. Data also included the percentage of students who passed distance chemistry since its inception and the enrollments in both distance and non-distance chemistry courses.

Analysis

The diary and telephone interview transcripts were analyzed using The Ethnograph (1995) software. All diary entries were typed so that the program could be used to number each line of typed data. The researcher marked the lines according to the fourteen codes which were established. Then a code search was completed and the program grouped together all the lines marked for each code. A list of the codes is included in the section on diary analysis.

One other expert in the field was asked to categorize selected student entries to confirm coding reliability. Random excerpts were taken from the complete data file and coded by both the researcher and this individual. The codes were compared according to

a list of criteria established. For example, the 'impression' code would include any references to initial impressions of distance education and any references to how the students' initial impressions had changed over time. Once the coding was completed and the data were grouped together according to the established codes, the lines were analyzed to determine the themes which emerged.

The analysis of the diary entries reported in this study included quotations from the writings. These quotations were edited for spelling errors only. The students were identified using letters to ensure that each individual remained anonymous. The same classification was used for the telephone interview data. The line numbers were also given for the diary data so that easy identification of the segments in the computer file could be completed.

The data collected from sources other than the diaries and the telephone interviews were analyzed using several statistical procedures. First, percentage responses were calculated for the questionnaire responses. Items included the number of distance courses students had completed, the reasons for taking distance chemistry, and opinions on workload, supervision, technology, and interactions. The attributional style of the distance and non-distance students was also compared. An analysis of variance was completed to identify any variation between the two groups. T-tests were done to compare the workload and participation of students in a teleconference course with those in a classroom science course. Finally, Pearson correlation coefficients were calculated for the causal dimensions on the CDS, for attributional style and approaches to distance

education, and for comparisons between the attributional style of the distance learners and their performance in distance education chemistry.

The analysis of results from all the instruments used for data collection is reported in the next chapter.

Chapter 5

Results

Questionnaire Analysis

Descriptive statistics reveal general tendencies and variability within a data sample. The range of students' opinion was determined by analyzing their responses in the questionnaire data. The reporting of the analysis is divided into the various issues which were targeted in the questionnaire. This is followed by a summary of the results as they apply to the research questions.

Generally these data were substantiated by the students' diary writings and their telephone interview responses. In fact, the diaries often served to illuminate in rich detail the questionnaire responses which contributed to a broader view of the students' opinions about distance education.

Demographics

The sample of students in distance education chemistry was composed of Level I's

(n=35), Level II's (n=56), and Level III's (n=51). There was almost an equal split between students who had taken previous distance courses and those who had not. Table 2 shows the experience these students had with distance education courses. The telephone interviews corroborated these results (first teleconference course for 42% of the sample).

Table 2: The Number of Courses Taken Through Distance Education (Current Year)

Number of courses	% Response
none	0
1 - 2	40
3 - 4	35
5 - 6	22
7 - 8	2
9 or more	1

Reasons for Taking Distance Education Chemistry

Table 3 identifies the various reasons students chose to take distance education chemistry. The numbers were not mutually exclusive because students could have selected more than one answer. The data revealed that students were not simply taking distance education chemistry to satisfy their graduation requirements. There was a general curiosity about the subject with 77% who cited their interest in chemistry as a contributing factor to selecting the course. As well, these students had future ambitions and they reported in the diaries many benefits from the distance education experience. According to the diary responses, the level of independence and responsibility associated with the

program were believed to be excellent preparation for university life.

Table 3: Reasons for Taking Distance Education Chemistry.

Reason	% Response
Interested in chemistry	77
Need the course for college/university	61
Teacher/principal advised me	35
Parent/guardian advised me	32
No particular reason	6
Other	22

The reasons for taking distance education chemistry were those that might be expected from students pursuing an academic program. The fact that 61% cited prerequisites for post-secondary education would confirm students' academic intentions. The 'other' category consisted of reasons that were generally career oriented. For example, a student wrote "it would help me get a job in the Armed Forces".

These students were generally interested in future academic endeavors. Whether or not these choices were of their own selection or from the advice of an adult is questionable. It was interesting to see whether or not these students were being advised by parents or teachers to enrol in chemistry via teleconference. It was difficult to determine whether the majority of students were making their own decision. Only 35% cited advice from a teacher/principal and 32% cited advice from a parent/guardian in their reason for selecting the course. A combined total would give the impression that most students had received advice. However, it was not determined whether these were the

same people who were receiving advice both in school and at home. The numbers were not a cumulative total since students could have selected as many responses that were applicable to them. No conclusion could be reached from these results.

The pattern of response revealed in Table 3 was corroborated by the diary entries The diaries revealed that 81% of the entrants cited career and university aspirations as the reason for their enrollment in distance education chemistry. Twenty-five percent of the diary writers further elaborated a category not included in this questionnaire. They wrote about the self-discipline and responsibility they would attain from the demanding workload of taking chemistry through teleconference. There were no references in the diaries to advice attained at home or at school in the reasons given for taking chemistry.

Distance Education Compared to Regular Classroom

The results reported in Table 4 indicate that students expended a great deal of energy in preparing for their distance education chemistry course. The work that students did for distance education was reported to be done more on their own (83% worked more independently) than that completed for a classroom course. The students reported doing more study (60%) and spending more time doing written homework (68%) for distance education chemistry compared to classroom based science courses.

Table 4: Students' Efforts in Distance Education Chemistry Compared to a Classroom Science Course.

In Distance Education, I.....	% of students
spend more time studying.	60
spend more time doing written homework.	68
rely more on my instructor.	15
work more independently.	83
rely more on my classmates.	56
spend less time studying.	7
spend less time doing written homework.	9
rely less on my instructor.	21
work less independently.	5
rely less on my classmates.	5

Only 15% of the students tended to rely more on their distance education instructor when taking a teleconference course. This is corroborated by instructor records of contact with students. In fact, only 44% of the students had telephoned their instructor. There had been a total of 123 calls in four months and a total of 551 faxes during the year from students. It appeared that students tended to use the fax machine more than the telephone when they had questions for their instructor. Students may have felt uncomfortable talking to their teacher over the telephone or they may have found faxing required less time. Regardless of the mode of communication, all correspondences were requests for help with various chemistry topics.

The diary entries shed some light on why fewer than half the students contacted the instructor. The may reason cited was that it simply took too much time and was too much trouble to telephone or send a facsimile. The fact that students were not reliant

upon their instructor supported their independent nature. These students simply went to a classmate for help, asked another teacher at their site, or waited for an on-line class.

These students were not highly dependent on communications with their instructor outside of the on-line classes. It appeared as if they had developed coping strategies to compensate for not having a teacher on-site with them. They established a support network among one another at their site. The students sought assistance from each other rather than contacting their instructor or students at other sites. The data in Tables 8 and 9 which appear later in the text have some bearing on this issue. For example, Table 8 shows that 98% of the students sought assistance from students at their site. This is corroborated in Table 9 where 93% felt that students at their site were helpful. Thus, the learner-learner interactions at each remote site were evident. These results were supported and elaborated upon in the diaries and telephone interviews.

Table 5 indicates that students reported spending more time doing homework, studying, and working independently in distance education compared to classroom courses. The majority of students (81%) agreed that taking a course through teleconference was more difficult than in the regular classroom. This could explain why the students reported putting more effort into the distance program.

Table 5: Students' Opinion of Distance Education Compared to Classroom Courses (%).

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Use different study techniques.	20	51	17	10	2
Work more independently in distance education.	49	35	9	6	1
Completing a course through teleconference is more difficult than through classroom instruction.	49	32	13	5	1
Distance education instruction is as effective as classroom instruction.	14	41	16	25	4
Lab videos are very helpful.	17	46	34	3	0
Supervised off-line classes would be more beneficial than unsupervised.	11	16	27	30	16
Supervised on-line classes would be more beneficial than unsupervised.	10	10	37	26	17
More organized with homework and study in distance education.	33	44	16	5	2
Feel isolated and unable to get help in distance education.	5	13	20	31	31

In Table 5 the students reported that they generally felt distance education instruction was as effective as classroom instruction. There was not much of a difference between classroom and distance instruction once students became accustomed to the equipment. The program itself was well structured and had many support materials such as handbooks and laboratory videos to ensure that students felt secure in an environment without their teacher on-site. The other students at the site seemed to provide a support network which was described in the telephone interviews. This sense of security was supported by the fact that only 18% of students reported in Table 5 that they felt isolated and unable to get help in distance education chemistry.

Students also reported in Table 5 that they were more organized with their study and homework in distance education. Since there was no opportunity to sit with the

teacher and have concepts explained after class, students felt the need to be prepared for their teleconference classes. The on-line classes were scheduled every second day. During on-line classes homework material was reviewed and new material was introduced. There was also an opportunity for students to ask questions and have a visual explanation completed on the monitor. If students were not prepared they would miss important explanations and would be confused with the new topics.

Table 6 reports the results of t-tests which were performed to identify any disparities in workload and participation between distance education chemistry and a comparable classroom science course. The table reports mean responses for one of six possible choices concerning assignments and one of seven possible choices concerning questions and homework. For example, when asked about the hours spent completing assignments, students could have responded 0 (0 h), 1 (1-2 h), 2 (3-4 h), 3 (5-6 h), 4 (7-8 h), or 5 (more than 8 h). The responses to the items concerning the number of questions asked included the choices: 0 (0), 1 (1-5), 2 (6-10), 3 (11-15), 4 (16-20), 5 (21 - 25), or 6 (more than 25). Finally, the choices for the hours spent on homework included: 0 (0 h), 1 (1-2 h), 2 (3-4 h), 3 (5-6 h), 4 (7-8 h), 5 (9-10 h), or 6 (more than 10 h). A potential confounding of variables should be recognized here, of course, since different courses were being compared.

Table 6: Comparison of Student Workload in Distance Education Chemistry and a Classroom Science Course.

Variable	Distance Chemistry Mean(SD)	Classroom Science Mean(SD)	t-value	p	
assignments	2.45(.901)	1.71(.904)	7.52		*
questions	1.77(1.06)	2.50(1.59)	-5.33		*
homework	2.67(1.13)	1.97(1.01)	6.45		*

*$p < .0001$

There were significant differences found in the workload ($t = 7.52$ and $t = 6.45$, $p < .0001$) and in the participation ($t = -5.33$, $p < .0001$) of students in distance education chemistry compared to a classroom science course reported in Table 6. On the questions concerning amount of time spent completing assignments and laboratory reports, the students reported a mean frequency of 2.45 which translated into 4-5 hours in distance chemistry compared to a mean frequency of 1.71 which translated into 2-3 hours in a classroom science course. Students also spent significantly more time doing homework in distance chemistry. The mean frequency on the homework item was 2.67 (5-6 hours per week) in chemistry versus 1.97 (2-3 hours per week) in classroom science. It would appear that there were more evaluation instruments in the distance course than in their classroom course which would require more effort by students. As well, these students would need more time to complete their work in a teleconference course since they did not have the presence of a teacher for immediate feedback and assistance.

The number of questions (mean of 1.77 which translated to 5-6 questions per week) that students asked during their on-line classes was significantly lower than the number (mean of 2.50 which translated to 10-11 per week) asked in a classroom course. It was noted that the length of the on-line and classroom classes were both 40 min. There are several factors which may have contributed to this result. For example, the classroom courses may have been more discussion oriented than the chemistry courses, students may have been reluctant to talk over the microphones, or the structure of the on-line class itself did not permit student participation. The instruction in the on-line classes could have been teacher directed and used for instruction, announcements, and correcting with little time allocated for questions. In fact, the students might not have been given the same opportunity to ask questions on-line as they were in the face-to-face environment.

From the perspective of being a distance education teacher, it was not always easy to include every student in on-line discussion during one class. Initiating discussion was much more difficult on-line than in a face-to-face setting. Sometimes students would take several seconds to respond to questions or would ask for statements to be repeated before they would answer. Often responses were delayed. There could be many reasons for the delay. For example, the instructor's voice was muffled and the student could not understand what was being said, the student was talking to another classmate, the student did not know the answer and didn't want to admit it, or other students were talking and the individual could not hear. Some students would not hesitate to ask questions concerning topics they did not understand while others students would not speak unless

they were directly asked a question. This makes teaching at a distance even more challenging because as an instructor you cannot see the puzzled looks on students faces when they do not understand. To target this problem, questions would be directed at specific individuals. During each class it was attempted to target every student at least once. However, it was not always easy to cover every question, correction, and explanation in the forty minutes for an on-line class.

Supervision

Table 7 reports the responses of students concerning the number of classes (on-line or off-line) supervised by an adult. The majority of all classes were not being supervised. These results were supported by those in Table 9. It should be noted that one site did have a teacher taking chemistry on-line with the students as a refresher course. This would likely account for the results where students reported all three on-line/off-line classes being supervised.

Table 7: Supervision of Distance Education Chemistry Classes (%).

Number of classes supervised/week	0	1	2	3
Off-line	84	5	2	9
On-line	89	4	1	6

Supervision may not have been considered possible by the schools because the

personnel were not available to provide supervision or because it was not considered necessary with the type of students enrolled in the distance program. Other reasons which were not targeted by this study could exist for the lack of supervision.

Interactions

Table 8 contains data concerning the interactions among students both at their own site and between different remote sites. It shows that over 91% of the students never sought help from their classmates at other sites. This is supported in Table 9 where 94% did not agree that students at other sites were helpful. Possibly there was not enough emphasis on learner-learner interactions between sites during on-line classes. This result does not support the full potential of the teleconference environment as proposed by Garrison. Garrison (1993) argued that learner-learner interactions were just as important between students at different locations as they were for students at the same location. The teleconference class was considered ideal for promoting interactions among students at various remote sites.

It is not surprising that students did not contact their peers at other sites outside of on-line classes. These students may not have known their on-line classmates well enough to call or fax them with a question or problem. However, it might simply have been easier to ask another student at their own site rather than making a long distance call or writing a fax. Otherwise students believed it would be more efficient to call their instructor,

ensuring an answer to their question, rather than trying to contact a student at another site.

Table 8: Interactions Among Distance Education Students (%).

Number of times/month help is sought from other students.	Never	1-5	6-10	11-15	>20
At your site	2	34	29	18	16
At other sites	91	7	1	1	0

Table 9 includes data which targets many different issues. These issues include supervision, comparison of distance education to classroom courses, technical familiarity, and learner-learner interactions. The issue of supervision centered around the off-line classes and laboratory activities. The off-line classes were generally not supervised by teachers at the schools (14% are supervised). A much greater percentage of the laboratory activities (57%) were supervised. These students were generally responsible for the completion of their work and were left independently to do it. Teachers were not monitoring these students to ensure their work was completed.

Table 9: Students' Responses to Issues in Distance Education Chemistry

	Percent Yes
Supervision	
Off-line classes are supervised.	14
Lab activities are supervised.	57
Comparison to classroom courses	
Less independent work in distance education.	5
More organized in distance education.	54
Teacher in school who can help with chemistry.	54
Technical familiarity	
Know how to start up teleconference equipment.	98
Have started up the teleconference equipment.	90
Have had to work out technical problems.	72
Adult in school to help with technical problems.	86
I fax my own assignments and reports.	68
Interactions	
Students at the site are helpful.	93
Students at other sites are helpful.	6

When the students compared distance education to classroom courses, very few (5%) agreed that there was less independent work in distance education. The majority of students (54%) reported that they were more organized in distance education chemistry. Overall, the distance students believed that they had to work more independently even though they were not more organized for a distance course. Possibly these students used the same organizational skills for all of their courses. For 54% of the sample there was a teacher in school who could help them with chemistry. However, it was not determined

what percentage of students actually took advantage of this help or the teachers level of expertise in chemistry.

Generally, the students reported that they were familiar with the teleconference technology. Table 9 shows that 98% of the students knew how to start-up the equipment for a teleconference class, and 90% had actually performed this task for their chemistry course. The majority of students (72%) had experience working with the operators to diagnose technical problems. The fact that these students had learned how to start up the equipment and to diagnose problems without the reliance on an adult supported the characteristic of independence. Students also reported (86%) that there was someone in the school who was able to help with technical problems. The fact that an individual is capable of assisting with technical problems was not surprising as this would be a requirement for the school offering distance programs.

The learner-learner interactions described by Moore were evident as 93% of students reported in Table 9 that students at the site were helpful. However, the potential of the teleconference classes to promote interactions between students at different remote sites as argued by Garrison was not confirmed. Only 6% of students reported that students at other sites were helpful.

Summary

The questionnaire data has provided insight for several research questions. A summary follows which is divided into the three main areas of interest: demographics/reasons for taking distance education chemistry, students' assessment of the distance learning environment, and the teleconference environment.

Demographics and Reasons for Taking Distance Education Chemistry. The areas covered by the questionnaire which were related to this research section included demographic information and reasons for enrolment in distance education chemistry. The majority of the students in chemistry were Level II and Level III students. The ratio was 60:40 for students who had completed previous distance education courses to those who had not. The students reported selecting chemistry because they were interested in the subject and because they believed it would be necessary for post-secondary programs. The majority of this group appeared to share the common goal of future academic ambitions.

The question of who, if anyone, advised these students to enrol in chemistry was not answered. It was not determined from these results whether the students had enrolled in chemistry from their own self-selection process or from the advice of individuals in school or at home.

Students' Assessment of Distance Learning Environment. The majority of the students reported spending more time studying, doing written homework, and working independently in distance education chemistry than in a comparable classroom science

course. The interpretation of these results must be cautious because the science course to which students were comparing might simply have been easier. Students also consistently reported being more organized with their homework and their study for distance education chemistry compared to classroom courses. There may have been more pressure felt by students to be better prepared for the on-line classes because the teacher was not on-site with them. In terms of study techniques, students did not report any differences between distance education and classroom courses. It does seem valid to conclude that these students were working harder to succeed in the distance course. If the students were working more diligently for their distance education course, then their achievement should reflect this.

Teleconference Environment. The results reported in this instrument focused on the learner-learner interactions described by Moore. These interactions were apparent during the off-line classes. Students' responses showed that other students at their site were helpful and were generally sought for assistance when it was needed. However, the potential for learner-learner interactions between students at different sites was not recognized. Students did not report having contact with students at other locations. The possibility does exist that students did not consider their on-line class interaction when answering questions related to interactions with students at other sites.

The second topic related to the teleconference environment was supervision of on-line and off-line classes. Generally, students were not supervised for either of these classes. There was one exception whereby the teacher was taking the chemistry course

with the students. Otherwise the students were left on their own during distance education chemistry class periods. When asked to rate their opinion concerning the supervision of these classes, most students were either neutral or did not agree that supervision would be more beneficial.

The third issue concerned the level of help available to students at the site. The results revealed that the majority of students did not feel isolated and unable to access help in distance education. In fact, over half of the students reported being able to get help from a teacher at their school. Most students reported seeking help from their classmates. Overall, the issue of help availability did not appear to be a crucial one.

Diary Analysis

The purpose of the diaries was to reveal the experiences and opinions of students in greater detail than was possible using questionnaires, and to allow for responses which might not have emerged from a more structured instrument. Many themes concerning the program were revealed in the data. The students disclosed their thoughts concerning positive and negative aspects of the distance learning experience, they compared their distance education chemistry experiences to those in a classroom science course, they outlined the traits a student might need to be successful in distance education, they described how their impressions changed as they became more familiar with the course

and the technology, and they identified why they were interested in distance education chemistry.

The diary analysis consisted of fourteen codes. These codes were developed from several readings of all the diary entries and identifying themes in the writings. This section is subdivided into each of these codes: initial impressions, reason for taking distance education chemistry, metaphors, motivation, learner characteristics, workload, comparison to regular classroom, teacher characteristics, benefits of distance education chemistry, communications in distance education chemistry, teleconference technology, scheduling of classes, supervision, and resources. The quotations contained in each of these sections were edited for spelling errors only. The students are identified by letters to ensure anonymity. The line numbers are included for easy reference to the master data file of the diary transcripts.

Initial Impressions

A common trend was found concerning students' initial impression of chemistry through teleconference and how their views had changed over time. At the start students were terrified, shy, and nervous. They felt the course was going to be very difficult. Students were not sure if they would be able to get help from a teacher in their school. They worried about being too shy to speak on-line and wondered if they would be able to keep up with the fast pace with which material would be covered in the course. Students

also thought the course was going to require a great deal of work as they expected many assignments, labs, and tests as well as large amounts of homework in distance education chemistry. As time progressed, however, the students adapted to the routine and found distance education classes to be just like regular classes. They became comfortable with the technology and overcame their shyness of speaking into the microphones. These points are illustrated by the following excerpt:

> In September I thought it was a lot of work and I would never make it through the year. I thought I would never understand it and I wouldn't be able to get help. Also, I thought I would be too shy to talk on-line. (Student K, Line 7194-7200). I found out that it wasn't that hard, it was almost like a regular classroom course. I also found out a lot about chemistry and really enjoyed learning chemistry. Also, I found that if I needed help I could call, and that I wasn't shy at all. (Student K, Line 7206-7211).

A couple of students found the course more difficult than they had anticipated and were frustrated with this mode of instruction. Their marks were not what they had expected and they began to loose confidence in their abilities. In fact, one of these students actually dropped the chemistry course due to a sense of hopelessness which developed from not being able to cope with the workload. The following quotation illuminates the frustrations of a student who persisted with the program and passed the course.

> I was optimistic. I thought that it would be an interesting course that wasn't too hard. My impression is different now. It has changed in the past month or so. My marks aren't what I want and if I miss one class or one day of school, or if I'm behind on one lesson, I feel totally lost. Chemistry is hard and I think it's hopeless. (Student Y, Line 430-439).

Reason for Taking Distance Education Chemistry

What motivated the students to continue with chemistry whose first impressions described the course as being hard, difficult, and a lot of work? The goal of attaining a post-secondary education emerged as a contributing factor in their decision. Most students felt that their experience in both distance education and in chemistry would provide skills needed for their future endeavors. Some students thought chemistry would be interesting and fun. Other reasons are highlighted in the following comments:

> I liked the challenge [of chemistry] from the beginning. I really enjoy learning new things, especially those that I had no knowledge of before. (Student G, Line 3540-3544).

> I know that university is a lot of work and that distance learning is a good way to prepare you for the work and give you the discipline you need to

> strive for your goal. (Student K, Line 1127-1132).

> I do like a challenge so I felt this was a good one....distance education gives you a lot of responsibility and I feel will help us get ready for college or university. (Student D, Line 2835-2840).

> I believe that the independent work coincides with preparations for University. (Student F, Line 6851-6853).

These students reported that they enjoyed being given a challenge such as learning a new subject in a different environment. They felt that the benefits derived from distance education such as fostering responsibility and an independent work ethic would prepare them for university.

Metaphors

The initial uncertainties with a teleconference environment were not surprising. How the students adapted to their new situation was quite interesting. The students persevered in unfamiliar territory and worked hard to overcome the obstacles they encountered. They persisted when faced with the challenges of distance education such as learning how to use the teleconference equipment and the fax machine. Many students used metaphors to describe the transition to distance learning. The following examples

illustrate the point:

> a rainbow after a storm. It's a struggle to make your way through. If you don't know how to prepare yourself for the storm, you will never live through the battle. But if you have a good knowledge in that area or are quick to catch on and understand, you will make it through to see the rainbow and you will be relieved and overjoyed with the beautiful results of the storm which have benefited you so much. (Student E, Line 1857-1867)

> changing from a three-wheeled to a two wheeled bike. Like riding a three-wheeled bike when you're a child you are used to regular classes with a teacher in the classroom. Then you are told that it is time to change. You wonder what it's going to be like and then when you start it's a bit strange. But after a few days you realize that it's really not that bad and then it becomes a regular part of your routine. (Student V, Line 2602-2614).

> a new pair of skates. At first the skate does not fit properly because they are too stiff or hard and hurt your feet. But after a while of wearing them the material begins to soften up a little and soon they feel comfortable. Distance learning was hard and frustrating at first but after a few classes I got into the routine and I felt comfortable with the method of teaching. (Student U, Line 2752-2763).

> a flowing river meaning that at times the work can get a little rough but sometimes the 'river' stills and there's the privilege to meet new people and become more independent. This 'river' travels to new, different places and you learn things in a new, fun way. (Student X, Line 6175-6183).

> like taking a new job. At first you don't really know what to expect and I guess it can be challenging because you aren't used to a routine. But then as time progresses the job just becomes another everyday event which you are perfectly comfortable with and there are no problems doing the required tasks. Chemistry is the same for me in distance learning. (Student L, Line 5950-5961).

A common theme emerged in which students felt that learning in the teleconference environment got easier with time, energy, and practice. An internal locus of causality and a sense of controllability were also illuminated in the metaphor explanations. These students did not quit when they faced challenges. On the contrary, they worked with more persistance and determination to succeed. They felt that their success was under their control and attributed both good and bad results to their efforts and not to external factors such as problems with the course delivery. This attributional style was corroborated on the CDS instrument which is analysed in a later section.

Motivation

Most of the students seemed to have similar characteristics in terms of an independent work ethic and a high sense of control over their achievements. The students reported that certain characteristics were necessary to be able to survive in distance education. One student who was having difficulty stated in the telephone interview "I'm not an independent worker and you are supposed to be independent" (Student M).

Themes of challenge, independence, and responsibility consistently emerged in the students' writings. These individuals appeared to be very mature and had both short-term and long-term goals established for their future endeavors. They were not frightened by the prospect of having to work hard to achieve. On the contrary, most students reported a great sense of pride and satisfaction when they succeeded due to the fact that they were facing a challenging course and a different learning environment. The fact that they were responsible for their learning and that they were working on their own made their accomplishments more significant and meaningful for them. Students wrote:

> it gives you a greater feeling of satisfaction that you're pretty much doing things yourself when you accomplish something new and different. (Student N, Line 4442-4446).

> the on-line classes are very interesting, it's like because you don't have a teacher there to help you every minute you seem to pay more attention, and so what you learn seems a lot more interesting. (Student O, Line 7407-

7412).

> I really enjoy working in the lab with no teacher present because it gives me a sense of independence and I strongly believe that working independently will better prepare me for what I am about to face in a post-secondary institution. (Student G, Line 3246-3252).

> it's [distance learning] a great learning experience, it helps prepare for university. (Student P, Line 5860-5861).

Most of the students attributed their successes to their own efforts which reflected an internal locus of control in which students attributed their success to themselves and not to external factors such as exam difficulty. The writings illuminated a sense of control over their performance and achievement. Generally students thought that success was attained by increasing their efforts and amount of study. Some of the comments written by the students follow:

> I found the test easy, but I still couldn't get a good mark. I guess I'll just have to study more. (Student Y, Line 310-312). I have to put more work into my chemistry assignment this week. I'm hoping for a good mark. (Student Y, Line 320-323).

> I found out that I got 100%...I did work really hard when I was studying. (Student W, Line 613-616). All I can do is try real hard and hope for the best mark that I can get. (Student J, Line 1297-1299).

> I only got 60%...I will just have to study harder and work on the lessons more in my spare time. (Student W, Line 1319-1323).

> I know that chemistry on line is not a easy course and I will have to work extra hard and make sure I understand everything taught in order to get the marks I expect. (Student A, Line 2014-2019).

> I believe that I did well. Most of this confidence is due to the fact that I worked really hard in preparing for the exam. (Student G, Line 3281-3284).

> I will continue to work hard at chemistry because I know that that is the only way that I will do well. (Student H, Line 3681-3683).

Even when the students did not achieve the mark they had anticipated, they still attributed their failure to effort, an attribution which was changeable and which was under their control. According to Weiner (1984), individuals who ascribe to internal, unstable, and controllable factors such as amount of effort tend to have higher expectations for

future successes. This expectancy of success then influences a variety of motivational factors such as intensity, quality, and persistence. The emotions of pride and happiness associated with achievement will serve to motivate them for future success.

Overall, the data revealed that there was a common attributional style among the distance learners. The majority of students shared a common link in their explanations for their achievement in chemistry. They attributed their level of success to the amount of effort they had put into the course. These students had reported feelings of satisfaction associated with their success in a challenging course. These feelings served to build their self-confidence and increased their persistence to ensure future success.

Learner Characteristics

A cooperative learning atmosphere whereby students took on various roles in the off-line classes contributed to a support system for learning and coping without a teacher on site. This atmosphere encouraged both learner-content and learner-learner interactions. However, this type of unsupervised, unstructured learning environment required students with particular characteristics. Not everyone would be capable of working on their own, being responsible for submitting their work, and figuring out problems without a teacher present. Due to the structure of distance education and the method of delivery, it was probable that there was a select group of individuals who were interested in the teleconference courses. The diary entries revealed a sense of exclusiveness by the students

taking distance education. The students reported that they had to be independent workers and responsible for their own work to be successful in distance education.

A preconceived notion did exist concerning the individual characteristics necessary for the successful completion of courses in distance education. Repeatedly throughout the student diaries references were made to the necessity of being organized, responsible, vocal, hard working, a good listener, independent, and cooperative. The criteria for taking distance courses appeared to be well-defined by the students. They felt that one must be an academic, dedicated, responsible, independent individual to succeed in distance education. These criteria would certainly limit the accessibility to teleconference programs as not all students would believe that they possessed such characteristics.

The following exerts illustrate the particular character traits that the students felt were necessary for enrolling in distance education:

> you need to be organized, resourceful, hard working, responsible and dedicated to succeed. Being helpful, inquisitive, straightforward and not afraid to ask questions often help as well. (Student C, Line 1642-1646).

> the ability to have self-discipline and keep yourself on track, even when you know you don't have to pay attention. You need to be able to catch on easily, with little help. You have to be prepared to do work, and a lot of it. You have to stay on top of things by reading ahead and doing extra work to help yourself understand. (Student E, Line 1801-1810).

> you need self-confidence and have to be able to do work on your own. You have to be able to work with others in class. (Student H, Line 3794-3797).

These characteristics were also highlighted in the telephone interviews analyzed in the next section. There was a consistent theme in the list of traits students felt were necessary to ensure success in distance education.

Workload

The diaries contained many references to the workload in distance education chemistry. In one of the questions faxed to students for their diary entry they were asked to rank the workload on a scale of 1 - 10 for their teleconference chemistry course and for a comparable classroom science course. The average ranking for distance chemistry was 8.6 in comparison to 5.5 for a classroom science course. A significant difference was also found on a t-test from the questionnaire data which compared the amount of time spent on assignments, etc. in distance chemistry compared to a classroom science course. The students had reported spending more time on work for chemistry than for a classroom science course.

In the diaries, most students explained that their work was completed during class time in non-distance courses whereas much more time was spent on assignments and laboratory reports at home in distance chemistry. Some students felt that there were more

assignments, tests, and laboratory reports required in distance education chemistry than in their classroom science courses. One student wrote that "in a regular class, you have less homework and less of what you have to do such as lab activities, homework, assignments, and questions" (Student K, Line 7113-7117) and "there is more work [in distance chemistry] than other courses with having to do lessons and more assignments and tests" (Student K, Line 7292-7294) while another wrote "there's too many assignments and labs [in distance chemistry]" (Student N, Line 4451-4452).

Was the heavier workload attributed to the course itself or to the distance delivery? The explanations provided by students who identified distance education chemistry as more work than classroom sciences can cautiously be interpreted to answer this question. Students generally compared distance chemistry to physics and biology courses in their school. The rationale for chemistry being a heavier workload highlighted the fact that the teacher was not in the classroom which made help more difficult to attain. As well, students felt they needed to be more prepared for their on-line classes than those in the regular classroom. Comments included:

> both biology and physics were easier than chemistry because you do all your work in class and the teacher is there all the time to give you a hand if you need it. It does not require much pre-studying. (Student F, Line 6887-6892).

> in my chemistry class I feel I need to keep up on top of my work. So

> almost every night I do something. In my biology class what we do that day continues in our next class and there's really nothing we can do until that class...on-line you have to make sure you understand the things you are doing and ask the on-line teacher about things you don't know how to do because there is not a techer there who can sit down and show you exactly how to do something. (Student A, Line 2129-2143).

> the workload was heavier in chemistry because we were forced to work more independently than in a regular classroom. When a problem came about, it was no longer as simple as getting the teacher to do it for you. (Student G, Line 3482-3487).

An element of frustration was evident in the diary writings concerning workload However, the heavy workload seemed to offer a challenge that appeared to motivate the students to work harder to ensure their success. A representation of the students' overall feelings was provided in the following comments:

> I don't think I would be able to handle any more work. Between labs, assignments and other work, it keeps me going. I always have something to do in chemistry...I have to admit, at times I do get frustrated with it. (Student W, Line 771-780).

> in order to keep up with it, a lot of hard work is required. But somehow,

> knowing that because it is up to me how well I do in this course, provides me with incentive to work hard and put 100% in everything that I do (Student G, Line 3263-3268). Between homework, labs and assignments, there is no time to waste. I think this is why I enjoy this course so much. (Student G, 3311-3314).

Overall, students consistently reported that there was a heavier workload in distance education chemistry compared to a classroom science course. From an instructor's perspective, this was possible. The evaluation instruments for distance education are very structured in terms of number and submission deadlines. All assignments, tests, and laboratory activities designed for the course were completed with no exceptions. As well, there were midyear and final exams from which students could not be exempt. Thus, the students followed a very demanding pace to complete every objective and to write evaluation instruments. Realistically, this is not always the same for classroom courses. For example, all laboratory activities may not be completed for whatever reasons. The same emphasis may not be placed on completing and submitting assignments. Thus, the perception of workload by students as being less for classroom courses compared to distance courses could be valid.

Comparison to Regular Classroom

The students' who preferred classroom instruction over distance delivery revealed

the need for more direct contact with the teacher. They liked having a teacher present and felt more comfortable asking questions when they knew the students in their class. The questionnaire results also supported this trend as the students reported that they asked more questions in the classroom situation compared to the teleconference environment. A reflection of these students' opinions is revealed in the following exerpts:

> I like the atmosphere of having a teacher present when I am learning. In the classroom I feel more comfortable speaking to the teacher that's because I know all the people in the classes with me and I am relaxed with them. (Student J, Line 5132-5138).

> I think that I would prefer chemistry that is taught in the classroom because the students have personal contact with their teachers which makes asking for help a whole lot easier. (Student U, Line 2685-2690).

> having a teacher close by is easier because you can feel the presence of a teacher and if you have a problem you can just raise your hand or go somewhere in the school to find them. You also build a better student/teacher relationship. (Student D, Line 2932-2938).

Although the students reported spending more time working on their distance chemistry course compared to classroom courses in the previous section, there did not appear to be a great difference in their approach to organizing their materials. They

consistently described themselves as very well organized and generally followed the same approach for all of their courses. For example, most students' kept their materials in binders or folders. This was consistent with the responses in the questionnaire.

One difference between distance and classroom courses did emerge in the data. Even though most students followed the same organizational plan in their courses, they felt that there were more sheets, assignments, and labs to keep track of in distance education chemsitry. There was some evidence that this was related to the mode of delivery. Students had to keep track of fax sheets, assignments, tests, labs, and answer keys that were faxed to them. There was more pressure not to lose these things because the teacher was not on-site to be asked for another copy. One student wrote "I organize all my courses and notes the same way, chronologically. They [classroom courses] usually are not much of a problem because there are not nearly as many sheets in other (classroom) courses" (Student Z, Line 4755-4762). When students felt they were not as organized in a classroom course, it was explained that there was not as much work in that course compared to distance chemistry. A student wrote "I am not as organized in my other classes because I usually use just one exercise for notes as well as work. It seems like there's not so much to do in my regular classes as in my chemistry" (Student A, Line 2160-2165).

Was there a preference for classroom instruction over distance delivery? Students were about equally divided on this issue. Those who preferred classroom instruction felt it was a more personable experience. These students liked the idea of having a teacher in

class with them and available to them in school at any time of the day. A student commented that:

> in regular classes you have a teacher 'right there' to help and work with you, showing you step-by-step procedures and to help you after school or anytime you need help. You don't get distracted as much or daydream, because there is a teacher there to keep you on track and make sure your paying attention. (Student E, Line 1791-1799).

Other reasons for their choice included less homework in a classroom course, more material in distance education, and too much uncertainty in distance education. A student wrote "In a regular class, there is communication between both parties which makes learning easier and also puts a student at ease" (Student F, Line 6932-6936).

The students who preferred distance delivery felt that only mature students were allowed to do distance education and that it prepared them for university. They felt that the concepts were explained well on-line and that they were easier to understand than in the classroom. To them distance education provided a nice break from the regular classroom routine. Is was appreciated that more work was covered in distance education than in their classroom courses and these students felt that they could catch on faster with the teleconference instruction. They also liked the smaller and quieter on-line classes. Students wrote:

> knowing that I can do it through distance education makes me feel that I can cope under pressure, and gives me a feeling of more importance than

> regular classroom courses, cause everyone can do that, but not everyone can do it through distance education. (Student R, Line 3029-3037).

> I spend more time working and figuring out things on my own when dealing with a distance ed course, I learn more and have more first-hand experience with what exactly is going on....I get more from the course. (Student G, Line 3577-3585).

> chemistry distance ed classes are, in every way, just as effective as regular classes. We still have a teacher, and a "blackboard"-the telewriter, and we still get to show our work and get it corrected by fax. (Student Z, 4603-4609).

> it [distance education] is a great learning experience and it helps you become independant, and helps you to prepare for university. (Student P, Line 5853-5856).

It is noted that there was a limitation associated with asking students to make comparisons with regular classroom courses. It could not be determined if the differences described were a function of distance education or of the chemistry course itself.

Overall, the students did not seem to take different approaches to organizing their materials for distance or classroom courses. However, they were aware of the fact that

there were more items including time lines, faxes, answer keys, tests, labs, and assignments which required more time to arrange for their teleconference course.

In terms of preference for distance or classroom modes of instruction, there was no definitive answer revealed. Some students preferred the distance delivery while others would rather be in the classroom environment. However, all were aware of the benefits provided by the opportunity to take chemistry via distance education as there were no other ways to access the course.

Teacher Characteristics

Some students wrote about their appreciation of the instructors' efforts to make the distance aspect of instruction more personal. One student wrote:

> one day he asked us if anyone had watched hockey, cause he was wondering who had won the game the night before. I think that little things like this really help us to gain respect for a teacher and to consider her/him on a more personal level rather than just a voice from a box that tells us what to do. (Student Z, Line 4520-4528).

Other teacher characteristics were revealed in the students' writings. For example:

> our teacher is very patient and has no problem with going over and over the same stuff until we understand it. (Student H, Line 3630-3633).
>
> In class if we are ever having trouble, our instructor is so patient,

> supportive and enthusiastic that it rubs off on us and that in turn allows us to enjoy learning. (Student G, Line 3269-3273). Not only was she understanding and patient when I had problems, but she even offered to come on-line after school hours to give me extra help...my instructor was always willing to do what she could to make things easier for me...it left me with a sense of respect and friendship toward her. These experiences have left me with a very good feeling about doing chemistry through distance education. (Student G, Line 3140-3154).

> he explains everything really well and always makes sure that everyone understands a certain topic before moving on to another one. When we have questions and fax him, no matter how many times, he is quick to respond and tries his best to help us. (Student W, Line 491-497).

> there are no preconceptions based on size, age, sex or any other characteristics. (Student C, Line 1639-1641).

All of the comments illustrated that students appreciated the patient, companionate, and understanding qualities of their instructors. It was important for them to feel their instructors understood the challenge of completing a course through teleconference.

Benefits of Distance Education Chemistry

When the students wrote about the reasons for taking chemistry most discussed the benefits that the distance learning experience would give them for going to university The autonomy they felt from working independently and without the direct supervision of a teacher gave the students a sense of maturity.

The academic value of their distance initiatives was not the only positive aspect students considered. They also recorded social advantages associated with being on-line with students in other parts of the province. A student wrote about the advantages of distance education in that "you meet other students around Newfoundland, and it gives you more responsibility making a student more mature" (Student I, Line 6822-6825).

Another positive aspect of the course was the laboratory activities. They were viewed as enjoyable and as an important part of the program. A sense of adventure and responsibility was associated with completing these activities. Students considered the labs fun and felt they gave them some 'hands-on' experience with chemistry. They generally liked working with the chemicals and actually seeing chemistry rather than simply reading about it. It seemed that most students did actively participate in the activities. Some statements concerning the labs were:

> I think it [lab activities] makes me feel a little more involved or something. Like I'm doing something important. Maybe that's why I enjoy them and take so much time and consideration with them. (Student T, Line 2436-2441).

> I really enjoy working in the lab. It gives me a chance to work independently and to accurately assess just how well I am progressing through the course. Lab work is fun as well as educational. It provides me with a chance to experience Chemistry first-hand-not just through a book. (Student G, Line 3325-3332).

In summary, the diary writings revealed more benefits than frustrations associated with distance education. These students were very appreciative of the opportunity to take chemistry, regardless of the delivery method.

Communications in Distance Education Chemistry

Even though the majority of the students found their distance education experiences to be fairly positive, there were some dislikes which emerged in the diary writings. This method of instruction was not without its challenges. There were times when students felt very frustrated with no teacher on-site with them. Students felt it was more difficult to telephone or fax their teacher for help outside of the on-line classes. One student commented that "it can be frustrating faxing back and forth" (Student W, Line 900-902), while another wrote "it's very confusing at times. It's harder to do without a teacher in the room with you" (Student Q, Line 169-171). Another common complaint was the lack of on-line time for asking questions and doing review. A student wrote:

> I feel that our classes on-line are too short. For example, when reviewing

> for an exam I often feel as though there is never enough time to have all of my questions answered. I do realize that there is a phone and fax machine at my disposal all of the time, but it is not the same as a session. (Student G, Line 3346-3355).

These comments offered an explanation for the significant differences found in the questionnaire results concerning student participation in the teleconference classes. Possibly students were not given enough on-line time to ask questions. This would limit the effectiveness of the teleconference in encouraging two-way communications. One student wrote "we don't have much time to ask questions in class" (Student B, Line 930-931), while another wrote "it's a little harder to ask a question because distance education instructors can't see you raise your hand. The only time you can ask a question is when no one else is talking or writing and you can't just cut people off" (Student Z, Line 4714-4720). The extent to which the teleconference class was used to promote learner-learner and learner-instructor interactions was questionable from these comments. Possibly the true interactive nature of audio-graphics teleconferencing was not being implemented to its full potential due to the short duration of class time.

Teleconference Technology

The students' writings revealed a progressive change in attitude towards the teleconference environment. There was a great deal of insecurity and frustration with

using the unfamiliar technology for the first time. Students were shy about speaking into a microphone where everyone else could hear them. They were afraid of making mistakes and embarrassing themselves. However, it was evident that students were quite comfortable with the equipment after a couple of months. It seemed that successful, positive experiences elevated their confidence level and motivated them to persist. Some comments were:

> it was really weird using the telewriter for the first time. I was sure that I would fool-up and humiliate myself. But I didn't and that's great. (Student J, Line 1220-1224).

> I felt very uncomfortable because it was really strange to me but now I have adjusted quite well and I am very comfortable and familiar with the equipment. (Student A, Line 2110-2114).

> when I first began using the teleconferencing equipment in September 1995, I felt very uncomfortable about phoning into Telemedicine and naming my site, my course, the number and my teacher. Now, it doesn't bother me because I'm used to it. (Student N, Line 4273-4281).

> I didn't like using the microphone or the telewriter, because I didn't want to make a mistake. I still feel that way at times now. (Student W, Line

757-761).

> the first time I was introduced to the teleconferencing equipment in Level I math, I was scared. It looked pretty complicated, and I didn't really know what to expect. But once we got familiarized with everything, it was no big deal. Personally, I love to use the telewriter. (Student Z, Line 4678-4686).

An element of enjoyment with using the technology was evident in the students' writings once they overcame their initial shyness. Students wrote:

> one of the best things about distance ed. is it's interactivity. It's a lot like a classroom, in terms of questions being asked and answered. This year we are also using the telewriter more than we usually do. The telewriter is one of the coolest things in distance ed. (Student C, Line 1501-1508).

> the monitors are really cool though, when it comes to communicating back and forth. (Student E, Line 1918-1920).

There were not many references to technical problems in the diary entries. One student wrote "I dislike the static noises in the speaker box and when the screen locks up on the computer" (Student V, Line 2651-2652). Overall, the impression was conveyed that the classes were generally trouble free. There was little indication that students'

learning was negatively affected by the technology employed in the teleconference environment.

Scheduling of Classes

The students were generally happy with the way classes were scheduled. One student wrote "it's good not having chemistry[on-line] everyday. It gives more time to do homework, and work at stuff with the rest of the class" (Student Y, Line 195-198), while another wrote "I like the idea of off-line classes because it gives us a chance to study what we have learned that week and also some time to work on the following lessons, assignments, and labs" (Student J, Line 1243-1247).

Students viewed the off-line classes as an opportunity to relax and relieve some of the pressures associated with taking a teleconference course. Some students reported chatting among themselves while completing their work in these classes. However, it did not seem that these classes were purely recreational. On the contrary, students were quite adament about the benefit of off-line classes and how these classes provided them with invaluable time to complete evaluation instruments. Some comments were:

> I find the off-line classes just as important as the on-line classes. This year I have a very heavy work load. So making good use of my off-line classes is very important. (Student W, Line 500-505). I also have to admit that my

> classmates and I do sometimes get off the topic of chemsitry, but we always get our work completed on schedule. (Student W, Line 866-870)

> in my off-line classes me and my classmates usually finish up our work from chemistry as well as other classes and when that is done we chat and relax to get our minds off of the workloads...I would never think of eliminating them! Our days are so hectic, so it's so nice to be able to just sit down and do nothing for 5 minutes or so, then you can catch up on work, or study for a test. (Student Z, Line 4787-4793).

> a typical off-line class could include many things such as doing labs, watching videos to help us with chemistry labs or work, studying for tests and getting cuaght up on regular work. We usually interact with each other during these off-line classes to help one another. (Student L, Line 5963-5974).

The off-line classes provided the opportunity for a peer tutoring environment. This was the time when students helped one another and developed a good support system. The learner-learner and learner-content interactions as described by Moore were evident in the writings of the students. However, it was not revealed whether or not the teleconference itself encouraged learner-learner interactions between different sites. This leads one to question whether or not the full potential of the audio-graphics teleconference

environment as proposed by Garrison was reached.

Supervision

Frequently, it was mentioned that both off-line and on-line classes were not supervised in the schools. There was almost an unanimous response that supervision of these classes was not necessary. The students felt that they were responsible enough to ensure that their work was completed on their own. One student wrote:

> we don't cause any trouble on our own, in on-line classes, we are mature enough to act accordingly. In off-line classes, we know when we have work to do, like labs or assignments and we know when we can just relax (Student Y, Line 404-410),

while another student wrote "we are young adults and in order to accept more responsiblity we have to be given the chance to show it" (Student R, Line 3073-3075). The students generally felt that if problems arose they would simply have to consult a teacher or report to the office. The attitudes of these students indicated that they were a homogeneous group who were very dedicated and focused on their achievements.

Supervision was suggested, however, for the laboratory activities. A student wrote:

> I think it's necessary to have our lab experiments carefully supervised. It always ends up that one or two of us end up doing the whole experiment

> by ourselves because the others are 'afraid' that some of the chemicals might burn their skin. (Student S, Line 5264-5271).

The concern that all students would share equally in the activity was raised by some individuals. However, this would not be a problem unique to distance education chemistry as most classroom science teachers grapple with unequal sharing of student responsiblity in laboratory activities.

Resources

References were made to the videos for the laboratory activities. One student wrote 'I think that putting out a video was a good idea. A pictures worth a thousand words. We really would have been lost in doing Lab 4 without it' (Student T, Line 2386-2390). In terms of the other resources available, most students also found the handbooks useful. Some comments were:

> I find the handbook easier to understand than the textbook. It is also really useful when studying for tests. (Student W, Line 559-562).

> they [handbooks] didn't beat around the bush and bore us. I think it was a good addition to the chemistry program. (Student T, Line 2315-2318).
>
> Even if there is a lot of information, it is still modified to just about the right amount for adequate learning. The examples they give are very helpful as well. Sometimes, when I can't figure out something that has

> been explained, I look at the examples and learn how to do the problems by seeing how they did them. (Student T, Line 2454-2463).

There was no mention of using video discs by any of the students in their diary entries and no explanation was given as to why they were not used. From students' verbal comments, not all schools had access to a video disc player. This issue was not investigated any further.

Summary

The general feeling which emerged from the diary writings was that a group of students with particular characteristics were taking part in distance education chemistry. The students themselves had a specific list of characteristics necessary to achieve when learning through teleconference. These students felt that not everyone was capable of completing programs via teleconference. They identified themselves as mature, responsible, hard working individuals who were capable of working independently. The fact that they were able to work without the assistance of a teacher on site was considered essential by these students. It appeared that there was an exclusiveness among the students enrolled in distance education. Their writings presented them as a select group who were more capable than the average student. If this is in fact true, then distance education is a program for a few academic students. The question of how these students were chosen would be a pertinent one. Do these individuals know their special qualities

and automatically select themselves for distance education or are these students selected as a result teacher and/or principal opinions? If there is a selective nature to the enrolment of students in distance education then the rationale for increasing access is no longer a valid one.

Generally, the students were taking chemistry through teleconference because they had future university ambitions. They felt that both the course and the experience of distance education would be beneficial to them when they pursued their interests at the post-secondary level. Overwhelmingly students thought taking a course through teleconference taught them self-discipline, helped them develop good study habits, and made them more responsible.

Students wrote that distance education chemistry was more demanding than classroom courses. The students perceived themselves as putting more effort into their distance chemistry program compared to their classroom courses. They wrote about having more assignments, tests, and laboratory reports in distance education courses than in a comparable classroom science course. This was supported in the questionnaire data analyzed in the previous section. Students also reported that they must be more prepared for their on-line classes than for a regular classroom course. The rationale seemed to be that it was important to keep up with the work in distance education as there generally was not a teacher available on site for extra help. Students were aware that if they missed instruction on-line then it would not be as easy to get the information since they would have to telephone or fax their instructor, or rely on the other students at their site.

Students did not report doing anything differently in terms of organization for their distance education course compared to classroom courses. The diaries revealed that most students were fairly organized in all of their courses. This was substantiated in the telephone interviews. However, students did comment on the amount of materials they had to organize. They wrote that there were many more papers including evaluation instruments and answer keys which they had to account for in distance education courses.

The students were aware of the demands associated with completing a course through distance education and they welcomed the challenge it presented. The students seemed to be internally motivated and possessed a sense of controllability over their achievements. They spent a great deal of time working in this course. However, effort alone was not the sole factor responsible for student achievement in distance education chemistry. A series of variables such as work ethic, organization, motivation, and attributional style contributed to students' success in this program.

With regards to the technology, the students did not report experiencing much anxiety with using the teleconference equipment. Initially, the students felt shy speaking over the microphones. However, after a couple of weeks they became more comfortable with the equipment and wrote that the experience quickly became routine. It was sensible to conclude that the experience gained from using the equipment contributed to the students' comfort levels with this instructional method.

Overall, these students enjoyed distance education because of the independent work. They thought that the fast pace and heavy workload would be a good preparation

for them when they went to university. Generally, they liked the sense of responsibility for their learning.

Telephone Interview Analysis

A telephone interview was conducted with each of the diary participants. These interviews were designed to supplement the diary entries, and to focus on specific questions of interest to the researcher, which might not have been revealed by the diaries. The same letter classification applies to each student as those for the diary participants.

The sample of students for the telephone interviews who had also completed the diaries was composed of Level I's (n=7), Level II's (n=4), and Level III's (n=15). There was almost an equal split between students who had and those who had not previously completed distance education courses. All participants in the sample reported being actively involved in both academics and non-academics in their schools. Extracurricular activities included sports teams, volunteer work, yearbook, drama, peer tutoring, green team, and graduation committee.

The responses to the telephone interviews are divided into five sections. They include teleconference technology, interactive nature of teleconference classes, teleconference instructor characteristics, approaches to learning through distance education, and student interactions.

Teleconference Technology

The students were questioned about voice quality, use of the microphones, and use of the telewriter. The consensus was that it was not too difficult to hear the teacher's voice over the speaker box, although sometimes students found it difficult to hear the voices of their classmates from other sites. Generally, once they were accustomed to the set-up, the students felt that it was "just like the classroom" (Student C). There were some references to static and distortion. However, students indicated that this was not a frequent problem.

The microphones did not appear to be a barrier to the students asking questions. Initially there was some uncertainty with the new technology which made the students a little uncomfortable. Student U reported "at first I was nervous, I wasn't sure what to expect. Now it is the same as a regular class - you just push a few more buttons". Most students, however, reported being very comfortable using the microphones in class.

The reason for the significant lack of questioning reported on the questionnaire does not seem to be caused by the technology itself. One student even said "they don't keep me from talking any less" (Student G). A possible explanation could be the limited amount of time for the on-line classes. In the diaries, students recognized the length of these classes as a problem. It is also possible that the instruction was teacher dominated and that there was not enough time for students to ask their questions.

As for the telewriter, the students all found it quite easy to use. Student C reported that "it is like you are called to do a question on the chalk board in class. You

must show your work to everyone in the class". Student N said that "I don't have much opportunity to use it. It helps from a teacher's point of view. Although when giving notes, the screen has limited space. The telewriter helps when you have a question - it saves time". The students appreciated the visual aspect of instruction with the use of the telewriter. The degree to which the students actually used it was somewhat questionable. Students commented that the most frequent use of the telewriter was during chemistry classes. However, a comparison between chemistry and other distance courses was not completed.

The telephone interviews confirmed the impression given by the diaries that there was little time for interaction in the teleconference classes. The students had also reported in the questionnaire that they asked fewer questions in their distance classes compared to regular classes. The data suggest that the learner-instructor and learner-learner interactions during the teleconference class were somewhat limited.

As an instructor, it was always a challenge to develop interactive classes. It was the intention to design lessons so that there would be interaction between the instructor and the student. Segments of a lesson would be teacher directed while other segments would be student focused. Instructional techniques such as targeting each student specifically to answer or complete problems on the telewriter were incorporated. This would sometimes be frustrating for other students in the class when it took a great deal of time to complete a problem. As well, there were always some students who vocalized their questions more than others. Thus, attempts were made to ask students by name

whether or not they had particular concerns. This was seen as an important technique by students from their interview responses. They felt it gave a more personal approach to learning at a distance. Overall, the teleconference classes were intentionally designed to be interactive. However, within a forty minute period it was sometimes challenging to allocate time so that each student participated in the lesson, especially when a student had questions that required explanation using the telewriter. In these cases, you could not simply direct the student to make contact after class rather than using the on-line time for expanation because the telewriter would not be available. Thus, there were challenges inherent in distance education that were absent from classroom teaching.

Interactive Nature of Teleconference Classes

When the students were asked about the characteristics of an effective teleconference class, generally they described an interactive one. They liked to use the on-line time to have learner-instructor interaction. Student W said:

> I like it when the students are involved in questions. If the teacher asks someone to draw on the screen and if you don't know something, you will learn it quickly. It is good when students can ask questions and when everyone is paying attention.

These classes were thought to be more like classroom classes and the students appreciated being able to get help directly from the teacher. Student X answered "I like it when the

teacher takes time out to help you with what you are having problems with"

Generally, the students found it effective to have their questions answered and found it useful when other sites asked questions on-line. They relied heavily on the on-line time with the teacher to clarify any confusion with the material. Both the learner-instructor and the learner-learner interactions proposed by Moore were highlighted by the students as being important. However, the classes did not permit enough of these interactions. The length of the class was identified in the diaries as a potential drawback

Teleconference Instructor Characteristics

A question was posed concerning the qualities of an effective teleconference instructor. Overwhelmingly the students identified humanistic qualities. They felt the individual should be patient, understanding, and encouraging. For example, Student G said:

> it is important for the instructor to be patient because sometimes there is no one to help us with chemsitry in our school. We are completely dependent on our distance education instructor. The instructor must take time to answer questions and have patience with a lot of questions being asked.

As well, some students felt it was important for the instructor to talk to the students, using their names rather than making general statements to the whole class. For example, asking each student by name whether or not they understood a concept rather than just making a

general statement to the whole group.

Some students believed it was important for the instructor to promptly answer faxes and return assignments. This was not considered a problem by any of the students. They also preferred an individual with a clear voice which could easily be understood through the speaker box. It was reported that asking questions directly to individual students was beneficial. Student H stated "by [the instructor] asking questions, it would make you ready at all times for when you were asked".

Overall, when the students were asked to compare the qualities of an effective distance education instructor to those of an effective classroom teacher, the majority did not think the qualities were any different. However, it was indicated that distance instructors needed to be more creative with their help as it was not easy to explain concepts over the telephone. The students found that the classroom environment was more personal because the teacher was physically present and the teacher was more familiar with the students.

Approaches to Learning Through Distance Education

When students were asked about their approach to distance education and whether they did things differently in classroom courses every individual responded that distance education required either more work, more study, or more assignments. Some student responses included:

it [distance education] is a different way of doing things which presents initiative to work harder on your own - you want to prove that you can do it yourself. (Student G).

where the teacher is not there all the time you try to learn it on your own. It makes you work harder. I am more organized with my materials and I study more and put more time and effort into it. (Student M).

you are not as spoon fed as in the classroom. It takes more initiative to do it on your own, more responsibility. I put a lot more work into DE classes because you have to keep up or you are lost. (Student W).

definitely have to be more organized with DE. I haven't been doing all that great in DE - 60's and 70's - I find there is more to know in course material. You have to study more and work harder - 10X the workload. (Student N).

I concentrate more on getting work done in my spare time. I don't have time to reach the teacher. It is too much trouble to fax - I just figure it out on my own. (Student C).

Generally the students felt that they worked harder in distance education because

there were more assignments and because there was less reliance on the teacher. The students did not appear to have a negative attitude towards distance education because of the extra study involved. They seemed to enjoy the challenge. The telephone interviews supported what was already reported in the diary entries concerning comparisons between distance education and classroom courses.

Student Interactions

Two-way interaction between students at the same site was evident in the responses about the importance of other students being present at their site. It was considered helpful for other students to be present when working on assignments and labs, and for having questions answered. Student H indicated that there was a cooperative learning atmosphere present in the comment "if there are things you don't think about the other students will think about it and come up with a couple of different ways to do something". One student mentioned that there was pressure from other students who wanted to know the answers but they [the students] seemed to work out a 'common ground'.

The majority of the students stated that they would consult with their classmates to have a question answered rather than telephoning or faxing their instructor. Generally, it was viewed as too much trouble or there was not enough time to call or fax. It seemed easier to get help from their classmates. The other options presented were to wait until

the on-line class, to read the handbook/textbook, to make a fax, or to ask another teacher at their school.

Overall, there appeared to be a fairly cohesive working atmosphere among the students at the same site. Some individuals did prefer to work without any help while others mentioned that they appreciated the help on assignments and labs, but prefered to study independently. However, the majority valued the support from their classmates with assignments, labs, and general questions. The opportunity to hear what their classmates were struggling with helped the students with their own understanding. It was viewed as good practice to explain material to other students and at times to have material explained to themselves. Although it was noted that sometimes it was distracting to have the others talking while they were trying to work.

Students gave a mean rating of 3.5 on a 5 point scale when asked how important it was for other students to be at their site. This rating was consistent with the theme of independent study revealed in the diary entries. Students like having their classmates available to ask questions and discuss chemistry topics, however, many prefered to study independently.

The interactions at the student sites supported the description of learner-learner and learner-content interactions described by Moore. However, learner-learner interactions between students at different sites were not reported. This benefit of teleconferencing highlighted by Garrison did not seem to be exercised.

Summary

The general consensus concerning the use of the teleconference technology was a positive one. Most students did not feel this method of instruction was any different from the classroom as they compared the telewriter with the black board. There were no major problems once they became familiar with pressing on the microphone button before speaking. Students noted that sometimes there would be static over the line or the voices would be muffled. However, this appeared to be the exception rather than a regular occurrence. Overall, the students did not view the teleconference technology as a barrier to their learning. Generally, they enjoyed the change in instructional delivery from the regular classroom.

Students felt that a good teleconference class was one in which their questions were answered and work was completed efficiently. They thought it was important for their classmates to be attentive and involved in the lesson. It was also important for their questions to be clarified and to understand the concepts being covered.

The characteristics of an effective teleconference instructor generally were no different than those for an effective classroom teacher. However, the students did make reference to the importance of having a clear voice so that they could hear the individual through the speaker box.

When asked about their approach to learning in the distance environment, most students responded that they did more work on their own. They reported being very conscientious about having their work completed for class since the teacher was not in the

school with them. Students said there was more study, homework, and assignments for their distance course. Generally, the students felt that they were responsible for understanding the material on their own in distance education. Some students felt there was not enough time to write faxes or make telephone calls to the instructor. They commented that it was better to simply try and figure it out on their own, or to ask their classmates for help.

Generally, the students found it beneficial to have other students at their site. The learner-learner interactions consisted of students helping one another to understand the concepts. It was easier to ask a fellow classmate for help than to call the instructor. Some students reported waiting for their next on-line class to have their questions answered. Overall, most students found it beneficial to have others at their site but generally preferred to study independently. This was consistent with the reports in the diary entries concerning the amount of independent work completed by students.

Motivation

Both the Causal Dimension Scale and the Attributional Style Questionnaire are instruments which measure attributional style. The CDS is based on a situational approach which assesses causal attributions for specific events. This instrument was administered to the distance education chemistry students to determine their attribution for

success in chemistry. A correlational analysis was conducted on the subscales of the CDS. It was found that four items, each of which assessed the locus of causality dimension, were significantly correlated. As well, two items which assessed the stability dimension were significantly correlated. Therefore, it was decided to use composite scores for these two dimensions.

The ASQ, on the other hand, follows a trait approach for measuring attributional style. The instrument contained hypothetical events to which the respondent must attribute a cause. The ASQ was administered to distance and non-distance students in the schools where students were enrolled in distance education chemistry. The Level II students not completing courses via distance education served as a comparison group for the assessment of attributional style. This was the only instrument in which a comparative approach was possible.

The comparative statistical analysis included an analysis of variance to determine any significant differences in attributional styles of the two groups: distance and non-distance learners. This analysis was completed for the three subscales (locus of causality, stability, and globality) found on the Attributional Style Questionnaire and for the composite scores of these subscales.

Finally, a correlational analysis was conducted using the ASQ and the questionnaire responses for the distance students. Preliminary investigation revealed that the stability dimension of the ASQ was not correlated with the questionnaire responses. The locus of causality and globality subscales were correlated with some items on the

questionnaire. These items included students' responses regarding the difficulty level of distance education chemistry, the amount of organization they used for distance chemistry, any feelings of isolation, and the amount of work they did independently

The analysis of the ASQ and the CDS are divided into two sections, one titled attributional style and the other titled attributional style and performance. The results are discussed in the following sections.

Attributional Style

Attributional style in a motivational context was investigated to determine whether any differences existed between the distance and the non-distance students. The personal characteristics previously identified by the distance students indicated that the distance learners were a special group of individuals. Table 10 illustrates the attributional styles of both distance and non-distance learners.

Table 10: Comparison of Distance and Non-distance Students on the ASQ

Variable	Distance Students Mean(SD)	Non-distance Students Mean(SD)	F	F Prob
CPCN	5.0(.44)	4.7(.57)	4.78	*
LC	5.4(.68)	5.1(.77)	3.57	**
STB	4.7(.53)	4.5(.62)	1.17	ns
GLB	5.2(.60)	4.7(.66)	7.49	***

ns - not significant, *$p<.001$, **$p<.05$, ***$p<.0001$

The composite score calculated for the attributional style was significantly different

($F = 4.78$, $p < .001$) between distance and non-distance students. The distance learners had a more internal locus of causality, attributed causes to be more stable and more global than their non-distance counterparts. Thus, the distance students had a more 'optimistic' attributional style than the non-distance students.

When each dimension was analyzed individually there were significant differences between the two groups on the locus of causality ($F = 3.57$, $p < .05$) and on the globality ($F = 7.49$, $p < .0001$) subscales. The distance students had a more internal locus of causality and were more global in their attributions than their counterparts. There were no significant differences on the stability dimension.

The results of the ASQ and the questionnaire were correlated to investigate any relationship between attributional style and work habits of the distance education chemistry students. Table 11 reports the results from this analysis.

Table 11: Pearson Correlation Matrix of ASQ Causal Dimensions and Student Questionnaire Responses.

	1	2	3	4	5	6
1. More difficult	1.000	.3684**	.3309**	.0044ns	.1108ns	.1524ns
2. More organized		1.000	.1314ns	.2021*	.0928ns	.1971*
3. Isolated			1.000	-.1044ns	.3821**	.2830***
4. Independent				1.000	-.1108ns	.0411ns
5. Globality(ASQ)					1.000	.7641**
6. Locus of causality(ASQ)						1.000

*$p<.05$, **$p<.0001$, ***$p<.001$

The Pearson Correlations show the relationships between the globality and the

locus of causality dimensions on the ASQ, and student responses on the questionnaire concerning whether the teleconference was more difficult than a classroom science course, whether they were more organized for teleconference chemistry, whether they worked more independently in distance education, and if they felt isolated in the program.

The results show that students who found the course more difficult through teleconference compared to classroom delivery were also more organized. However, the perception of being difficult did not mean the students felt isolated. There was also a relationship between the students working more independently in distance education and being more organized. The results indicate that students were aware of the demands that were placed on them in distance education and developed strategies to cope with this type of learning environment.

In terms of attributions, an internal locus of causality was significantly correlated with being more organized, not feeling isolated, and applying the causation for an event to a wide variety of situations (more global). There was also a correlation between the global dimension and not feeling isolated in distance education. It appeared that these students were capable of applying their study approaches to both the classroom and to distance learning environments which reduced any feelings of isolation.

Attributional Style and Performance

The distance education chemistry students were given the CDS to measure the causal attributions of a specific event. The students could choose either ability, effort, course difficulty, or luck as the cause that would determine their performance in distance education chemistry.

The greatest percentage of students attributed their performance in chemistry to effort (80.2%) compared to ability (14.4%), course difficulty (5.4%), or luck (0%). According to Weiner (1984), the students who attributed their success to effort would demonstrate higher future expectancies for success than those who would attribute their success to ability, course difficulty, or luck. Students would view effort as an attribution under their control and changeable which would enhance persistence towards a goal and augment performance (Weiner, 1984). In fact, the mean was 6 on a 7 - point scale when students were asked to rate the cause as 'under your control' or 'out of your control' Thus, the majority of distance students attributed their performance to effort and strongly believed that this cause was under their control. It was possible that this attribution contributed to the performance of students in distance chemistry.

Table 12 reports the performance and percent pass of students enrolled in distance chemistry and those taking chemistry provincially. Even though students have reported in the diaries that they perceived chemistry to be a difficult course, they were successful (89-96% of students passed) in the program. The distance students had consistently higher marks than the non-distance students. This reinforces the selectivity hypothesis.

Table 12: Performance in Distance Education Chemistry Since Inception Compared to Provincial Performance in Chemistry.

Course	1995 - 1996 mean mark	1995 - 1996 % pass	1996 - 1997 mean mark	1996 - 1997 % pass
Distance education				
Chemistry 2202	74	96	73	89
Chemistry 3202	n/a	n/a	77	100
Provincial				
Chemistry 2202	69	89	62	85
Chemistry 3202	73	97	70	94

The relationship between attributional style and performance was examined for the distance education students. Table 13 shows the relationship between the locus of causality and stability dimensions measured by the CDS and performance.

Table 13: Pearson Correlation Matrix for the CDS and Performance.

	LC	STB	Mark
Locus of causality	1.000	.4298*	.0872ns
Stability		1.000	.2829***
Mark			1.000

ns - not significant, *p<.0001, **p<.05, ***p<.01

There was no correlation with locus of causality and performance in distance chemistry. Stability was, however, significantly correlated with performance. Students who rated the cause of their performance in chemistry as more stable actually performed better than

those who rated their attribution for success as less stable. This is consistent with Seligman and Schulman who described an 'optimistic' attributional style as having a stable attribution rating on the stability dimension. Individuals who consider their attributions as stable would tend to be more persistent in their endeavors. Finally, there was a high correlation between the locus of causality and the stability dimensions. This indicated that students who had an internal locus of causality also rated high on the stable end of the stability dimension. Both these ratings are consistent with an 'optimistic' attributional style.

Summary

There was a different attributional style evident for the distance and non-distance students. The distance students rated more internal, stable, and global on the locus of causality, stability, and globality dimensions. This was consistent with the 'optimistic' attributional style described by Seligman and Schulman. Individuals with this style tended to be more persistent whereas those with the opposite attributional style would be less persistent (Seligman & Schulman, 1986).

Attributional style was another characteristic contributing to the profile of a distance learner which distinguished these students from their non-distance counterparts. This, combined with the traits of being independent, responsible, and hard working, identified by students in other instruments, implied that a particular type of student had

enrolled in distance chemistry. The notion of student selectivity in distance education was consistently supported in all data sources. Whether that selectivity is student or school driven was still questionable.

Students revealed in the diaries that they perceived distance education chemistry as a difficult course which required a great deal of work. Most of the students succeeded in chemistry regardless of their perceptions about the difficulty level. The students' attributional style could have been a contributing factor. The majority of the distance students attributed their success to their level of effort. According to Weiner, this attribution is a good indicator of high expectations of future success which in turn leads to persistence by the students. This would increase the probability of students' success in the course. Thus, this rationale could be applied to the distance education chemistry students as an explanation for their performance.

When the relationship between performance and attributional style was examined, there was a correlation between the stability dimension and the mark attained in chemistry. Seligman and Schulman argue that individuals who consider their attributions as stable tend to be more persistent in their endeavors. This could explain the fact that performance in distance education chemistry is above the provincial average. The data have shown that a homogeneous group of students with a common attributional style and characteristics are enrolled in distance education. This would contribute to the success seen in chemistry. It should be noted, however, that there could be other contributing factors to students' success in their courses that were not investigated in this study. Further research is

required in this area.

Chapter 6

Summary, Conclusions, and Discussion

Distance education was implemented in Newfoundland to provide access to high school courses for students in rural areas. The courses that were developed for distance delivery included those in the academic stream such as Advanced Mathematics, French, Physics, and Chemistry. The proportion of students enrolling in the program has been somewhat limited, possibility because of the academic nature of the courses and the preconceptions about the type of students capable of completing teleconference programs. As a result of the small segment of the school population taking courses, distance education has remained a marginal endeavor.

This study was not designed to evaluate the participation rates of students in distance education. It has covered much broader issues surrounding the program such as students' motivation, student characteristics, interactions, and opinions concerning issues associated with taking a distance course such as workload and technology. The intention was to provide a comprehensive understanding of the complexities involved with taking a

distance education course.

Problem

Distance education has undergone many changes since the implementation of correspondence courses. Advances in technology have found their way into the delivery of distance courses. Some examples include broadcast media, teleconferencing, video and computer conferencing, the Internet, and World Wide Web applications. The technology of focus in this study was audio-graphics teleconferencing. The main medium of communication, the teleconference class, was supplemented by facsimile and telephone correspondence in distance education chemistry. The distance students were a homogeneous group with similar characteristics and attributional style which differentiated them from the non-distance students.

Some teacher characteristics reported in the literature as important for teleconference participants included speaking clearly and slowly, not rambling or wasting air time, and being well prepared for class (Burge & Howard, 1990). However, there were no studies that assessed student characteristics from a motivational perspective. In fact, Sponder (1990) suggested that research on student motivation in distance education should be conducted from the viewpoint of attribution theory. He found in his study that many students felt that they had little or no control over the educational process (Sponder, 1990). This would influence students persistence and performance in distance programs.

Motivation was investigated in this study from the perspective of Weiner's

attribution theory. In this theory, it is proposed that the future successes/failures of students may be predicted according to the particular attributions they have associated with their past success or failure. As well, there are certain emotions connected to these attributions. For example, a student with a history of failure tried hard and failed a relatively easy task. The student attributes the lack of success to low ability which is a stable cause that produces a low expectancy of future success. This low expectation, accompanied by feelings of humiliation, contribute to a lack of persistence in the face of future failure. Performance decreases in achievement-related tasks as a result of reduced persistence.

A particular attributional style can be determined according to the cause students attribute to an event (Seligman & Schulman, 1986). This attributional style is a predictor of the effort level students' will exert to ensure their success in future endeavors For example, students with an 'optimistic' attributional style will more likely continue to persist after failure than those individuals with a 'pessimistic' one. The pass rate of students in distance education was 95% compared to 90% for the province. A valid question is whether or not attributional style is a predictor of students performance.

The common qualities that were shared among students and the fact that the performance of these individuals in chemistry was above the provincial average indicated a select group of students were participating in the program. There were several contributing factors to students' success in distance education chemistry besides motivation. These included student characteristics and the interactive capability of

technology.

In terms of the technology, research has shown that participants in distance education strongly support technology that is interactive (Beare, 1989; Boone, Bennett & Ovando, 1995; Eastmond, 1994; MacLaren, 1993; Slaton & Lacefield, 1991). Students have placed a high value on learning that resulted from interactions both on-site and off-site with students as well as with teachers (Anderson, 1994). Generally, participants felt that the interactive capability provided both a means and a motivation for them to engage in deep levels of meaning and understanding. The students also appreciated the direct, real-time feedback from the instructor which would not be possible in correspondence courses (Eastmond, 1994).

Garrison has argued that teleconference technology has great potential in distance education due to its interactive capabilities. The two-way communication in an audio-graphic teleconference offers the same types of interactions as in the regular classroom. The interactions considered essential to learning were described by Moore as learner-learner, learner-content, and learner-instructor. Garrison has proposed that all of these interactions are supported in the teleconference environment.

From the review of the literature, several areas of research were determined. The study focused on the technology in an audio-graphics teleconference course and the interactions supported by this learning environment, the attributional style of both distance and non-distance students and whether attributional style would predict the performance of distance students, and students' opinions concerning issues such as workload,

communications, and necessary character traits to be successful in distance education.

Methodology

The type of research employed in this study could be considered action research in which the researcher had the dual role of teacher and researcher. Even though most of the data collection was from the students' perspective, the researcher could, at times, offer opinions from the viewpoint of an instructor. There are, however, limitations inherent in this type of research. For example, the students could have been biased in their reports because the researcher was also their teacher. However, measures were taken to dissociate students participation in the study from their participation in distance education chemistry. All correspondence concerning the study occurred outside of regular school hours, students were given a letter of consent which explained the full details of the study, and students were informed that participation in the study had no connection to their performance in chemistry.

Consent forms were mailed to all participants in the study. The population included all distance education chemistry students and all non-distance Level II students attending the same schools. A questionnaire, a Causal Dimension Scale (CDS), and an Attributional Style Questionnaire (ASQ) were administered to the distance students. As a comparison group for attributional style all the non-distance Level II students in the

distance chemistry schools were administered the ASQ. A random sample of distance chemistry students was selected to complete diary entries and telephone interviews. Finally, performance data for the distance and provincial chemistry courses were obtained from the Department of Education.

There were five instruments used for the data collection. The diaries and telephone interviews provided students' opinions concerning issues such as work load, interactions, student and teacher characteristics, and technology. These data revealed in-depth descriptions of the students experiences in distance education. The questionnaire and the telephone interviews targeted the same issues that emerged in the diaries but not in the same descriptive detail. The questionnaire results provided data from a much larger sample than the diaries and telephone interviews. Finally, the ASQ and the CDS were used to assess students' attributional style. A trait approach (ASQ) versus a situational approach (CDS) was taken in the assessment of students' attributional style. The results of the ASQ were used for a comparative analysis to identify any differences in the attributional style of the distance and non-distance groups. The CDS was administered only to distance students and the results were correlated with performance to see if attributional style could be used to predict students' performance. The fact that there was no comparison group for the CDS was a limitation of the study.

Summary of Results

A brief synopsis of the results for each of the research questions is provided in this section. The questions targeted three research areas: the teleconference environment, the characteristics and motivation of the students, and the students' assessment of the distance learning environment.

Teleconference Environment

1. Do on-line and off-line classes offer students the opportunity for learner-instructor, learner-learner, and learner-content interactions identified by Moore?

All of the interactions outlined by Moore were revealed in the students' descriptions of their distance program except learner-learner interactions between different sites. The students valued the interactive nature of the classes and felt that it was very beneficial to be able to ask questions on-line. They appreciated the on-line time as this was the only opportunity to have material clarified visually as well as verbally. There were reports from some students that it was difficult to ask questions during the on-line classes because individuals could not talk when someone else was speaking. Therefore, it was not easy to interrupt to ask questions. This was a limitation of the technology.

The students reported in both the diaries and the telephone interviews that they would seek assistance from classmates at their site when they experienced difficulties. Support groups at the same site were evident in which students worked together to

complete assignments, to do laboratory reports, and to answer each others questions. They also reported relaxing and chatting with one another during the off-line classes. Thus, the social nature of learning was revealed in which students used this off-line time to take a break from the pressures of studying. There was no evidence of interactions between students at different sites. These results were supported in research by Anderson (1994) where his students valued the interactions among students at the same site and found it more difficult to develop support groups with students at different sites.

The learner-content interactions were evident in the students' use of the handbooks and other resources available in the program. The print material and the video tapes were considered to be extremely beneficial by the students. The videos provided demonstrations for the laboratory activities and explanations concerning correct techniques that the student's reported as invaluable.

Overall, the combination of all three types of interactions provided for a successful and generally pleasant learning environment for the students. The interactive capability of the teleconference classes could be improved with slight modifications such as lengthening the time for class. However, both the on-line and off-line classes did provide the opportunity for the interactions described by Moore even though interactions between students at different sites were not prominent.

2. How does teleconference technology (voice quality, telewriter, microphone) influence students' learning?

There were very few accounts of technical problems in the teleconference classes.

Students reported no problems with hearing the teacher's voice over the speaker box. However, there was some indication that students from other sites were difficult to hear at times. All of the students enjoyed using the telewriter and some compared it to the chalk board in the classroom. They felt the visual component was a necessity in the teleconference class. From an instructor's perspective, students would often ask for an extra teleconference class to have questions explained so that they had access to the telewriter rather than trying to rely on verbal communication over the telephone.

With regard to the audio component of the teleconference class, some students reported being uncomfortable and shy initially with using the microphones. However, after a few weeks, students became accustomed to their use and did not feel that they reduced their participation. Once they were familiar with the equipment, students reported that it was just like a regular classroom. In fact, the diary writings and the telephone interview responses both tended to support the notion that experience with this medium builds support for it.

In summary, the technology did not present any barriers to the students' learning in distance education chemistry. The telephone interview results did not indicate any problems or inhibitions with the use of the microphones, telewriter, or monitor. Students did recognize their initial shyness with speaking on-line but explained that they felt quite comfortable after a couple of weeks and did not think the equipment was a barrier to their learning.

3. How much supervision is provided at the site for on-line and off-line

classes in distance education chemistry? What level of supervision, conducive to learning, is considered necessary by the students?

The level of supervision of on-line and off-line classes reported by the students was almost zero. There was a unique situation at one site whereby the teacher was taking the chemistry class with the students as a refresher course. This would account for the reported supervision of on-line and off-line classes.

The majority of students did not feel that supervision of their classes was necessary. They viewed themselves as responsible, mature adults and actually enjoyed the fact that they were not being supervised by a teacher and were left to work on their own. It was felt that if any problems arose in the classes, someone could contact a teacher to have the concern addressed.

4. What level of help is available at the site for the student taking distance education chemistry?

The majority of students did not feel isolated and unable to get help in distance education. Approximately half of the students reported that there was a teacher in their school who could help them with chemistry. However, the expertise of these teachers was not investigated. Thus, the level of help these individuals could provide was not determined.

Students also relied on their classmates for help at their site. This was a more popular source of assistance for the students. The majority of students reported seeking help from their classmates rather then telephoning or faxing their instructor. Offering

assistance to other students was not viewed as cumbersome. The individuals reported that it was good practice for them to explain material to other students and to have this reciprocated.

Overall, the students did have help available to them at their site. Some students contacted a teacher in the school while others relied on their classmates for help This contributed to the fact that students did not feel isolated in their chemistry course.

Characteristics and Motivation of Students

1. Why do students choose to enroll in a distance education chemistry course?

There were several reasons cited for why students took distance education chemistry. Some students were generally interested in chemistry and felt that it would be interesting and fun. Others were concerned about requirements for their future endeavors in college or university. They believed that distance courses would prepare them for the heavy workload anticipated in university. The responsibility, discipline, and experience from working independently in distance courses were thought to be good preparation for the skills required to be successful in post-secondary institutions.

Overall, these were academic students who had set future ambitions for a university education. They enjoyed being faced with a challenge and they perceived learning a new subject in a novel environment as an interesting one.

2. Are there particular types of students that participate in distance education chemistry because of the nature of the course and the level of independent

study?

Some of the distance students did report preconceived notions about the characteristics of an individual capable of being successful in distance programs. These students often reported that one must be a mature individual, responsible for completing ones work, and capable of working independently to excel in distance education. They were self-motivated to have their work completed and to come to class prepared for their lesson. An attitude of superiority emerged in the diaries when some students wrote that not everyone would be capable of learning through distance education.

A select group of students did seem to be enrolled in distance education chemistry. Many students wrote that they had enrolled in this course because of the independent work and the challenge of doing a course through distance. It was perceived to be more difficult to complete a course through distance than in the regular classroom. Thus, it does appear that a particular type of student was enrolling in distance education chemistry because of the nature of the course and the level of independent study associated with this method of instructional delivery.

3. Is there a selectivity, either self or school directed, in the type of student chosen to enrol in distance education chemistry?

The data has revealed students with common characteristics who have enrolled in the distance program. It could not be conclusively determined whether this selection was self or school directed. Students reported receiving advice from adults at home and/or from principals at school. However, this was not probed in any further detail and it was

not elaborated upon in the diary entries. Therefore the degree to which the selection was self or school directed was not determined.

4. Do students in distance education chemistry have a different attributional style from students not participating in distance education chemistry?

The majority of the distance students possessed an optimistic attributional style where they rated towards the internal end on the locus of causality dimension and rated high on the stability dimension. The results showed that the causal attributions for events affected a wide variety of situations rather than just isolated events. On the contrary, the non-distance learners ranked more on the external, unstable end of the dimensions. They also tended to attribute the cause of a particular event to a specific situation rather than generalizing to all events.

Seligman and Schulman have reported that students with an optimistic attributional style are more persistent in their future endeavors and have a better chance of success than those who have a pessimistic attributional style. This could account for the level of performance in distance education which was above the provincial average in chemistry.

In summary, the results of this study revealed that the distance students had a different attributional style than their classroom counterparts. This along with difference in performance provides supporting evidence that a select group of students were participating in the distance program.

5. Does the attributional style of the distance learner predict their level of success in a distance education chemistry course?

When the results of the Causal Dimension Scale instrument were compared to the performance data of distance education chemistry students there was a positive correlation between the stability dimension and mark in chemistry. The stability and locus of causality dimensions were also correlated.

The individuals who attributed their performance in chemistry to stable causes had higher marks. These individuals also rated more internal than external on the locus of causality dimension. These attributions are consistent with the description of an optimistic attributional style as described by Seligman and Schulman. They argued that individuals with this particular attributional style are more persistent and as a result will experience higher achievement levels. This was supported by the data in this study.

Students' assessment of distance learning environment

1. Do the students achieve because of a much higher level of effort in a distance education course?

The students felt that there was more work associated with completing a course through teleconference. However, they focused more on the benefits that the distance courses would provide them in their future endeavors than on complaining about the extra work required. These students were aware of the demanding pace and workload associated with distance courses and generally were prepared for the challenge. In fact, the perception of facing a challenging course seemed to motivate the students to be determined to succeed. As a result of their efforts, the students felt a great sense of pride and satisfaction when they experienced success. This is consistent with Weiner's

attribution theory and its predication for future successes based on affect and attributions.

In summary, the students reported exerting more effort in their distance education course compared to classroom courses. It would be logical to conclude that these students experienced a higher level of achievement as a result of their continued persistence and high level of effort.

2. What might a student do differently to be successful in distance education chemistry compared to a face-to-face classroom course? Is there more independent work required of the student in distance education chemistry or in a classroom course? Is the student required to be more organized with his/her time and materials in distance education compared to regular classroom courses?

Students reported completing more work independently, doing more study. and spending more time doing written homework for distance education chemistry compared to a classroom science course. The diaries revealed that students felt there were more evaluation instruments required for distance education chemistry than for a classroom course. From the perspective of being an instructor this is quite possible because all pieces of evaluation were completed in the course with no exceptions. The students also completed all laboratory activities which is not always done in classroom courses for various reasons. There were very strict time lines followed and high demands placed on the students for completion of the required work.

Students also felt the need to be prepared for their teleconference classes which

kept them current with their work. The students considered it necessary to be prepared for class because their chemistry teacher was not in the same school. Therefore, the opportunity to sit with their teacher after school and have a concept explained was not available to them. Generally, they had their questions ready to be answered by the instructor at the beginning of class.

The majority of students consistently reported on all instruments that they completed more work independently for distance education than for classroom courses. The students felt that they did more work independently because their teacher was at a distance. It was noted that students did not have a negative attitude towards distance education because they were working more on their own. In fact, they perceived this as good preparation for life at a post-secondary institution.

In terms of organization for the courses, students did not report any differences for either distance or classroom courses. They used the same techniques for both such as keeping materials in binders or folders. However, students noted that there were more materials to account for in distance education chemistry.

3. How does distance education chemistry require a different amount of work than a course in a traditional classroom?

Students did not necessarily approach their work for teleconference classes any differently than for classroom courses. However, they reported spending more time working independently since there was no teacher on-site to give them immediate face-to-face help. The diary writings revealed that students believed teleconference courses were

perceived as challenging because of the course content and because of the medium for delivery. The majority of students agreed on the questionnaire that taking a course through teleconference was more difficult than in the regular classroom.

In terms of the differences in work between distance and classroom courses, students felt the distance learning environment required significantly more work. They believed there was more study required outside of regular school hours, whereas in courses with classroom instruction the majority of work was completed during the class time. Despite the demanding pace and workload the students did not report a negative attitude towards distance education. Generally, they enjoyed being challenged and saw this as a benefit for their future endeavors.

It should be noted that there were limitations associated with having students make comparisons with classroom courses. Any differences reported could potentially be due to the nature of the courses themselves and not due to the method of delivery. However, students were asked to use a science course similar to chemistry when making their comparisons. Even though many of the students listed physics or biology as the course for comparison, the researcher recognized that these results must be interpreted cautiously.

Discussion

Is distance education merely a last resort, or is it an integral part of the new notion

of education? It is felt that distance education has depreciated because it is only used when there is no traditional way of learning available (Peters, 1993). Evans and Nation (1992) feel that institutions practicing distance education have proven their viability and that it is no longer a marginal activity. Whether or not this is a valid assumption has not been determined. However, it is clear in this case that fewer students enrol in the courses by distance than is the case for the same classroom based courses. It is also clear that distance education students are a select group, both in terms of attributional style and performance.

To the extent that distance education is driven by access, it is unlikely to yield the promise suggested by Ljoså. For this reason, it may be argued that distance education will not flourish in settings where access is not a problem. This essentially limits the approach to the margins, because the proportion of students without reasonable access to programs is quite small in most jurisdictions. Whether distance education continues as a means of access to programs that were otherwise unavailable or whether it becomes an integral part of mainstream education remains to be seen.

Kelly (1990) proposes that "there are clear advantages in adopting these modes of education in terms of widening access to education, fostering a more independent approach to learning, and providing a more economical use of human resources for teaching" (p. 77). It is necessary for designers and developers of distance programs to get beyond the access issue and focus on more pertinent questions concerning distance initiatives. Would all students be able to succeed in this learning environment? Should

other non-academic courses be developed for implementation in distance education? Will distance education remain a marginal endeavor because it requires a particular type of student capable of learning in this environment?

Implications for Further Research

The attributional style and character traits identified in this study have revealed a particular type of student enrolling in the distance education program. An exclusiveness attitude among the students was revealed in the diary entries. The dynamics that exist in the school concerning the attitude towards distance programs and who would be capable of completing such a program deserves further attention. Do the distance students feel that they have special qualities because they are doing distance education? How does this impact on their performance? Do the teachers in the school have preconceived notions of who should be chosen to complete courses on-line? These questions require further investigation and their answers will illuminate the selective nature of students in distance education.

Some interesting results were revealed in this study with regards to attributional style and achievement. The majority of students in distance education had an optimistic attributional style compared to their classroom counterparts. Those who had an internal locus of causality were correlated with being more organized, not feeling isolated, and being more global (applying the cause of an event to a variety of situations). It was

possible that these students were motivated as a result of their attributional style. Generally, the distance students felt that their success was under their control and attributed success to their level of effort. Regardless of success or failure, they continued to persist in the course with the hope of future success.

Further research is required in the area of motivation, particularly from the viewpoint of attribution theory. In distance chemistry there was very little attrition. Generally, the students who left the program did so because their family was moving to another community. However, some programs have very high attrition rates. Further research into the characteristics and attributional style of students, and the relationship to persistence and attrition in distance courses is necessary. This research may clarify the reasons why students choose to persist or drop out of distance courses.

For the students who continued in the distance programs, the importance of interactions between students and instructor and among students was clearly evident. The ability to have one-on-one interaction with the instructor was considered important so that individual questions were addressed. The visual component of the teleconference class was also imperative as this equated the instruction to that in a face-to-face classroom. Further research is required which focuses on the teaching strategies that promote the interactions between students at different sites. The results of this study showed that these interactions were lacking. Thus, the full potential of the teleconference class was neglected. Students' attention and their ability to critically analyze may be enhanced by getting students to interact with one another rather than the teacher simply pointing out

errors or making clarifications. This would promote the educational process described by Shale.

The population of distance students for this study were all in chemistry. Further research should include students from other subject areas to determine whether or not there is a homogeneous group of students in distance education or if it was isolated to chemistry. Are distance programs only suitable for a particular type of student? The results could have implications for the future of distance education.

Policy Implications

The results of this study did reveal some issues which have implications for policy in distance education. Clearly there is a select group of students who enrolled in distance education chemistry. There is not just an overall small proportion of students in the province but also a small proportion of students within the affected schools. This is a costly enterprise for a marginal group of individuals. The justification for offering such a venture to a very small proportion of the student population must be examined. The type of program choices need to be assessed to determine if other courses with less academic requirements could be implemented via distance education. This would potentially increase the number of students who may be able to take teleconference courses, thereby increasing accessibility. As well, the application of distance initiatives should be considered. On-line field trips and guest speakers would be arranged so that distance

opportunities could be incorporated into any subject area for students of all ability levels.

In this study, the teleconference technology did simulate a classroom environment in which there were interactions between the learner and the instructor. However, the extent of these interactions was limited. Several explanations could be offered for the limited number of interactions between students' and the instructor, and among the students themselves. Possibly the on-line classes were too short in duration and tended to be monopolized by the teacher. As well, the teaching approach rather than the technology may have inhibited student participation. Learner-learner interactions between different sites and learner-instructor interactions will not evolve just because students are taking an audio-graphics teleconference course. Instructional strategies must be intentionally planned to promote these interactions. The length of the on-line classes should also be extended to offer more opportunity for discussion and interaction among the participants, and between participants and instructor.

The importance of the teleconference component in distance education courses should be examined more closely. Is the teleconference component necessary or will these students achieve regardless of the mode of delivery? The results of this study and others (Anderson, 1994; Eastmond, 1994; MacLaren, 1994; Slaton & Lacefield, 1991; Sponder, 1990) have identified the importance of interactions to students and their learning. However, are there other technologies such as the World Wide Web, which are more cost-efficient, that might promote the interactions described by Moore more effectively?

Overall, there are many questions which remain unanswered concerning the

delivery and design of distance education courses, especially at the high school level. Further research from the participant perspective would offer more insight into the interactions which are imperative to promoting students' learning. As well, the motivational factors which drive these students to be successful in this challenging learning environment warrant further investigation. The results of this study did not determine whether or not the selection process for students was self or school directed. This could have major implications for the development of future distance education courses. Distance initiatives need not remain a luxury for a select group of students. Future research is needed to develop programs that target a wider audience thus integrating distance learning into mainstream education.

References

Abraham, I. L. (1985). Causal attributions of depression: reliability of the Causal Dimension Scale in research on clinical inference. Psychological Reports, 56, 415-418

Abramson, L., Seligman, M., & Teasdale, J. (1978). Learned helplessness in humans: critique and reformulation. Journal of Abnormal Psychology, 87, 49-74.

Adler, S. A. (1993). Teacher education: research as reflective practice. Teacher & Teacher Education, 9(2), 159-167.

Amundsen, C. (1993). The evolution of theory in distance education. In D Keegan (Ed.), Theoretical principles of distance education (pp. 61-79). New York. NY Routledge.

Anderson, T. (1994). Socially shared cognition in distance education: an exploration of learning in an audio-teleconferencing context. Unpublished doctoral thesis, University of Calgary, Calgary, Alberta, Canada. (MicF th-93850)

Anderson, C., Jennings, D. & Arnoult, L. (1988). Validity and utility of the attributional style construct at a moderate level of specificity. Journal of Personality and Social Psychology, 55(6), 979-990.

Arger, G. (1990). Distance education in the third world: critical analysis on the promise and reality. Open Learning,5(2), 9-18.

Barker, B. O. (1987). Interactive distance learning technologies for rural and small schools: a resource guide. Lubbock, TX: Texas Technical University. (ERIC Document Reproduction Service No. ED 286 698)

Barker, B. O. (1989). Distance learning case studies. Washington, DC: Office of Technology Assessment. (ERIC Document Reproduction Service No. ED 332 661)

Barker, B. O. (1991). Technological delivery systems and applications for K-12 instruction in rural schools. In A. J. DeYoung (Ed.), Rural education: issues and practice (pp.). New York, NY: Garland Publishing, Inc.

Bar-Tal, D. & Darom, E. (1979). Pupil's attributions for success and failure. Child Development, 50, 264-267.

Beare, P. L. (1989). The comparative effectiveness of videotape, audiotape, and telelecture in delivering continuing teacher education. American Journal of Distance Education, 3(2), 57-66.

Beckner, W. & Barker, B. O. (1994). Technology in rural education. Bloomington, IN: Phi Delta Kappa Educational Foundation. (ERIC Document Service Reproduction No. ED 369 586)

Boone, W. J. (1994). Teaching hands-on science with fully interactive distance education technology. Technology and Teacher Education Annual, 709-712.

Boone, W. J. & Andersen, H. O. (1994). Delivering interactive hands-on science methods instruction to remote sites using television. Journal of Information Technology for Teacher Education, 3(1), 51-61.

Boone, W. J., & Andersen, H. O. (1995). Training science teachers with fully-interactive, distance education technology. Journal of Science Teacher Education, 6(3), 146-152.

Boone, W.J., Bennett, C., & Ovando, C. (1995). Teachers' attitudes towards distance learning technology in a science/society global issues course. Journal of Computers in Mathematics and Science Teaching, 14(3), 305-323.

Burge, E. J., & Howard, J. L. (1990). Audio-conferencing in graduate education: a case study. American Journal of Distance Education, 4(2), 3-13.

Charron, E., & Obbink, K. (1993). Long-distance learning: continuing your education through telecommunications. The Science Teacher, 60(3), 56-59.

Coldeway, D. O., Spencer, R., & Stringer, M. (1980). Factors effecting learner motivation in distance education: the interaction between learner attributes and learner course performance. REDEAL Research Report #9. (ERIC Document Reproduction Service No. ED 249 346)

Dobbins, G. H. (1985). Effects of gender on leader's responses to poor performers. An attributional interpretation. Academy of Management Journal, 28, 587-598.

Eastmond, D. V. (1994). Adult distance study through computer conferencing. Distance Education, 15(1), 128-152.

Eiserman, W.D. & Williams, D.D. (1987). Statewide evaluation report on productivity project studies related to improved use of technology to extend education programs. Sub-report two: distance education in elementary and secondary schools. A review of literature. (ERIC Document Service Reproduction No. ED 291 350)

Evans, T. & Nation, D. (1992). Theorising open and distance education. Open Learning, 7(2) , 3-13.

Figueroa, M. L. (1992). Understanding students' approaches to learning in university traditional and distance education courses. Journal of Distance Education, 7(3), 15-26.

Garrison, D. R. (1990). Communications technology. In D. R. Garrison & D Shale (Eds.), Education at a distance: from issues to practice (pp. 41-52). Malabar, FL: Robert E. Krieger Publishing Co.

Garrison, D. R. (1993). Quality and access in distance education: theoretical considerations. In D. Keegan (Ed), Theoretical principles of distance education (pp. 9-21). New York, NY: Routledge.

Garrison, D. R. & Shale, D. (1990). A new framework and perspective. In D. R. Garrison & D. Shale (Eds.), Education at a distance: from issues to practice (pp. 123-134). Malabar, FL: Robert E. Krieger Publishing Co.

Garrison, D. R. & Shale, D. (1990). Tilting at windmills? Destroying mythology in distance education. ICDE Bulletin, 24, 42-46.

Heider, F. (1958). The Psychology of Interpersonal Relations. New York: John Wiley & Sons.

Henry, J.W. & Campbell, C. (1995). A comparison of the validity, predictiveness, and consistency of a trait versus situational measure of attributions. In M. J. Martinko(Ed.), Attribution theory: an organizational perspective (pp. 35-51). Delray Beach, FL: St. Lucie Press.

Holmberg, B. (1990). A paradigm shift in distance education? Mythology in the making. International Council for Distance Education Bulletin, 22, 51-55.

Holmberg, B. (1995). Theory and practice of distance education. New York, NY: Routledge.

Kelleher, K. & Cross, T. B. (1985). Teleconferencing: Linking people together electronically. Englewood Cliffs, NJ: Prentice-Hall.

Kelly, M. (1990). Course creation issues in distance education. In D. R. Garrison & D. Shale (Eds.), Education at a distance: from issues to practice (pp. 77-99). Malabar, FL: Robert E. Krieger Publishing Co.

Kirby, D., & Boak, C. (1987). Developing a system for audio-teleconferencing analysis(SATA). Journal of Distance Education, 2(2), 31-42.

Kirby, D., & Boak, C. (1989). Investigating instructional approaches in audio-teleconferencing classes. Journal of Distance Education, 4(1), 5-19.

Kirby, D., & Chugh, U. (1992). An investigation of instructors' perceptions of elements in the audio-teleconferencing environment. Journal of Distance Education, 7(1), 25-38.

Kirby, D., & Chugh, U. (1993). Two views from the bridge: a comparison of the perceptions of students and instructors of elements in the audio-teleconferencing environment. Journal of Distance Education, 8(2), 1-17.

Ljoså, E. (1992). Distance education in a modern society. Open Learning, 7(2), 23-30.

MacLaren, J. (1993). Designing for interaction in graduate level distance education: the reactions of students. Unpublished master's thesis, University of Calgary, Alberta.

Mark, M., Mutrie, N., Brooks, D. & Harris, D. (1984). Causal attributions of winners and losers in individual competitive sports: toward a reformulation of the self-serving bias. Journal of Sport Psychology, 6,184-196.

Martin, E. D. & Rainey, L. (1993). Student achievement and attitude in a satellite delivered high school science course. American Journal of Distance Education, 7(1), 54-61.

McAuley, E. (1985). Success and causality in sport: the influence of perception. Journal of Sport Psychology, 7,13-22.

Meyer, J. P. & Koelbl, S. L. M. (1982). Dimensionality of student's causal attributions for test performance. Personality and Social Psychology Bulletin, 8, 31-36.

Moore, M. G. (1991). Editorial: distance education theory. The American Journal of Distance Education, 5(3), 1-6.

Moore, M. (1990). Recent contributions to the theory of distance education. Open Learning,5(2), 10-15.

Moore, M.G. (1993) Three types of interaction. In K. Harry, M. John & D Keegan (Eds.), Distance education: new perspectives (pp.). New York, NY: Routledge

Morgan, A. (1984). A report on qualitative methodologies in research in distance education. Distance Education, 5(2), 252-265.

Morgan, A., Taylor, E. & Gibs, G. (1982). Understanding the distance learner as a whole person (Paper 32). In J. Daniels, M. Stroud & J. Thompson(Eds.), Learning at a distance: a world perspective (pp. 103-106). Athabasca, AB: Athabasca University.

Mugridge, I. (1991). Distance education and the teaching of science. Impact of Science on Society, 41(4), 313-320.

Van Overwalle, F. (1989). Structure of freshmen's causal attributions for exam performance. Journal of Educational Psychology, 81(3), 400-407.

Peters, O. (1993). Understanding distance education. In K. Harry, M. John & D Keegan (Eds.), Distance education: new perspectives (pp.). New York, NY: Routledge.

Peterson, C., Semmel, A., von Baeyer, C., Abramson, L.Y., Metalsky, G. I., & Seligman, M. E. P. (1982). The attributional style questionnaire. Cognitive Therapy and Research, 6(3), 287-300.

Riggs, F. T. (1987). Report of the small schools study project. St. John's, NF: Jesperson Press.

Ritchie, H., & Newby, T. (1989). Classroom lecture/discussion vs. live televised instruction: a comparison of effects on student performance, attitude and interaction. American Journal of Distance Education, 3(3), 36-45.

Rotter, J. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 80, 1-28.

Russell, D. (1982). The causal dimension scale: a measure of how individuals perceive causes. Journal of Personality and Social Psychology, 42(6), 1137-1145.

Russell, D. (1991). The measurement of attribution process: trait and situational approaches. In S. L. Zelen(Ed.), New Models, New Extensions of Attribution Theory. New York: Springer-Verlag.

Seidal, J., Friese, S., Leonard, D. C. (1995). The Ethnograph (Version 4 0) A User's Guide [Computer Software Manual]. Amherst, MA: Qualis Research Associates.

Seifert, T. (1995). Human learning and motivation, course manual. MUN School of Continuing Education.

Seligman, M. E. P. & Schulman, P. (1986). Explanatory style as a predictor if productivity and quitting among life insurance sales agents. Journal of Personality and Social Psychology, 50(4), 832-838.

Shale, D. (1990). Toward a reconceptualization of distance education. In Contemporary Issues in American Distance Education (pp. 333-343). Oxford: Pergammon.

Slaton, D. B., & Lacefield, W. E. (1991). Use of an interactive telecommunications network to deliver inservice education. American Journal of Distance Education, 11(2), 64-74.

Sponder, B.M. (1990). Reaching the way-out student: a qualitative study of students enrolled in audioconference courses in Western Alaska. Unpublished doctoral dissertation, Utah State University, Logan, Utah.

The Ethnograph (Version 4.0) [Computer software]. (1995). Amherst, MA: Qualis Research Associates.

Walker, K., & Hackman, H. (1992). Multiple predictors of perceived learning and satisfaction: the importance of information transfer and non-verbal immediacy in the televised course. Distance Education, 13(1), 81-92.

Wall, M. (1986). Technological options for rural schools. Educational Leadership,

43(6), 50-52.

Weiner, B. (1979). A theory of motivation for some classroom experiences. Journal of Educational Psychology, 71, 3-25.

Weiner, B. (1980a). Human Motivation. New York: Holt, Reinhart & Winston.

Weiner, B. (1984). Principles for a theory of student motivation and their application within an attributional framework. In Ames, C. & Ames, R. (Eds), Research on Motivation in Education, Vol. 1. Toronto: Academic Press.

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. Psychological Review, 92(4), 548-573.

Weiner, B. (1986). An attributional theory of motivation and emotion. New York: Springer-Verlag.

Weiner, B., Frieze, I.H., Kukla, A., Reed, L., Rest, S., & Rosenbaum, R. M. (1971). Perceiving the causes of success and failure. Morristown, NJ: General Learning Press.

Withrow, F. (1990). Star schools distance learning: the promise. T.H.E. Journal, May, 62-64.

Wong, P. T., & Weiner, B. (1981). When people ask 'why' questions and the heuristics of attributional search. Journal of Personality and Social Psychology, 40(), 650-663.

Wright, A., Banfield, H., & Drover, Z. (1989). Evaluation of the distance education pilot project advanced mathematics 1201. Department of Education, Division of Evaluation and Research, NF and LB.

Appendix A

Consent Forms

Ms. Kimberly Madore
P.O. Box 549
Bonavista, NF
A0C 1B0

email: kmadore@calvin.stemnet.nf.ca

(709)468-2141(bus)
(709)468-2158 (fax)

Dear Sir/Madam:

I am currently a graduate student in the Faculty of Education at Memorial University of Newfoundland and I am completing a study on the experiences of students in Distance Learning Chemistry. My data collection will involve a sample of thirty randomly selected individuals who will complete diary entries over the course of this year. The students will be requested to complete one entry per week about their experience taking chemistry through teleconference. Upon completion of the diary entries I will be contacting these students to conduct a 10 min telephone intervies. I will also be administering a questionnaire later in the year to these students and to a population of students in your school.

I am requesting your consent for the students in your school to participate in my study. If you are in agreement, simply check the appropriate box, sign your name and identify your school.

□ I give my consent for the students in this school to participate in this study.

□ I do not give my consent for the students in this school to participate in this study.

Name (please print): _____

Signature: _____

School: _____

Thank you for your consideration to this matter.

Kindest regards,

Kim Madore

Dear Parent or Guardian:

I am a graduate student in the Faculty of Education at Memorial University and I am a distance learning instructor for chemistry. I am requesting your permission for the participation of your child in a study concerning the learning experiences of students in the distance learning chemistry program.

Your child's participation will consist of writing diary entries on a weekly basis and faxing them to me on a two/three week period. The writings of your child should be their personal opinions/reflections on the experience of learning chemistry at a distance. The entries of your child will in no way influence his/her grade in the chemistry course. Your child will be asked to complete entries in his/her diary beginning the first week of October until the beginning of April. Upon completion of the diaries, I will contact each participant and conduct a telephone interview to discuss their experience in participating in this study. These telephone interviews will be conducted at your child's convenience outside of school hours.

The interviews will be approximately 10 min in duration. The topics covered will relate to your child's experience in distance learning chemistry and their experience in writing diaries for this study. Your child may decline to answer any question in the interview. A questionnaire will also be mailed to your child after Christmas. He or she may complete any or all of the diary, interview or the questionnaire as he/she desires.

All information gathered in this study is strictly confidential and at no time will any individual be identified. I am interested in the learning experience students undergo in a distance learning environment. Participation is voluntary and you may withdraw your child at any time. This study has received the approval of the Faculty of Education's Ethics Review Committee. The results of my research will be made available to you upon request.

If you are in agreement with having your child participate in this study, please sign below and return to the principal so that a copy may be faxed to my attention at (709) 468-2158. You may keep the original for your information. If you have any questions or concerns please do not hesitate to contact me at (709) 468-2141(work) or (709) 468-1867(home). My supervisor for this study is Dr. Robert Crocker and he may be contacted at Memorial University of NF, Faculty of Education. If at any time you wish to speak with a resource person not associated with the study, please contact Dr. Patricia Canning, Associate Dean, Research and Development, Memorial University of Newfoundland. Thank you for your consideration of this request.

Yours sincerely,
Kimberly Madore

I _____ (parent/guardian) hereby give permission for my child to take part in a study of high school chemistry students' learning experiences in distance learning undertaken by Kimberly Madore. I understand that participation is entirely voluntary and that my child and/or I can withdraw permission at any time. All information is strictly confidential and no individual will be identified in this study.

_____ _____

Date Parent's/Guardian's Signature

Ms. Kimberly Madore
P.O. Box 549
Bonavista, NF
A0C 1B0

To: Principals of Distance Learning Chemistry Schools
Fr: Kim Madore

Good day!

I am currently a Distance Learning Chemistry teacher and a graduate student in the Faculty of Education at Memorial University of Newfoundland. I am completing a study on the experiences of students in Distance Learning Chemistry. The second component of my data collection will involve a questionnaire. All distance learning chemistry students will be requested to complete a questionnaire which will take approximately one class (40 min) period. As a comparison group, I will request all Level II students, who are not in distance education, to complete a questionnaire.

A letter of consent will be faxed for each student and their parent/guardian to read and sign if they are willing to partake in the questionnaire. All participation is voluntary and whether or not a student participates will, in no way, affect their grade in chemistry.

I am asking for your cooperation and consent for students in your school to participate in the questionnaire. The administration of the questionnaire will require approximately forty minutes (40 min.) of student time. It would be greatly appreciated if you could fax me the names of all the Level II students in your school. I will forward a letter of consent to be given to all the Level II students and all the distance learning chemistry students. This letter may be faxed to me at (709)468-2158.

I would like to thank you for your cooperation and participation in my study. Without your support my data collection would certainly not be successful. I look forward to corresponding with you.

Kindest regards,
Kim Madore

I _____(name) give my consent to have a questionnaire administered in the

school _____(school name).

_____(Signature)

Ms. Kimberly Madore
P.O. Box 549
Bonavista, NF
A0C 1B0

Dear Parent or Guardian:

I am a Distance Learning Chemistry instructor and a graduate student in the Faculty of Education at Memorial University. I am requesting your permission for the participation of your child in a study concerning the learning experiences of students in the distance learning chemistry program. My sample includes students who are and are not completing distance learning chemistry.

Your child's participation will consist of completing a questionnaire which will take approximately forty minutes (40 min.) of their time. The questionnaire may be returned in the supplied postage paid envelope.

All information gathered in this study is strictly confidential and at no time will any individual be identified. Participation is voluntary and the decision of participation will in no way influence your child's school grades. This study has received the approval of the Faculty of Education's Ethics Review Committee. The results of my research will be made available to you upon request.

If you and your child are in agreement with participating in this study, please sign below and return to the principal so that a copy may be faxed to my attention at (709) 468-2158. You may keep the original for your information. If you have any questions or concerns please do not hesitate to contact me at (709) 468-2141(work) or (709) 468-1867(home). My supervisor for this study is Dr. Robert Crocker and he may be contacted at Memorial University of NF, Faculty of Education (709-737-8741). If at any time you wish to speak with a resource person not associated with the study, please contact Dr. Patricia Canning, Associate Dean, Research and Development, Memorial University of Newfoundland (709-737-8587).

I would appreciate it if you would please return this sheet to me at your earliest convenience. Thank you for your consideration of this request.

Yours sincerely,
Kimberly Madore

I _____ (parent/guardian) and _____ (student's name) hereby give permission for my child to take part in a study of high school chemistry students' learning experiences in distance learning undertaken by Kimberly Madore. I understand that participation is entirely voluntary and that my child and/or I can withdraw permission at any time. All information is strictly confidential and no individual will be identified in this study.

_____ _____
Date Parent's/Guardian's Signature

_____ _____
Date Student's Signature

Appendix B

Instruments

Questionnaire for Distance Learning Chemistry Students

Section A: Answer each of the following by checking the appropriate box.

1. What grade level are you currently in? ☐ Level I ☐ Level II ☐ Level III

2. Is this the first distance learning teleconference course you have taken? ☐ Yes ☐ No

3. Including this course, how many distance learning teleconference courses have you taken to date?
   ☐ 1 - 2 ☐ 3 - 4 ☐ 5 - 6 ☐ 7 - 8 ☐ 9 or more

4. Why did you decide to take distance learning chemistry? (Check all that apply to you)
   - ☐ I am interested in chemistry
   - ☐ I need the course to enter college/university
   - ☐ My teacher/principal advised me to take the course
   - ☐ My parent/guardian advised me to take the course
   - ☐ No particular reason
   - ☐ Other reasons. Please specify. _____

5. What do you do differently in distance learning chemistry compared to face to face classroom courses? Check as many that apply.
   - ☐ Nothing
   - ☐ I spend more time studying
   - ☐ I spend more time doing written homework
   - ☐ I rely more on my distance learning teacher
   - ☐ I work more independently
   - ☐ I rely more on my classmates
   - ☐ I spend less time studying
   - ☐ I spend less time doing written homework
   - ☐ I rely less on my distance learning teacher
   - ☐ I work less independently
   - ☐ I rely less on my classmates
   - ☐ Specify any other things. _____
     _____

_Section B: Check either YES or NO for each of the following statements.

	Yes	No
6.The off-line classes in my school are supervised by an adult in the school.	☐	☐
7.There is less independent work required of me in a distance learning course than in a face to face classroom course.	☐	☐
8.I am more organized in distance learning chemistry compared to a regular classroom course.	☐	☐
9.There is a teacher in my school who I can ask for help with my chemistry.	☐	☐
10. I know how to start up the computer, monitor and telewriter for the teleconference class.	☐	☐
11. Since Sept., I have had to turn on and start up the equipment for a distance learning teleconference class.	☐	☐
12. I have had to work out technical problems, as directed by the operator at telemedicine, during a teleconference class.	☐	☐
13. There is a teacher/adult available in my school to help solve technical problems, if they occur during an on-line class.	☐	☐
14. All distance learning chemistry lab activities are supervised by an adult in our school.	☐	☐
15.I use the fax machine myself (not an adult at school) to fax distance learning chemistry lab reports and/or assignments to my distance learning instructor.	☐	☐
16.The students in my chemistry class, at my site, help me with my chemistry work.	☐	☐
17.The students in my class, at my site, are very helpful to me when I do not understand a topic in chemisty.	☐	☐
18. Students at other sites are very helpful to me when I do not understand a topic in chemisty.	☐	☐

Section C: Read each of the following statements. Check one of the following to describe your opinion about each statement: strongly agree, agree, neutral, disagree, strongly disagree

		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
19.	I use different study techniques for distance learning chemistry compared to a face to face course.	☐	☐	☐	☐	☐
20.	I spend more time working independently in distance learning chemistry compared to a regular classroom science course?	☐	☐	☐	☐	☐
21.	Completing a course through teleconference/distance learning is more difficult than completing a course through face to face instruction.	☐	☐	☐	☐	☐
22.	The instruction in a distance learning teleconference course is as effective as instruction in a regular classroom course.	☐	☐	☐	☐	☐
23.	The lab video is very helpful to me when I do the lab activity.	☐	☐	☐	☐	☐
24.	Supervised off-line classes would be more beneficial to me.	☐	☐	☐	☐	☐
25.	Supervised on-line classes would be more beneficial to me.	☐	☐	☐	☐	☐
26.	I have to be more organized with my time for homework and study in a distance learning course compared to a regular classroom course.	☐	☐	☐	☐	☐
27.	I feel isolated and unable to get help with my work when taking distance learning chemistry.	☐	☐	☐	☐	☐

Section D: Read each of the following statements. Check ONE of the boxes after each statement.

28. What final mark do you expect to achieve in distance learning chemistry this year?

☐ below 50 ☐ 50 - 60 ☐ 61 - 70 ☐ 71 - 80 ☐ 81 - 90 ☐ 91 - 100

29. How many hours, in one week, do you spend on completing labs, writing lab reports and doing assignments for distance learning chemisty?

☐ 0 ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ 7-8 ☐ more than 8

30. How many hours, in one week, do you spend writing lab reports/reports and doing assignments in a course that is not a distance learning science course?.

☐ 0 ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ 7-8 ☐ more than 8

31. How many times, in one week, do you ask questions in an on-line distance learning chemistry class?

☐ 0 ☐ 1- 5 ☐ 6 - 10 ☐ 11 - 15 ☐ 16 - 20 ☐ 21 - 25 ☐ more than 25

32. How many times, in one week, do you ask questions in a face to face classroom course?

☐ 0 ☐ 1- 5 ☐ 6 - 10 ☐ 11 - 15 ☐ 16 - 20 ☐ 21 - 25 ☐ more than 25

33. How many hours, in one week, do you spend on homework for distance learning chemistry?

☐ 0 ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ 7-8 ☐ 9-10 ☐ more than 10

34. How many hours, in one week, do you spend on homework for a face to face classroom course comparable to chemistry?

☐ 0 ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ 7-8 ☐ 9-10 ☐ more than 10

35. Since September, how often are your distance learning classes (off-line and on-line) disrupted by fellow classmates chatting at your site?

☐ Never ☐ Sometimes ☐ Often ☐ Always

36. Since September, how many times is your distance learning class interruped by technical difficulties?

☐ Never ☐ Sometimes ☐ Often ☐ Always

37. Since September, how often are your face to face classroom classes, in a course comparable to chemistry, disrupted by other students?

☐ Never ☐ Sometimes ☐ Often ☐ Always

38. When you have 3 off-line classes in one week, how many are supervised by an adult in your school for the full class?

☐ 0 ☐ 1 ☐ 2 ☐ 3

39. When you have 3 on-line classes in one week, how many are supervised by an adult in your school for the full class?

☐ 0 ☐ 1 ☐ 2 ☐ 3

40. How many times, in one month, do you get help from other students in your class, at your site, with distance learning chemistry?

☐ Never ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ over 20

41. How many times, in one month, do you get help from distance learning chemistry students at other sites?

☐ Never ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ over 20

Causal Dimension Scale

What will determine your performance in distance learning chemistry?

Select **ONE** of the following for your answer to the above question:
ability, effort, course difficulty **or** luck

Record the cause you chose in the space provided.

Cause: _____

Answer each of the following questions, keeping in mind the cause that you believe will determine your performance in distance education chemistry. Rank how you feel about each question on a scale of one to seven. The extremes of the scale are described in each case.

1. Is the cause something that:

Reflects an aspect of the situation	1	2	3	4	5	6	7	Reflects an aspect of yourself

2. Is the cause of this due to something about you or something about other people/circumstances?

Totally due to others	1	2	3	4	5	6	7	Totally due to me

3. Is the cause something that is:

Out of your control	1	2	3	4	5	6	7	Under your control

4. Is the cause something:

About you	1	2	3	4	5	6	7	About others

5. Is the cause something that is:

Temporary	1	2	3	4	5	6	7	Permanent

6. In the future, will this cause again be present?

Never present	1	2	3	4	5	6	7	Always present

7. Is the cause something that:

Changes over time	1	2	3	4	5	6	7	Is always stable over time

Attributional Style Questionnaire

Read each event carefully and imagine yourself in the situation. Think of one reason/cause for the event, even though there may be many possible causes of each. Record your answer in the space provided.

Now answer the questions related to the event by circling the number of the scale from one to seven that corresponds to how you feel about the reason you gave for the event.

Cause: _____

a. Is the cause of this due to something about you or something about other people or circumstances?

Totally due to others	1	2	3	4	5	6	7	Totally due to me

b. In the future will this cause be present again?

Never present	1	2	3	4	5	6	7	Always present

c. Is this cause something that affects just this type of situation or does it also influence other areas of your life?

Just this situation	1	2	3	4	5	6	7	All situations

Write down the one major cause in the space provided and answer each question about the cause you wrote.

Events:

1. You cannot get all the reading done that your teacher assigns.
2. You give a presentation in class and receive a favorable grade.
3. You fail an exam.
4. Your teacher praises your work in class.
5. You receive a poor grade on a surprise quiz in class.
6. You receive a higher grade than expected on an exam.
7. You do not have enough credits to graduate from high school.
8. You are one of the few students who successfully completed a project for extra credit.
9. You cannot advance to the next grade level because your grades are too low.
10. You are caught up on your class assignments.
11. You cannot get started writing a paper.
12. You are assigned a set of 20 homework problems and successfully complete them all.
13. You get a "D" in one of your core subjects needed to graduate high school.
14. A fellow student comes to you with a problem and you are able to help.
15. You cannot understand the points your teacher makes.
16. You make the honor's list.
17. You receive an incomplete in a course.
18. You fully understand the course material.

Telephone Interview Questions

1. In what grade are you currently enrolled?
2. Is this your first distance education course? If not, how many other distance education courses, including the ones you are currently doing, have you taken in high school?
3. In what extracurricular activities are you involved outside of school?
4. How did the technology of the teleconference affect your learning? (Voice quality, using microphones, use of the telewriter)
5. In your opinion, what are the characteristics of a good teleconference?
6. What, in your opinion, are the qualities of a good teleconference instructor? Are these characteristics different from the characteristics you would list for a good classroom teacher? If so, in what ways?
7. How did taking chemistry through teleconference change your strategies or approaches to learning? Did you do anything differently for your teleconference course compared to your classroom courses? If so, what?
8. What effect does studying with other students at your site have on your learning?
9. What do you do when you do not understand a topic in distance learning chemistry?
10. In terms of the interactions with students at your site, would you describe them as helpful or distracting to your learning? In what ways? How important to your learning, on a scale of 1 (not important) to 5 (very important), is it that there be other students at your site?