**Science and Mathematics Education Centre**

# Student Achievement in and Student and Teacher Attitude Towards the Integration of Technology in the New York State Living Environment Course

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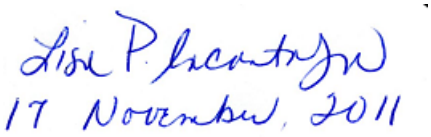
# Declaration

This thesis contains no information that was previously accepted or awarded a degree or diploma in any university. To the best of my knowledge and belief, this thesis contains no material previously published by any person except where due acknowledgement has been made.

Signature: 


Lisa P. Incantalupo

# Abstract

For more than twenty years, considerable amounts of research have been conducted on the integration of technology into the classroom-learning environment and the effect of technology on student achievement. In an attempt to improve the effectiveness of schooling, educators and policymakers are making substantial investments in infrastructure and teacher training to support successful technology implementation and integration in schools.

Contemporary research strongly suggests that in order for students to compete globally in the 21st century workplace, pedagogy must be transformed to include the integration of technology into the curriculum. Technology has been linked to improved student learning and achievement when the teacher effectively incorporates innovative teaching strategies into lessons. Since there is an association between teacher attitude and the use of technology in increasing motivation and engagement, it is necessary to examine teacher attitude toward technology as a tool for improving student learning and achievement.

This research study conducted in one large suburban school district on Long Island, New York in the United States of America, examines students' attitudes toward learning with technology and their achievement in the Regents Living Environment science classroom when technology is used as an instructional strategy. The effect of the technology on grade level and were also conducted. An examination of the research study district was conducted because of the sizeable investment both financially and in human resources to implement and integrate

technology into the curriculum. Nearly 700 students and 11 teachers participated in the research. A co-educational sample represented a diverse population of students.

To obtain quantitative data, a pilot study was conducted with nearly 200 students in April 2010 using a combination of two existing questionnaires, the Pupils' Attitude Toward Technology – USA (PATT-USA) and one scale – Technology Teaching – from the modified Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI). The researcher embedded district-specific items to make the study more meaningful to the students in this research district. Using the response of students to the PATT-USA and one scale from modified TROFLEI, several items were omitted resulting in 79 items that were administered to almost 700 students across grades 9-12 between May and June of 2010.

In turn, these student responses were subject to principal component and principal factor analysis resulting in the deletion of items and the creation of new scales that demonstrated high Cronbach alpha reliabilities. There are statistically significant gender differences in all the scales of the questionnaire. However, only two scales demonstrated significant differences when tested for grade level. This new instrument: *Learning Environment Questionnaire - Assessing Students' Attitude to Technology* can be used by future researchers. To supplement and validate quantitative data, qualitative data were collected using the Students' Reaction Towards Learning Science in a Technology-Supported Classroom interview schedule. To investigate teachers' views toward technology, the Teachers' Views of Technology and Teaching Instrument (TVTT) were used.

Results indicated that while both students and teachers had positive attitudes and views toward technology integration in the Regents Living Environment classroom, significant increases in achievement were not found over a two-year period. Additionally, the results suggest that there are significant differences toward technology integration based on grade level and gender in favour of grade 12 and males. Information obtained from this research implies that the value of technology integration shows promise in improving learning and achievement, but the ability of

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achievement based on current standardized assessment and transform technology tools to accommodate differences in grade level and gender have not been attained. Furthermore, implications for educators and policymakers must be in adapting the use of technology into their assessment of achievement to incorporate the preparation of students to learn and achieve in the global society.

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*You let me be a perpetual student,*

*You have been my strength, my pillars,*

*You gave me all the time I needed and then some,*

*You gave me confidence to pursue my goals.*

*You gave me love and laughter to get me through the tough times...*

*I could not have done it without you...I am truly blessed.*

"In my family and friends I have discovered treasure more valuable than gold." Jimmy Buffett

# Abbreviations

| | |
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| CARET | Center for Applied Research in Educational Technology |
| EETT | Enhancing Education Through Technology Act |
| ICT | Information and Communication Technologies |
| IWB | Interactive White Board |
| ISTE | International Society for Technology in Education |
| LEQ-ASAT | Learning Environment Questionnaire - Assessing Students' Attitude to Technology |
| MST | Mathematics Science and Technology |
| NETP | National Education Technology Plan |
| NETS | National Educational Technology Standards |
| NCLB | No Child Left Behind |
| NYSED | New York State Education Department |
| PATT-USA | Pupils Attitude Toward Technology Questionnaire |
| P21 | Partnership for 21st Century Skills |
| QTI | Questionnaire on Teacher Interaction |
| SRS | Student Response System |
| TROFLEI | Technology-Rich Outcomes-Focused Learning Environment Inventory |
| TVTT | Teachers' View of Technology and Teaching Questionnaire |
| WIHIC | What Is Happening In this Class? Questionnaire |

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# Chapter 1

# Introduction

## 1.1 Introduction

This study examines the implementation of technology in one large suburban school district in Long Island, New York, in the United States of America and the effect of technology integration on learning and student achievement in the Regents Living Environment science classroom. In order to understand whether technology implementation affects achievement, it is necessary to investigate learning with technology and students' and teachers' attitudes toward learning when integrating technology into the curriculum. Through an analysis of student achievement, the results of technology integration and its effect on the learning of science were examined. This chapter provides a background exploring technology implementation in meeting national and state guidelines (Section 1.2) examines the nature of assessing student achievement in New York State (Section 1.3) and provides a rationale for conducting the research (Section 1.4). The methodology is briefly introduced with the research questions (Section 1.5), research methods (Section 1.6) and the significance of conducting the research (Section 1.7). The chapter concludes with an overview of the thesis (Section 1.8), and with a summary of the chapter (Section 1.9).

## 1.2 Background

Prior to 2001, the United States federal government valued the discretion of the individual states to determine educational frameworks and standards. As a consequence of meeting state-mandated guidelines, teachers were restricted by

pressures that have been placed upon them and their students to perform to a certain standard. In 2002, through federal government legislation, the New York State Education Department (NYSED, 2002) implemented the "No Child Left Behind Act" (NCLB, 2002) which was signed into law. Standardized testing became the measure of accountability with which the federal government determined the success or failure of schools, their teachers and students.

Title II, Part D of NCLB is the Enhancing Education Through Technology Act of 2001 (Enhancing Education Through Technology Act [EETT], 2001). States were required to make certain that there was ongoing integration of technology into the school curricula by December 2006. The International Society for Technology in Education [ISTE] has published the National Educational Technology Standards (NETS-S, 2007) for Students and Teachers (NETS-T, 2008) [NETS] in order to set the standard for technology in education. There are six standards and performance indicators for students and five standards and performance indicators for teachers. Both sets of standards provide guidelines with which to integrate technology into the teaching and learning experience.

### 1.3 Assessing Student Achievement in New York State

As far back as 1817, the New York State Education Department has attempted to quantify and qualify high academic standards for secondary schools. In 1877, a New York State statute authorized the Regents to give "academic examinations as a standard for high school graduation and college admissions" (Folts, 1996, p. 17). One aspect of financial aid to New York State schools is based upon the number of students passing Regents examinations. Trends in the content of Regents examinations range from those based on learning and reciting facts in the late 1800's

to changes in curricula and teaching methods in the 1920's and more significantly after World War II “to fit education to the child’s social and intellectual development” (Folts, 1996, p. 17), and "emphasize conceptual understanding" (p. 18). Regents examinations and therefore the Regents diploma "function as a guideline for what is taught and learned in New York's public and private schools; in this sense, they shape the curriculum" (Kramer, 1996).

Since 1865, New York State has administered Regents examinations to help colleges make admission decisions. Numerous changes have occurred over the years as trends in education and pedagogy have changed. By 2004, New York State mandated that all students pass five Regents examinations in order to graduate from high school. One of those examinations is the New York State Living Environment Regents (New York State Education Department [NYSED], 2010). The Core Curriculum for the Regents Living Environment course is not a course syllabus but rather identifies topics that are to be assessed on the Living Environment Regents examination. Topics covered in the course include scientific methods, biochemistry, evolution, human interactions within the environment, human homeostasis, genetics and reproduction and ecology. Laboratory periods augment learning within each topic.

Living Environment Regents examinations began incorporating laboratory coursework in 1905. Since 1906, committees of teachers have prepared questions for Regents examinations that involve a “multi-step process involving needs assessment, project planning, research and drafting, and field review and testing” (Folts, 1996, p. 18). Curriculum requirements for Regents Examinations continue to change based on “political and intellectual trends” (Folts, 1996, p. 18). Other factors

influencing the Regents examination include conceptual understanding, interest in curriculum subject matter, and technological and scientific advancement. Furthermore, since the inception of NCLB it was mandated that by 2007-2008, students in all the 50 states must be tested in science at least once in elementary school (3-5), once in middle school (6-9) and once in high school (10-12) (Day & Matthews, 2008).

Of all the 50 states in the United States, the State University of New York and the Board of Regents "is the only state board of education having authority over all educational activity at all levels, including private and public, non-profit and for profit institutions" (Folts, 1996, p. 4). The New York State Living Environment Regents Examination highlights skills and knowledge based on the NYSED (2010) Living Environment Core Curriculum Standard 1, Scientific Inquiry, which includes three Key Ideas and Standard 4, (which is part of the NYSED Mathematics, Science and Technology (MST) Learning Standards, 1996) which includes seven Key Ideas in addition to a Laboratory Checklist. According to the State University of New York, the Core Curriculum is a detailed description of the "science content of the mathematics, science, and technology learning standards document and its Key Ideas and Performance Indicators" (p. 3) (New York State Education Department [NYSED], 1996). According to the Core Curriculum document, "Key Ideas are broad, unifying, general statements of what students need to know, and the Performance Indicators for each Key Idea are statements of what students should be able to do to provide evidence that they understand the Key Idea" (p. 3) (NYSED, 1996). This document does not advise teachers how to teach the curriculum or what the syllabus should be in the Regents Living Environment course, but speaks to the material that will be covered on the Regents Living Environment Examination. In

addition, a section on Scientific Inquiry and Laboratory Skills are addressed. These sections are based on what materials should have been taught based on Learning Standards for Mathematics, Science, and Technology in previous grades.

In 2001, the Biology Regents became the Living Environment Regents, which included mandatory laboratory activities embedded into the Regents Examination beginning in 2004 (Day & Matthews, 2008). These changes reflected the change by the New York State Education Department in integrating teaching and learning of mathematics, science and technology into the Learning Standards for Mathematics, Science and Technology (1996) to add and measure scientific inquiry as a component of the Living Environment Examination (Day & Matthews, 2008). In 2004, the state of New York mandated students graduating from high school to have passed five Regents Examinations including the Regents Living Environment Examination. However, there is debate about whether the Living Environment Regents Examination measures proficiency or achievement of knowledge in a particular area, and there is uncertainty about what aspects of biology the Living Environment Regents Examination actually measures.

Research conducted by Day and Matthews (2008) investigated questions from Regents examinations in years 2004-2006. Questions were measured according the Learning Standards for Mathematics, Science, and Technology (MST) Standard I and Part D of the examination related to scientific inquiry (p. 337). The analysis concluded that the New York State Living Environment Regents inadequately measures inquiry as mandated by MST Learning Standards, and that "many of the questions that are intended to test inquiry actually only test content knowledge" (Day & Matthews, 2008, p. 339).

## 1.4 Rationale for the Study

Technology is a tool that can increase rigor, student academic performance, and proficiency in a topic area. Technology also supports students in taking responsibility for their own learning and therefore promotes students building the necessary skills to become lifelong learners. As technology has become ingrained into everyday life, the United States Department of Education National Educational Technology Plan ([NETP] 2010) calls upon the educational system to "provide engaging and powerful learning experiences, content, and resources and assessments that measure student achievement in more complete, authentic and meaningful ways" (NETP, 2010, p. 3). Within the research study school district, investments have been made financially in teacher training, infrastructure, and implementing guidelines to comply with federally mandated laws. Therefore, research into whether or not learning outcomes have improved with the use of technology by measure of student achievement is necessary. According to Irving (2006), accountability must be measured in the use of technology as a tool "of and for learning," (p. 13).

New York State Mathematics, Science, and Technology standards provide guidelines for integrating technology into the curriculum (NYSED, 1996). According to the New York State Learning Standards for Mathematics, Science and Technology Learning Standard 2 (1996): "Students will access, generate, process, and transfer information using appropriate technologies" (p.1) in their science classroom. Additionally, ISTE and NETS provide leadership through support and innovation in advancing technology used in improving teaching and learning and ways to integrate technology into the classroom. As previously mentioned, in 2010, the United States Department of Education, Office of Educational Technology,

issued a report outlining the National Educational Technology Plan as "a model of 21st century learning powered by technology" (NETP, p. 4) which presented goals and recommendations in "five essential areas" (NETP, p. 4) including learning, assessment and teaching.

In an effort to supplement curricula and meet the State and Federal guidelines, in 2008 the school district where this research study was conducted initiated a district-wide Technology Plan. The district purchased and installed an Interactive White Board (IWB) with a projector and one computer for every classroom, which included an Easiteach software program discussed in Chapter 3.

In the 2009-2010 school year, the high school Science Department made use of one lap-top cart which was shared among them and three sets of hand-held Student Response Systems (SRS). Each classroom had newly installed IWB's with Easiteach software and access to interactive multi-media including the use of Google, g-mail, photostory, and podcast software. Additionally, teachers could make use of a digital video library and other software at the discretion of the district. The main focus during the 2009-2010 school year was mainly on the introduction of 21st century learning skills which include integrating communication, collaboration, creativity and innovation to increase higher order thinking skills. According to Wenglinsky (2005/2006) technology in the classroom was most effective in promoting student achievement when it was used to promote higher order thinking skills. Technology tools were being embedded into lessons within the curriculum at the discretion of the teacher to increase student learning through motivation and engagement and increase student performance and achievement.

Eleven Regents Living Environment science teachers participated in using these technologies over the 2009-2010 academic years. The IWB with access to district-allocated technology and interactive multi-media technology was the only change to the curriculum. Teachers were able to embed the technology into their lessons at their discretion. As high school graduation requirements continue to be based on high-stakes testing (Warren & Edwards, 2005), the debate continues about how to test students and what type of exit examinations to use. According to a report by the Center on Education Policy Brief (Zabala, 2007), since 2002 and the implementation of NCLB, 22 states have some type of exit examination to qualify for high school graduation. That number will rise to 25 states by the year 2012. Additionally, Gewertz (2010) noted that 23 states use on-line assessments. Therefore, the significance of investigating whether technology integration improves student achievement in the Regents Living Environment science course and whether a relationship exists between students' and teachers' attitudes toward technology in improving achievement in the Regents Living Environment science classroom merits consideration.

## 1.5 Research Questions

Four research questions were presented for investigation in the research study. A large co-educational student sample enabled the investigation of research questions one and two. A small content specific teacher sample responded to a questionnaire in order to be able to answer research question three. Both students and teachers responses were examined to explore research question four.

To investigate whether or not technology integration improves student achievement in the New York State Regents Living Environment science classroom, Research Question 1 asks:

> Does technology integration in the science classroom improve student achievement on the Living Environment Regents Examination?

To investigate differences between the perceptions of students toward technology in terms of grade level and gender, Research Question 2 asks:

> Is there a difference between the attitude of students toward technology in the Regents Living Environment science classroom based on grade level and gender?

To investigate the views of teachers when implementing technology in the Living Environment classroom, Research Question 3 asks:

> How does the use of technology affect teachers' views of teaching science in the Regents Living Environment classroom?

To determine whether a relationship exists between students' and teachers' attitudes toward technology in improving achievement in the Regents Living Environment science classroom, Research Question 4 asks:

> Are there any relationships between students' and teachers' attitudes toward technology and student achievement in the Regents Living Environment science classroom?

## 1.6 Research Methods

To investigate the attitude of students toward the use of technology in the Living Environment science classroom the Pupils' Attitude Toward Technology

Questionnaire - PATT-USA (Appendix A) (Bame & Dugger, 1989) and Technology Teaching (TT) scale of the modified Technology-Rich Outcomes-Focused Learning Environment Inventory – TROFLEI (Appendix B) (Gupta & Koul, 2007) were used to gather quantitative data. To investigate teachers' views on technology integration, the Teachers' Views of Technology and Teaching Instrument - TVTT (Appendix C) (Christensen, 1997) was used. In order to gather qualitative data on students, the Survey of Students' Reactions Toward Learning Science in a Technology-Supported Classroom Interview Schedule (Gupta & Koul, 2007) (Appendix D) were used. Four items were added by the researcher to the combination PATT and TVTT questionnaires that were specific to the research district. In Chapter 2, Section 2.5 and Section 2.6, the instruments referenced above are described. Using the Living Environment Regents examination results from 2008-2009 and comparing them to 2009-2010 results, the researcher attempted to identify whether standardized test scores improved through the use of technology, and whether a relationship existed between students' and teachers' attitudes toward technology in improving achievement in the Regents Living Environment science classroom.

Permission was received from the School Principal to conduct a pilot study using the Pupils' Attitude Toward Technology (PATT-USA) instrument and the Technology Teaching (TT) scale of the modified Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) instrument with the Living Environment science students in March of 2010. Questionnaires were pilot tested and administered to a sub-sample of students at the high school to ensure the readability and comprehensiveness of the survey items and instructions. As noted by Anderson (1998), pilot-testing questionnaires will “identify ambiguities in the instruction” (p. 179), and alert the researcher as to any “omissions or unanticipated

answers in multiple choice or ranking questions" (p. 179). Additionally, pilot studies "provide an excellent way of avoiding trivial or non-significant research" (p. 12). Two teachers and the researcher each provided two classes of students to participate in the pilot study totalling six classes. Classes contained students who were first time students to the Regents Living Environment science course as well as students who were repeating the course. The sample provided a diverse group of students with varying levels of knowledge of vocabulary and reading levels for a reliable and valid pilot study. The researcher personally entered the PATT-USA instrument with Technology Teaching (TT) scale of the modified TROFLEI into the on-line survey tool at www.http://docs.google.com database. The researcher posted the questionnaires to the school allocated electronic-board (e-board). This pilot study provided a 27% sampling of the students enrolled in the Regents Living Environment science course. A discussion of the pilot study is located in Chapter 4, Section 4.4.

Once the pilot study was conducted, the questionnaire was reviewed and responses evaluated. Items that contributed to low-scale reliability were not used. The new instrument: Learning Environment Questionnaire - Assessing Students' Attitudes to Technology (LEQ-ASAT) were distributed electronically via the on-line survey tool at https://docs.google.com on nearly 770 Regents Living Environment science students. In order to deliver the questionnaire electronically, the Technology Department of the district agreed to assist the researcher in the technology needs, including how to use the on-line tool, and delivery and security of the on-line responses. Instructions were provided to each teacher on how to administer the on-line questionnaire. As the researcher works in the district, visits were made to the teachers participating in the study to make certain that there were no

misunderstandings regarding the administration of the questionnaire. Teachers verbalized understanding and willingness to cooperate to ensure a successful study.

## 1.7 Significance

Today's students have grown-up in an age of multimedia. They have been exposed at an early age to a variety of technology with varying amounts of educational value. It is natural in the educational setting to incorporate technology into the curriculum as a strategy to stimulate students' interest and increase engagement. Investigating the implementation of technology use in the classroom is significant as it relates to improved student learning. If technology positively affects learning, an improvement in student achievement would be noted. Since state and federal funding to schools mandate that technology be incorporated into the school curriculum, it is important to assess the attitude of students' and the views of teachers' when using technology in improving learning. As much money, time, and effort is being spent by the research school district to implement technology, it is necessary to evaluate its impact, if any on student learning and achievement.

## 1.8 Overview of the Thesis

The purpose of the research is to investigate whether student learning improves and whether an increase in student achievement is noted when technology is embedded into the curriculum in the Regents Living Environment science course. Previous research shows that links to student achievement when using technology in the classroom corresponds to both students' attitudes and teachers' views toward using technology in the classroom. Consequently, an examination of students' perceptions of attitude toward technology based on grade level and gender were assessed. This research was designed to complement and add to previous research

associated with improved students' attitude to learning and achievement with teacher use of technology within the science classroom.

## 1.9 Summary of the Chapter

In the past 20 years, considerable amounts of research have been conducted regarding the infusion of technology into the classroom-learning environment and the effect of technology on student achievement. In an attempt to improve the effectiveness of schooling, educators and policymakers are making substantial investments in infrastructure and teacher training to support successful technology implementation and integration in schools.

Contemporary research strongly suggests that in order for students to compete globally in the 21st century workplace, pedagogy must be transformed to include the immersion of technology into the curriculum. Technology has been linked to improved learning and achievement when the teacher effectively incorporates innovative teaching strategies into lessons. Since there is an association between teacher attitude and the use of technology in increasing motivation and engagement, it is necessary to examine teacher attitude toward technology as a tool for improving student learning and achievement. For the purpose of this research, the Teachers' Views of Technology and Teaching (TVTT) instrument was used.

Additionally, the research study attempts to examine the attitudes of students in one large suburban school district toward learning with technology and as a result, achievement when technology is used as an instructional strategy in the Regents Living Environment science classroom. For the purpose of this research, the Pupils' Attitude Toward Technology Questionnaire (PATT-USA) and one scale of the modified Technology-Rich Outcomes-Focused Learning Environment Inventory

(TROFLEI) – Technology Teaching (TT) were used together with four contextual questions. To gain insight into the experience of students when using technology in the Regents Living Environment science classroom and to supplement quantitative data for Research Question 4, data were gathered of a textual nature using the Students' Reaction Towards Learning Science in a Technology-Supported Classroom interview schedule. Suffice to say, that when technology is implemented, student learning and achievement may improve as noted by test scores.

This chapter provided a rationale for the study and the significance of implementing technology into the classroom. Background information was included to provide the reader with a historical perspective of the criteria for assessing achievement in the Regents Living Environment science course in New York State. An introduction into the rationale for using technology in the Regents Living Environment curriculum was provided, leading to research questions and an introduction to the Research Methods.

# Chapter 2

# Literature Review

## 2.1 Introduction

This chapter provides the literature review by addressing the findings in several areas. Learning with technology is discussed (Section 2.2) followed by an investigation of the implementation (Section 2.3) and evaluation (Section 2.4) of technology in schools and especially in science. An examination of attitudes and views of technology in school and in science (Section 2.5) along with an examination of learning environments (Section 2.6) is provided. The chapter concludes with a summary (Section 2.7).

## 2.2 Learning with Technology

Early research into the effect of computer technologies on improving educational achievement must remark on Gavriel Salomon and his contemporaries. As far back as 1991, Salomon, Perkins and Globerson (1991), questioned the cognitive effect of technology implementation on improving educational performance. Salomon et al. (1991) made recommendations to interested researchers that investigation into the use of "intelligent technologies" (p. 2) be conducted to understand the effect on students when using technology and the "residue" left on students by their use of technology in terms of improving "mastery of skills and strategies" (p. 2). Salomon et al. (1991) examined the relationship between technology and the user as an "intellectual partnership" (p. 3) in learning. However, these authors proposed that the way in which technology is used and the types of technology used has a significant impact on educational performance. Additionally,

Salomon (1992) proposed that the use of technology should be studied within the "social and cultural context in which it occurs" (p. 167); in this case, the science classroom learning environment.

Schools are investing significant amounts of resources to implement technology into the curriculum. Since the International Conference on Computers in Education in 2002, and prior, researchers have been trying to ascertain whether technology affects student achievement (McMahon, 2009). According to Aldridge, Fraser, and Fisher (2003) and Christensen and Knezek (2002) studies have indicated that student attitude toward technology integration has been positive. However, "researchers have been less successful in identifying positive effects of technology infusion on student achievement" (Christensen & Knezek, 2002, p.7). Described in this section is a literature review based on the investigation of the effect of technology integration on student learning and achievement.

Studies identified by Christensen and Knezek (2002) and conducted by Bailo and Sivin-Kachla (1995) asserted that "technology to support instruction improves student outcomes in language arts, mathematics, social sciences and science" (p. 7). Similarly, Christensen and Knezek (2002) identified that the West Virginia Basic Skills/Computer Education Program (Mann, Shakeshaft, Becker, & Kottkamp, 1999) concluded that the use of technology in the classroom led to increases in mathematics, reading, and language arts skills.

Despite the challenges of assessing whether technology integration affects student achievement, researchers (Cradler, McNabb, Freeman, & Burchett, 2002) have found that "evidence is mounting to support technology advocates' claims that alignment between content-area learning standards and carefully selected technology

uses can significantly increase test scores" (p. 47). These studies investigated by Cradler, et al. (2002) represent highlights from a larger body of evidence reviewed by CARET (Center for Applied Research in Educational Technology, 2002) that effective use of computer software in a technology-rich learning environment enhances higher-order thinking skills, and therefore positively affects student achievement.

However, research conducted by O'Dwyer, Russell, Bebell and Tucker-Seeley (2008) found that "traditional methods of assessing student performance may not be valid when technology is used" (McMahon, 2009, p. 270). Furthermore, standardized achievement tests used in some states such as California, and Illinois, "do not measure higher order thinking skills or technology skills or the context in which these skills are developed" (McMahon, 2009, p. 270). In New York State, initiatives are underway to revamp its testing programs to incorporate, 21st century literacy into their Regents level examinations using computer-based assessments. According to a report prepared by Bakia, Mitchell and Yang, (2007) "twenty-six states reported either offering technology-based academic assessment or funding research and development activities that supported student assessment in FY 2003" (p. 19).

One of the most important factors in improving learning is the teachers' integration of a variety of instructional strategies and tools into the curriculum. Investment in educational technology into the classroom does not replace existing teaching but is used as an instructional strategy to improve upon and supplement current instruction and pedagogy. According to Lawless and Pelligrino (2007) "technology is not one thing but many things that can be woven into the instructional

environment by a teacher to assist the teaching and learning process" (p. 578). Gorder (2008) concurs in that the issue is not about integrating technology but about the teacher's effective use of technology in the classroom that affects learning.

If teachers effectively implement technology into the Regents Living Environment science curriculum as an instructional strategy to improve learning, then improved test scores would demonstrate the effect of that technology on improved student achievement. Thus, an effective measurement of achievement in New York State is the New York State Living Environment Regents Examination.

Technology is entrenched into the fabric of society. Since 1983, the student to computer ratio in the United States has decreased from 60 to 1 to about 4 to 1 nationwide in 2007 (Allen, 2008). Furthermore, Barron, Kemker, Harmes and Kalaydjian (2003) found that the "percentage of public schools that have Internet access has increased from 35% (1994) to 99% (2002) and the percentage of public classrooms connected to the Internet has risen from 3% in 1994 to 87% in 2001" (p. 489).

Prior to and since the implementation of NCLB, mandatory examinations are required to assess students' skills and applications of scientific processes. According to the United States Department of Education, Enhancing Education Through Technology [EETT] program (2001), all states must be provided with assistance to implement and support a comprehensive system "that effectively uses technology in elementary schools and secondary schools to improve student academic achievement" (Part D - EETT, 2001; SEC.2402). As noted in Chapter 1, the New York State Education Department mandates that students in New York State pass the standardized New York State Living Environment Regents

Examination as a prerequisite to graduation (NYSED, Curriculum & Instruction, 2010).

Research by Dorman and Fraser (2009) in Western Australia and Tasmania, sampling 4,146 high school students, concluded that despite the fact that the attitude of students were positive in a computer assisted learning environment, there was "no significant link between attitude to computer use and attitude to subject" (p. 95). On the other hand, Blood and Neel (2008) reported that the effects of using Student Response Systems (SRS) to increase mastery and engagement in a content area had positive results in increasing weekly quiz scores in addition to fostering a positive learning environment. One shortcoming of both research studies is the need for replication studies to validate the robustness of the results.

Additionally, studies conducted by Bayraktar (2002) and Bielefeldt (2005) concur that although preliminary results showed a positive correlation between the use of computers in improving student achievement in the science classroom, further studies must take into account other variables that may affect student achievement such as the types of technology used and the approach to using that technology. Both studies revealed that technology is not a replacement for other teaching strategies in the learning of science. Bayraktar (2002) and Bielefeldt (2005) also recommended that more correlated research be conducted to show the relationship between the use of technology and improved student achievement. Li (2007) and Bayraktar (2002) concluded that use of technology in conjunction with, and as a supplement to, other strategies increases student achievement.

In order to understand whether technology improves student achievement, researchers must determine the instructional benefits of using technology. Barnes

(2008) and Shane and Wojnowski (2007) concur that technology supports a constructivist, student-centered learning approach which advocates that students construct their own meaning of learning by taking an active role in the learning process through their prior knowledge and experiences. The constructivist approach promotes student collaboration and teacher as facilitator of learning. According to Carr (1996), gaining insight of students' understanding helps teachers build effective teaching and learning approaches.

An analysis of five large-scale studies to determine the effect of the impact of educational technology on learning included the examination of over 500 individual studies, a partnership between Apple and five schools across the United States, and the state of West Virginia's 10-year nationwide technology initiative (Schacter, 1999). Some results of the analysis of the individual studies indicated that student achievement on tests increased (Kulik, 1994), positive achievement overall in all subject areas were noted (Sivin-Kachala, 1998), and test scores rose (Mann, Shakeshaft, Becker, & Kottkamp 1999). Wenglinsky (1998) noted gains in mathematics scores and a positive relationship between academic achievement and technology use in West Virginia. In addition, all studies noted that students had positive gains in achievement on researcher constructed tests, standardized tests, and national tests when students had access to "computer assisted instruction, integrated learning systems technology, and simulations and software that teaches higher order thinking skills" (Schacter, 1999, p. 9).

In a policy brief published in June 2008 by the International Society for Technology in Education ([ISTE], 2008), Knezek (2008) notes that research conducted over the past 20 years indicates that "when implemented appropriately,

the integration of technology into instruction has a strong, positive impact on student achievement" (p. 5). Knezek (2008) cites studies done in Missouri (2001-2003), Michigan (2004-2005 and 2005-2006 academic school years), Texas (2004-2005 and 2005-2006 academic school years), and Iowa (2004-2005 and 2005-2006 academic school years) that indicated significant increases in student engagement and academic achievement when technology is integrated into mathematics, reading and science courses. In science, research by Schroeder, Scott, Tolson, Huang, and Lee (2007) showed positive effects on achievement as indicated by test scores when educational technology was implemented. However, there is a disparity among educational stakeholders, which include administrators, teachers, and employers in the workforce in terms of which technology strategies being implemented will be helpful in increasing student achievement.

For successful implementation, administrators and educators must update standards and their curricula to infuse technology. It is essential that teachers be included in how the infusion of technology into the curriculum will take place. Teachers must have input into the best ways to integrate educational technology effectively into their classroom to improve teaching and learning and therefore, student achievement. Since standardized testing is the measure of achievement in the New York State Regents Living Environment science course, exploring the effect of a technology-supported curriculum and the effect on student achievement on standardized tests warrants further analysis. Furthermore, if administrators, educators, and teachers work together collaboratively, then using technology in the classroom can provide students with the necessary skills to become globally competitive individuals. Additionally, incorporating technology into the learning environment may assist students in their ability to become critical thinkers, problem

solvers, innovators and work collaboratively with others thus, meeting the challenge of the 21st century learning initiative.

On the other hand, according to Kmitta and Davis (2004) and to Kohn (2001) there is no consensus as to what constitutes student achievement. In New York and many other states, the standardized test is the assessment of student achievement. Meta-analytic and traditional review of literature by Kmitta et al. (2001) argue that technology does have a positive effect on achievement but there are many variables based on type and frequency of technology used. According to Kmitta et al. (2001), "On average, the effect size on strength of the correlation between computer technologies and student achievement varies from low to moderate. Most of the effect sizes range from 0.10 to 0.40" (p. 326). Similarily, Protheroe (2004) argues that it is the teacher, not the technology that impacts student learning and achievement. Furthermore, Protheroe (2004) concurs with Kmitta et al. (2001) that standardized testing as noted by Glennan and Melmed (1996) does not measure the wide range of outcomes of using technology such as improved problem-solving skills, deeper understanding and higher motivation (p. 47).

In a more recent review by Tamim, Bernard, Borokhovski, Abrami, and Schmid (2011) a second-order meta-analysis (a summary of many meta-analysis) was conducted to investigate the research that has been conducted over the past 40 years into the effect of technologies on student achievement. The study included 25 meta-analysis involving 1,055 primary studies (Tamim, et al., p. 13). Results concur with Kmitta, et al. in that technology had a low to moderate effect size for "supporting students' effort to achieve" (p.17) and that other factors may influence

effect size such as the goals of instruction, pedagogy, teacher effectiveness, subject matter, age level, fidelity of technology implementation" (p. 17).

### *2.2.1 21st Century Learning*

Currently in the United States the teaching of science (and other core academic subjects such as English and Mathematics) under NCLB require that students be assessed on their understanding of the topic through standardized tests based on curricula suggested by the National Science Education Standards. States may adopt the science curriculum according to their own state standards and interpretation of achievement.

However, research by Owens (2009) concluded that teachers give science education a low priority in grades K-8 because of the emphasis on high-stakes testing in reading and mathematics. If teachers are "teaching to the test" because of accountability pressures, students may not be vigorously engaged in the learning of science. According to Owens (2009), Bybee states that "...how much students learn is directly influenced by how they are taught" (p.52).

Policy statements and publications from 2006, 2008, and 2009, by Partnership for 21st Century Skills [P21] (Vockley, 2006) identify skills needed by students to succeed in the core subjects as defined by NCLB. Cores subjects include English (reading or language arts) World Languages, Arts, Mathematics, Economics, Science, Geography, History and Government, and Civics. In order to prepare students for 21st century learning, a realignment and reorganization of the current system of education for grades K-12, and at the post-secondary level merits consideration. The Partnership for 21st Century Skills ([P21], 2004), working with

educators, businesses, the community and the government, advocates that content standards should include critical thinking, problem solving and information and communication technology as well as literacy and life skills. In addition, new content areas such as global awareness, civic literacy, financial and health awareness are being incorporated into student academic content areas (P21, 2004). In the United States, in 2005, North Carolina and West Virginia became two of the first states in the nation to have implemented the framework of the Partnership for 21st Century skills. As of 2010, 15 states have joined the Partnership for 21st Century Skills initiative (P21, 2004).

Information Communications and Technology (ICT) literacy and Information, Media and Technology skills are a vital part of the 21st Century learning initiative. In the report, "Maximizing the Impact: The pivotal role of technology in a 21st century education system" Vockley (2007) reports that technology should be integrated into the education system "to develop proficiency in 21st century skills, comprehensively to support innovative teaching and learning, and comprehensively to create robust education support systems," (p. 3). For this reason, it is necessary to investigate what research has shown about the current state of technology implementation up to this point in school and in science.

The perception of students as it relates to teaching technologies, attitudes and achievement in science in a technology-rich learning environment are being examined to understand technology implications. From the college level to high school and middle school, policy makers and educators grapple with their attempt to appreciate the role of technology in the education of children and young adults. Today's students are digital natives having grown up with a technology-rich

environment in their homes in an age where they have access to an overabundance of information available to them. Many students know more about a variety of technology but may not know how to utilize the technology in an appropriate way to help themselves improve their academic achievement. Consequently, teachers should teach their students the ways how to apply technology to improve their learning potential. However, according to Means (2010), more research needs to be conducted in how to support teachers on the best way to facilitate learning with technology.

As previously discussed, the perception and attitude of students toward learning science in a technology-rich environment is through measurement of academic achievement. In one study by Park, Khan and Petrina (2009), students' attitude and achievement in middle-school science classrooms were assessed when ICT was integrated. In another study Hsieh, Cho, Liu, and Schallert (2008) examined middle school students' motivation and achievement in science learning and engagement in science in a technology-rich environment. College level students were examined regarding their learning when teaching technologies were used and how it coincided with their academic performance (Tang & Austin, 2009). In both middle-school studies, students' academic achievement increased when technology was used.

Both the middle school and college level studies concluded that when the attitude of students' are positive and they perceive that they are doing better in a particular subject area, in this case science, the improvement may not necessarily be due to technology. In general though, at the college level Tang and Austin (2009) reported that combining "technologies, assignments, and materials...achieve the

highest amount of learning" (p. 1252), and "the combination of these (lecture methods, PowerPoint) technologies actually contribute to students' learning performance" (p. 1252).

According to Tang and Austin (2009), "it is not the technology, but the instructional implementation of the technology that contributes to learning effectiveness" (p. 1243). Learning styles and the type of technology utilized in the classroom affects student outcomes. Tang and Austin (2009) also noted that students' perception of the professors' "effective" application of technology in the classroom affected their attitude. In both the middle school and college level studies, some reference has been made to students' self-reported efficacy in learning when technology is implemented indicating that technology affects students' own perception of academic achievement. When students have high self-reported academic grades, the teaching performance of the professor is perceived as a student achievement motivator. When a technology-enhanced learning environment was evaluated for improvement of student achievement, it was noted that in both the Korean (Hsieh, Cho, Liu & Schallert, 2008) and the United States studies (Park, Khan, & Petrina, 2009) that science students had improved academic achievement, and that improved achievement influenced their attitude toward science. Another factor related to students' perception and attitude toward science and improved achievement in the technology-rich learning environment in science is gender.

### *2.2.2 Gender Differences*

Numerous studies have been conducted to understand whether gender differences influence students' attitude toward learning with technology. Research conducted by Mayer-Smith, Pedretti and Woodrow (2000) over a seven-year period

investigated the concept of technology as being “gender dependent” (p. 51) in The Technology Enhanced Secondary Science Instruction (TESSI) project for the 1995-1996 academic year. Quantitative and qualitative data were collected from students in grades 8-12 and from their teachers. The results indicated that gender was not as significant as “how the science and technology-rich classroom environment is structured, and what pedagogical practices are in place” (p. 61). These findings are significant as they concur with Salomon (1991) insofar as the context with which technology is used in the learning environment.

Cooley and Comber (2003) conducted an investigation of the attitudes of 11-12 year olds and 15-16 year olds in the United Kingdom to technology usage in the classroom. Their findings indicated that despite increased computer usage in schools, there was still a gender difference towards computer usage with girls responding that they “use computers less, like them less and evaluate their computing skills less” than do boys” (p. 164). This study concurs with Bain and Rice (2006/2007) and Heemskerk, et al., (2009) in that continued progress needs to be made toward technology that is inclusive to both genders.

In another study by Bain and Rice (2006/2007), the Computer Attitude Questionnaire (CAQ) and the PATT-USA were used in a small-scale study of 59 sixth grade students aged 11 and 12 years. A major finding in their study was that "gender differences in attitudes, perceptions, and uses of computers were not found to be significant" (p. 128). However, for the participants of the study, "males indicated they were better at using the computer than females," (p. 128). Overall, the results of the study for this group indicate that "gender uses of computers are changing" (p. 129) and that "all participants indicated a positive attitude toward technology at home and at school" (p. 129). The study is in agreement with

Heemskerk, et al. (2009) in that "educators need to help females develop a greater sense of accomplishment in their computer skills" (p. 129). Heemskerk et al. (2009) found that insofar as technology education tools are concerned, girls preferred "games and educational tools facilitating cooperation" (p. 254) whereas "boys appreciate pictures and competition more than girls" (p. 254). Furthermore, educators need to be more mindful of technology integration in their curriculum insofar as "the inclusiveness of (the use of) educational tools on students' learning outcomes", p. 273), and how "the use of technology in education affects girls and boys differently" (p. 253).

Heemskerk, ten Dam, Volman and Admiraal (2009) investigated gender inclusiveness and differences in the learning experiences of girls and boys when technology is implemented in the educational setting of 81 ninth grade students aged 14-15 years. They concluded that the type of technology used influences the learning experience of boys and girls, and those technological tools used might be more inclusive to boys. The study found that after investigating the way designers and developers of educational technology have a specific user in mind, these "user representations" or "scripts" are unintentionally designed with boys in mind (p. 255). While the study was small scale, Heemskerk et al. (2009) noted that when girls are interested in the educational tool, learning performance improves whereas boys learning experience is not affected by the type of educational technology tool used. In interviews, both girls and boys reported agreement that they liked working with technology in school.

### *2.2.3 Grade Level Differences*

In conjunction with National Educational Technology Standards [NETS-S] (for Students, 2007) the International Society for Technology in Education [ISTE] 2007, has developed grade-level benchmarks to describe the technological experiences students should encounter during their educational career. Grade levels include Pre-K-grade 2 (age 4-8), grades 3-5 (age 8-11), grades 6-8 (age 11-14) and grades 9-12 (14-18). In a mixed-methods study conducted by Smarkola (2008), research "builds upon prior grade-level educational technology studies" (p. 389). The study investigated responses of 160 student teachers and 158 experienced teachers who were surveyed using the Computer Usage Survey to determine if teachers of different grade levels were meeting the ISTE standards. The study attempts "to determine whether patterns exist between grade-level computer usage...and NETS grade technology standard tasks" (p. 389).

Results indicated that while all grade levels integrate technology, varying degrees and types of technology are used depending on the grade level. Kara-Soteriou (2009) concurs that a variety of technologies may be used "to differentiate instruction across grade-levels" (p. 86). Smarkola's study (2008) concluded that elementary grades are more in compliance with meeting the ISTE grade-level standards than upper grades. In contrast, according to research conducted by Gorder (2008) on 300 teachers who attended the Advanced Technology for Teaching and Learning Academy in South Dakota, and who teach in grades K-12, results for the 174 respondents indicated that "teachers in grades 9-12 tend to integrate and use technology more than teachers in grades K-5 or grades 6-8" (p. 73).

Studies by Smarkola (2008) and Gorder (2008) revealed that while teachers have good intentions when it comes to integrating technology across grade-levels, more attention must be given to meeting NETS-S and ISTE standards to develop students to meet the needs of the 21st century learner and to help students develop skills necessary for higher education.

## 2.3 Implementation of Technology in Schools and in Science

Teachers play a vital role in implementing pedagogical changes in education in learning and teaching within their classrooms. Levin and Wadmany (2008) noted that information and communication technologies (ICT) place new challenges on schools and "challenge teachers in terms of their technical ability, knowledge and expertise" (p. 234). Since students spend a great deal of time in on-line social networks, text-messaging, game playing, and internet surfing, teaching must adapt to assimilate more technology into the curriculum to engage students and capture the audience which encompasses students who have grown up in the digital age.

Teacher's beliefs regarding the effectiveness of ICT in the classroom certainly impacts the teacher use of technology. Research conducted by Ertmer and Ottenbreit-Leftwich (2010) examined the "characteristics, or qualities of teachers that enable them to leverage information and communication technologies (ICT) resources as meaningful pedagogical tools" (p. 258). According to these authors, teachers need to know how to "use technology effectively" (p. 260) in ways which support teaching and learning in the 21st century (Section 2.2.1). Furthermore, the "belief" that teachers placed on the pedagogical importance of technology effects teachers' use of technology**.** Ertmer and Ottenbreit-Leftwich note that teachers with a more constructivist view of teaching who believe that technology has 'value' in

relation to their instructional goals and objectives will be more inclined to use it. If teachers believe that a change in pedagogy which integrates technology that is content specific and grade level appropriate will have positive results on student outcomes, then they will be more inclined to make changes into their curriculum which includes technology.

Depending on how teachers use technology in the classroom, technology can positively affect teaching and learning "by being a source of knowledge, a medium for transmitting content, and an interactive resource furthering dialogue and creative exploration" (Levin & Wadmany, 2008, p. 234). Hennessy, Wishart, Whitelock, Deaney, Brawn, la Velle, McFarlane, Ruthven, and Winterbottom (2007) concur that the use of technology in the classroom encourages students to be actively engaged in whole group activities and can build upon and address current knowledge, prior knowledge, and challenges misconceptions. Furthermore, technology can enhance understanding while still making students feel that they are receiving individualized learning and attention.

In general, teachers are knowledgeable about learning theories and methodologies about teaching but one challenge that teachers face is their technical ability and knowledge and expertise in implementing technology into the curriculum. According to studies by Levin and Wadmany (2008) and Dawson, Forster and Reid (2006) formal training is only one component of effective technology integration. School administrators must provide time for teachers to effectively integrate technology into the curriculum. Theoretically, effectively integrating technology on the part of the teacher will actively engage students and improve learning on the part of the student.

According to Gorder (2008) teachers need to be competent in their ability to incorporate technology into their activities consistently and proficiently. Both pre-service teachers and veteran teachers (Dawson, Forster & Reid, 2006, Harwell, Gunter, Montgomery, Shelton & West, 2001, & Swenson & Redmond, 2009) concur that factors such as teachers' comfort levels, access to technology, experience using technology, adequate training, on-going support with mentors who are knowledgeable about the technology-related school mission and vision statement and philosophy, are necessary to implement technology in order to enhance student learning. Lawless and Pelligrino (2007) indicate that it is not enough to have had professional development (in the use of technology) but that "the impact on teacher knowledge and behavior and/or specific student-learning outcomes" (p. 582) must be examined.

Furthermore, administrators within schools must provide teachers with support by allowing them time with colleagues to integrate technology into the curriculum. Consequently, teachers need to be equipped to be able to prepare, organize and improve upon the science curriculum through the use of technology. According to Wenglinsky (2005-2006), improved student achievement is dependent upon how teachers choose to use technology in the classroom to help students address their learning needs.

## 2.4 Evaluation of Technology in Schools and in Science

### *2.4.1 Presentation Technology*

One way that teachers may address the learning needs of their students is in the presentation of content material. An Interactive White Board (IWB) connects a projector to a board where teachers may project their lessons. As noted in Section

2.3, IWB technology can be used by teachers to foster engagement through the presentation of their lessons for whole group instruction. Furthermore, the Interactive White Board may be used in situations where students come up to the board and participate in hands-on lessons either through writing on the board or manipulating material presented on the board. Additionally, teachers may embed website links into their presentations to enhance lessons.

An investigation into the use of Interactive White Board use in Australian schools by Kearney and Schuck (2008) used a classroom-based qualitative research approach to investigate six schools. Findings indicated that "there were over 40 different uses for the IWBs in lessons"… (p. 9) and that they were "typically in whole class settings, to offer a large variety of resources, attractively presented and dynamically arranged" (p. 9). Lessons presented were mainly teacher facilitated. Kearney and Schuck (2008) also noted that teachers who had access to the IWB for a greater period of time incorporated more authentic, real-world lessons. Additionally, a positive attitude by both teachers and students was noted when using the Interactive White Board in the learning of material.

A literature review conducted by DiGregorio & Sobel-Lojeski (2009-2010) concurred with earlier research by Kearney and Schuck (2008) that while IWBs foster whole group learning and group interaction, and that use of IWBs positively motivates students to be engaged in classroom learning, there is no direct link to the use of IWB's on student achievement. Their literature review concluded that more research needs to be conducted on the use of the IWB in affecting student learning and achievement including an instrument to assess the IWB as an instructional method.

### *2.4.2 Student Response Systems*

One method to determine whether or not the investment in technology increases student learning and achievement is to measure correct responses to test questions and test scores. Student Response Systems (SRS) can be used as a strategy to increase student engagement. Students use a hand-held device called "clickers" to respond to relevant course questions and receive immediate feedback. The teacher has the ability to track the performance data of each student. Teachers may use the clickers to embed assessments into learning activities or lectures to gauge student conceptions and misconceptions during a unit of study. Teachers may also use student response systems to record responses to tests or quizzes, provide reviews, and conduct surveys. Teachers have an immediate opportunity to discuss student responses and clarify meaning and misconceptions. Students can answer individually, and can still be part of a group learning experience.

Research into the use of Student Response Systems (SRS) conducted by Barnes (2008) found that students preferred working in small groups rather than individually to increase learning. According to Barnes (2008), students are more actively engage in their learning when using some type of student response system. Results of this research were consistent with Judson and Sawada (2002), in that students expressed increased understanding when they were actively engaged in helping each other understand incorrect responses when using student response systems.

In research conducted by Li (2007), teachers reported that problems with equipment in the classroom made the use of technology a hindrance at times throughout the learning process. Some students also voiced this concern. Research by Levin and Wadmany (2008) concluded that a major concern of teachers is that

curriculum planning that integrates technology is difficult, takes up too much time, and therefore has not been accomplished.

The question is not whether technology can be used as a strategy to increase student learning and achievement but to what extent the use of technology is meeting the 21st century model of learning. Embedding assessment into the curriculum using SRS engages students in learning and provides them with relevance, motivation, and instantaneous feedback on their achievement. Teachers can restructure their lesson immediately or prepare a revised assignment to remedy student ambiguities. Thus, students have on-the-spot clarification of their misinformation which they can correct promptly on a one-to-one basis or within the group to facilitate effective learning outcomes.

However, research conducted by Clarke-Midura and Dede (2010) states that "using technology to deliver automated versions of item-based paper-and-pencil tests does not realize the full power of information and communication technologies (ICT) to innovate via providing richer observations of student learning" (p.309). Their research suggests that the assessment of educational achievement will be transformed using virtual assessments which replace paper and pencil tests with more authentic assessments that measure higher-order thinking skills such as scientific inquiry, and the understanding and application of scientific processes.

## 2.5 Attitudes and Views of Technology in School and in Science

### *2.5.1 Pupils' Attitude Toward Technology Questionnaire – PATT - USA*

One instrument to determine the attitude of students toward the technology classroom in improving learning is the PATT-USA instrument (Bame & Dugger,

1989) (Appendix A). The PATT-USA instrument was developed based on the original version of Pupils' Attitude Towards Technology (PATT) instrument developed by Ratt and de Vries in the Netherlands in 1985 to investigate the attitudes of middle school students toward technology and technology concepts (Boser, Palmer, & Daugherty, 1998). According to Weir (2008), "ongoing research shows that students learn more quickly and easily with instruction across multiple modalities or through a variety of media" (p. 37) of which technology is a part.

Modifications on the wording of items were made to the PATT by Bame and Dugger (1988) to make it more suitable for use in the United States. Items were field tested in five middle schools in the State of Virginia in the United States of America. The final version, PATT-USA was produced in 1988 and was field tested and validated in seven states. Results validated the initial 1985 version of the PATT created in the Netherlands. Furthermore, the study by Boser, et al. (1998) achieved the same conclusion in terms of the scales of the PATT-USA in 1996. In both studies, students had a positive interest in technology; boys and girls had significant differences in attitudes and interest in technology. In the 1996 study with seventh grade students, Boser, et al. (1998) found that males perceived technology to be more interesting than females and females found technology more difficult than did males.

The PATT-USA instrument consists of a five-part Likert-type scale asking respondents to agree or disagree to statements about the use of technology by students in the home, attitude toward technology, and concept of technology. Part one consists of a short written description of technology. Eleven questions gather data on the technological climate of students' homes, 57 statements (items 12-69) to

assess students' attitudes toward technology, and 31 statements (items 70-100) with a three-part Likert-type scale to assess students' concept of technology (Boser, et al.,1998).

Assuming that students have a positive attitude toward technology, they would be more interested in the subject when technology was integrated into the course curriculum. If students were more interested, increased engagement and learning would likely take place. Increased engagement and learning would be reflected by way of improved test scores. Thus, a positive relationship between the attitude of students toward learning with technology and achievement would be noted. Therefore, an investigation into learning environments and instruments used to assess students' attitude toward learning with technology is warranted.

### *2.5.2 Teachers' View of Technology and Teaching Instrument - TVTT*

One instrument to determine the views of teachers toward the use of technology in improving learning and achievement is the Teachers' View of Technology and Teaching (TVTT) instrument (Appendix C) (Christensen, 1997). The TVTT instrument uses a 30-question Likert-type scale to assess teachers' attitude and beliefs about technology use in the classroom. For a more meaningful study, the researcher added four district-specific items related to technology implementation at the high school.

Christensen (1997) developed the TVTT in 1997. In her study, which ran from August 1996 through January 1997, 22 elementary school teachers in Irving, Texas completed the TVTT. In 2005, a modified version of the TTVT was administered to 30 teachers in Malaysia and proven reliable with a Cronbach coefficient alpha of 0.83 (Sa'Ari, Luan, & Roslan, 2005).

## 2.6 Learning Environments Research

Today's classroom learning environment is a balancing act between perceptions of what students deem important in helping them learn and creating a positive learning environment, and the mandates that rely on assessment of educational achievement. Educational stakeholders, who include students, teachers, administrators, parents, the community, and the workforce, are all concerned with developing the abilities and preparing students for meeting the challenges of the 21st century style of learning, which include critical thinking and problem solving skills. Nix, Fraser, and Ledbetter (2005) concur that successful students are the ones who are able to transfer knowledge and skills to become creative thinkers and problem solvers.

According to Wagner (2003), students need to be educated in an environment that fosters critical thinking skills and problem solving ability. Teachers must recognize that the learning environment is pivotal in facilitating student achievement. Not only is it important to make content material relevant and engaging, but a rigorous and constructive learning environment positively affects student self-efficacy, student motivation and promotes successful and independent learning. Research indicates that improving student achievement is linked to the classroom-learning environment.

Research conducted by Aldridge, Fraser, and Sebela (2004) found that there is a direct relationship between the learners' perception of the classroom environment and affective classroom outcomes. Teachers are instrumental in creating a positive learning environment which affects student achievement through relationship building. According to Fraser (2001), "It is the quality of life lived in classrooms

that determines many of the things that we hope for from education – concern for community, concern for others, commitment to the task in hand" (p. 2). Vogel (2009) supports this idea by stating, "Learning is a very social thing" (p. 23).

Creating a learning environment with conditions to help students achieve and succeed in the classroom requires collaboration and teamwork among students, their peers and the teacher. Because student and teacher perceptions of the learning environment differ, it is important to take into account both perceptions. According to Fraser (2001), "students certainly have a great interest in what happens to them at school and university and students' reactions to and perceptions of their educational experience are important" (p. 1).

Part of the role of a teacher is to reflect on professional practice which includes not only improving upon curriculum, but improving upon the learning environment. Success in the classroom depends on the way in which the teacher imparts knowledge and the extent to which students believe that they are involved in the learning process. Learning environment instruments which assess students' perceptions of teacher behaviour in the classroom include the *What Is Happening In this Class?* (WIHIC) (Aldridge, Fraser, & Huang, 1999).

### *2.6.1 What Is Happening In This Class?*

Since learning environment research has matured to include selecting aspects of learning environment instruments that would best fit the classroom environments of which they are studying, the *What Is Happening In This Class? (WIHIC)* questionnaire (Aldridge, Fraser, & Huang, 1999) "has formed the foundation for the development of learning environments questionnaires that incorporate many of the WIHIC's dimensions" (Fraser, 2007, p. 109). In its original version, *What Is*

*Happening In This Class? (WIHIC)* questionnaire consists of a 90-item, nine-scale version which was refined by statistical analysis to the present form of the WIHIC which contains the seven eight-item scale existing today (Aldridge, et al., 1999). Today's contemporary version makes the WIHIC distinct because it assesses students' classroom environment perceptions both actual and perceived, and it allows for exclusion of irrelevant scales based on grade level and within different educational contexts and disciplines without affecting the validity and reliability of the instrument.

The WIHIC assesses seven dimensions including Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equity. The WIHIC has been validated in the United States over many years as a reliable indicator of students' perceptions of the learning environment by Pickett and Fraser (2009) and Wolf and Fraser (2007) to name a few. Furthermore, in studies undertaken by researchers in Taiwan and Australia (Aldridge, Fraser & Huang, 1999), Korea (Kim, Fisher & Fraser, 1999), and Singapore (Chionh & Fraser, 2009), validated English versions of the WIHIC and were translated into the aforementioned native languages. These studies replicated findings in previous studies involving the use of WIHIC and report "strong associations between learning environment and student outcomes for almost all scales" (Aldridge, et al., 1999, p. 49). As a result of comparing learning environments in validated studies, "researchers, teachers, and teacher educators …gain better understandings about their own beliefs and social and cultural restraints to their teaching" (p. 60). The information gleaned suggests ways to create learning environments that influence students to develop a lifelong love of learning. Furthermore, understanding students' perceptions of their classroom

environment affords teachers and teacher educators the opportunity to reflect on practices, which create constructive learning environments.

In one such study, Wolf and Fraser (2007) initiated the use of the WIHIC to assess and evaluate 1,434 students from 71 classes in Grades 7 and 8 physical science about their perceptions of the learning environment when using inquiry-based and non-inquiry based laboratory activities. A subsample of 165 students in eight seventh grade classes were analysed in terms of classroom learning environment, attitude to science, science achievement, and whether an association exists between the nature of the classroom learning environment and students attitude and achievement (Wolf & Fraser, 2007). Although the sub-sample was small, the WIHIC proved valid with consistent reliability when differentiating between perceptions of students in different classrooms. Results replicated past research that indicates consistent associations between students' attitudes and learning environment scales.

Given that the majority of past studies of learning environments have been undertaken in the field of science, Chionh and Fraser (2009) conducted a comprehensive study using the WIHIC in geography and mathematics classes in Singapore. This study authenticated the WIHIC's effectiveness in assessing students' actual and preferred perceptions of their classroom environment and investigated the adaptability of the WIHIC to different school subjects using a large (n = 2,300) student sample. Not only did the study measure the attitude of students, but it also measured students' self-esteem and achievement in external examinations (Chionh & Fraser, 2009). These results indicated that when students' perceptions of the classroom-learning environment are positive in relation to psychosocial aspects,

and where there is greater student cohesiveness, higher achievement is attained. The study replicates past research in learning environments whereby positive attitudes and self-esteem were affected by positive teacher interaction including equity and task orientation to subject.

### *2.6.2 Technology-Rich Outcomes-Focused Learning Environment Inventory - TROFLEI*

Learning environments researchers Aldridge, Dorman and Fraser (2004) added elements to enhance the breadth and scope of the WIHIC to form *Technology-Rich Outcomes-Focused Learning Environment Inventory* (TROFLEI) to assess the attitudes of students when technology is added as an enhancement to the learning environment. The TROFLEI was developed using an intuitive-rational approach complemented by exploratory and confirmatory factor analyses. The first stage of the development of the TROFLEI was made much simpler by using an existing classroom environment instrument *What Is Happening In this Class* (WIHIC) as a starting point. The development of the TROFLEI instrument included all seven original scales from the WIHIC and three new scales labelled Differentiation, Computer Usage and Young Adult Ethos scales with eight items per scale. According to Aldridge et al. (2004) these scales were based on scales from the Test of Science Related Attitudes (TOSRA; Fraser, 1981), Computer Attitude Scales (CAS; Newhouse, 2001), and Academic Efficacy (Jinks & Morgan, 1999), respectively. The TROFLEI "is a widely-applicable questionnaire for assessing students' perceptions of their actual and preferred classroom learning environments in technology-rich outcomes-focused learning settings" (Aldridge et al. 2003, p. 168).

According to Fraser (2007), results obtained by Aldridge, et al. (2003) in a longitudinal study utilizing the TROFLEI reveal that "over time, the implementation of an outcomes-focused, technology-rich learning environment led to more positive student perceptions…and educational innovations and new curricula" (Fraser, 2007, p. 112). This study revealed that the use of technology positively impacts the transformation of the learning environment. Similarly, Aldridge, Dorman, & Fraser's (2004) research validated that the distinctiveness of the TROFLEI indicating that the instrument is valuable in assessing technology's use within the learning environment. The TROFLEI was established as a valid and reliable questionnaire to "monitor teachers' and students' success in creating outcomes-focused learning environments" (Aldridge, & Fraser, 2008, p. 15) from both the perspective of students and teachers when introducing technology into the secondary classroom.

### *2.6.3 Modified TROFLEI Instrument*

The TROFLEI was modified for the first time for use in a school in India to include a new scale called "Technology Teaching." Research conducted by Gupta (2007) used the modified version of TROFLEI (Appendix B) to investigate secondary students' perceptions, attitudes and academic achievement in a technology-supported science classroom-learning environment, to determine whether gender differences affected attitude, perception and academic achievement in the technology-supported science classroom-learning environment. Seven hundred students in 11 science classrooms ranging in age from 11-17 years old participated in the study.

Gupta (2007) used the Cronbach alpha reliability coefficient and ANOVA to examine the new scale "Technology Teaching". According to Gupta (2007), the

"Technology Teaching is in harmony with other scales" (Gupta, 2007, p. 100) in TROFLEI and "will contribute to the study of technology-supported learning environments in science classrooms" (Gupta, 2007, p. 100). Furthermore, overall factor loading results confirmed, "the modified version of the TROFLEI could be used with confidence in technology-supported science classrooms in Indian settings" (p. 194).

### *2.6.4 Survey of Students' Reactions Towards Learning Science In A Technology-Supported Classroom*

In order to understand the attitude of students toward the learning of science in a technology-supported classroom and to understand their viewpoint on the effectiveness of the teacher when teaching with technology, as part of Research Question 4, students were interviewed using the *Survey of Students' Reaction Towards Learning Science In A Technology-Supported Classroom* interview schedule (Appendix D). This interview schedule, is a combination of items based on different scales of the Technology-Rich Outcomes-Focused Learning Environment Inventory TROFLEI (Aldridge, Dorman & Fraser, 2004) and the Questionnaire on Teacher Interaction (QTI), which was used by Koul and Fisher in 2003 to gather "information concerning students perceptions of teacher interpersonal behaviour" (Gupta 2007, p. 88) in an Indian school setting. 50 students from 15 classes were interviewed and their scores entered into an excel spreadsheet, with results "converted to percentages for purpose of interpretation" (p. 139). Results of students interviewed for this study are located in Chapter 5, Section 5.3.2.

## 2.7 Summary of the Chapter

Educators have attempted to ascertain the best ways to implement educational technology into the classroom since its inception more than twenty-plus years ago. With state and federal mandates and the 21st Century Skills initiative, it is critical to integrate technology into the curriculum that encompasses all students' learning needs. Although research shows that males and females have both responded to the use of technology in the classroom positively, it remains troubling that there are significant differences in interest and knowledge of technology when it comes to gender. While teachers seem to be integrating technology at all grade levels, there needs to be more focus on addressing International Society for Technology in Education (ISTE) guidelines in meeting the needs of students at each grade level to achieve each students maximum potential when it comes to learning with technology.

It has taken a significant amount of time to integrate technology into the classroom based upon infrastructure not to mention financial constraints of each state. While numerous studies indicate that technology use in the curriculum increases motivation and engagement, other factors may influence achievement when technology is used such as the type of technology used and teacher implementation of technology. Furthermore, the types of technology used may influence achievement in terms of gender and grade level.

In this chapter, the researcher has attempted to provide a review of literature as it relates to the question of examining students' attitudes and teachers' views toward the implementation of technology in the science classroom and the impact of

technology use on learning and achievement. Additionally, an examination of the instruments used to evaluate attitudes and views of technology are discussed.

The following are some key points to be addressed in Chapter 6, Section 6.2 when reviewing the data from this study.

- A reassessment of the most appropriate ways to assess student achievement with technology without relying on standardized tests must be conducted.
- Increasing the use of technology in the classroom warrants more authentic assessment to assess academic achievement and educators at all levels must begin to identify strategies to address this issue.
- Students and teachers generally respond positively to technology integration into their lessons and believe that technology engages and motivates students to improve learning.
- Technology integration into the curriculum will continue to pervade classrooms as educators struggle to determine the effects of that integration on academic achievement.
- Determining the most suitable technologies to integrate into the classroom learning environment that is beneficial to academic growth based on gender and grade level will be a significant challenge.
- Integration of appropriate technology to increase student success in 21st century skills in preparation for the workforce is imperative.

# Chapter 3

# Methodology

## 3.1 Introduction

This chapter outlines the research questions, describes the research design, research methods, and survey instruments, and explains how the data were analyzed. Following the aim of the study and research questions are presented (Section 3.2), the research design and method (Section 3.3) and the sample population (Section 3.4) are discussed. Instruments used for the data collection (Section 3.5) and the procedure for collecting the data are next presented (Section 3.6). Limitations of the study (Section 3.7) and ethical considerations (Section 3.8) precede the chapter conclusion with a summary (Section 3.9).

## 3.2 Aims and Research Questions

The 2007-2008 school years were the first year of a five-year technology plan in the district. The purpose of the plan was to prepare and outline how technology would meet both New York State and Federal requirements. Furthermore, guidelines were written to represent the districts mission and vision statement when assimilating technology into the curriculum as a motivator for teaching and learning. The district began taking steps to implement a technology-integrated learning environment using the revised International Society for Technology in Education (Ed.) standards: National Educational Technology Standards for Teachers (2008) and the National Educational Technology Standards for Students (2008) (NETS-T, and NETS-S, [NETS], 2008).

Incorporating the International Society for Technology in Education Standards (ISTE) National Educational Technology Standards - NETS-S (for Students) and NETS-T (for Teachers) as part of their district-wide technology plan in February, 2008, district-wide training began in the use of Interactive White Boards (IWBs), Student Response Systems (SRS), and use of EasiTeach software. Training was provided by two in-house Education Technology Specialists and a variety of trainers from outside sources specializing in their respective use of software and equipment. The Education Technology Specialists are available, on demand, for teachers to gain advice from their expertise. Furthermore, professional development is provided on an on-going basis through courses offered by the district in integrating technology resources into the curriculum. Consequently, the study was designed to determine students' attitude toward and teachers' views of learning with technology and whether or not technology integration improves student achievement in the Regents Living Environment science classroom.

As part of Research Question 1, New York State Living Environment Regents examination test scores were examined in an attempt to determine if there is a relationship between the use of technology and improved student achievement. An investigation into whether or not technology tools provided by the district for use by teachers influences student achievement was also included to make the study more meaningful. For example, an investigation on the use of Castle Learning (2001-2011, para. 1) an on-line tool which "supports classroom instruction through content-related review assignments, practice sessions and benchmark testing" which was utilized by some teachers for students to use at home was included to make the study more meaningful to the district. Investigation into the use of the Interactive White

Board (IWB) and Student Response Systems (SRS) were also conducted to determine the impact on achievement.

Research Question 2 investigated whether differences exist between students' perception of attitude toward technology in the Living Environment science classroom based on grade level and gender.

Research Questions 3 and 4 investigated whether or not there is a relationship between students' attitudes toward technology and teachers' views of technology integration affects achievement in the Living Environment classroom. The research questions introduced in Chapter 1 are:

- Research Question 1: Does technology integration in the science classroom improve student achievement on the Living Environment Regents Examination?
- Research Question 2: Is there a difference between the attitude of students toward technology in the Regents Living Environment classroom based on grade level and gender?
- Research Question 3: How does the use of technology affect teachers' views of teaching science in the Regents Living Environment classroom?
- Research Question 4: Are there any relationships between students' and teachers' attitudes toward technology and student achievement in the Regents Living Environment science classroom?

As noted in Chapter 1, a pilot study using the PATT-USA and eight items (65-72) from TROFLEI – Technology Teaching (TT) scale was conducted in March of 2010 with a 27% sampling of students enrolled in the Living Environment science course. The pilot study was administered to ensure the readability and

comprehensiveness of the survey items and instructions. The procedure for administering the pilot study is located in Chapter 4, Section 4.3.

## 3.3 Overview of Research Design and Research Methods

Data collection focused on the administration of questionnaires to students and teachers, student interviews and examination and comparison of New York State Living Environment Regents Examination results from 2008-2009 to 2009-2010. These data were collected in order to determine if students' attitude toward technology and teachers' views toward technology integration in the Living Environment science classroom improved achievement. Four items regarding the attitude of students' toward the use of district provided technology were included to make the study more meaningful to the district where the research was conducted.

### *3.3.1 Research Design*

Since there was no random assignment of students, and variables within and among classrooms were not controlled (Shulman, 1997), a quasi-experimental design was used comprising quantitative and qualitative research methods. According to Creswell (2002), in the quasi-experimental design "the investigator determines the impact of an intervention on an outcome for participants in a study" (p. 314), In this case, the technology intervention was examined to determine if there was any influence on achievement. A correlational research design was used "to describe and measure the degree of association (or relationship) between two or more variables" (p. 361) in this case gender and grade level.

The design involved convenience sampling. Classes of students were intact and consisted of pre-existing groups of which comparison was possible (Punch,

1998). Furthermore, convenience sampling was used to survey the 11 Living Environment teachers. Teachers are the colleagues of the researcher and were cooperative in their willingness to participate in the study. The curriculum taught followed the guidelines for New York State and was standard for every Regents Living Environment science classroom in the research study. There was no control over the methods by which teachers used technology in their classrooms to teach lessons or whether they used technology in an attempt to attain improved student achievement outcomes.

### *3.3.2 Research Methods*

Multiple methods were used to collect both quantitative and qualitative data to investigate whether a relationship exists in the data collected on students' attitudes and teachers' views of technology in improving achievement in the Regents Living Environment science classroom. According to Shulman, (1997) "curriculum-specific interventions in classrooms that are theoretically driven, collaboratively designed and progressively adapted with classroom teachers, and documented and assessed via combinations of quantitative and qualitative methods are both experimental and naturalistic," (p. 22). Research conducted must "enlighten and shape the understandings of others," (p. 26).

To determine the attitude of students toward the integration of technology in the Regents Living Environment science classroom and to find out the degree to which technology integration impacts student achievement, quantitative data were collected using formal questionnaires which are discussed in Section 3.5. The questionnaire was pilot-tested and a discussion of the pilot study is located in Chapter 4, Section 4.4.

Additional quantitative data were collected by way of comparing standardized test score results from 2008-2009 and 2009-2010 New York State Living Environment Regents Examinations. In order to qualify to sit for the New York State Living Environment Regents Examination, students must meet the eligibility requirement of completing 30 laboratory reports or 1200 minutes of laboratory coursework. Attendance issues such as suspensions and truancy also affect eligibility. Special Education students are not factored into the teachers' results but are kept separate; therefore, this does not affect the scores represented in the research study. The rationale for excluding special education students is provided in Section 3.7.

To examine teachers' views toward technology integration in the Regents Living Environment classroom, quantitative data were collected using a formal questionnaire located in Chapter 3, Section 3.5.4.

As part of Research Question 4, qualitative data were collected using student interviews. "An interview is defined as a specialized form of communication between people for a specific purpose associated with some agreed subject matter" (Anderson, 1998, p. 193). Interviews can elicit valuable information to uncover the conception of students on the teaching and learning process when technology is implemented. According to Snyder, (2005) "Today, youth are giving cues to adults as to how to embrace and integrate technology into the fabric of educational institutions" (p. 1). Interviews are a way to obtain the viewpoint of students' on technology integration in the classroom and the effect on learning and achievement. Interviews were conducted using student volunteers. Interviews supplemented quantitative data by providing a variety of student perspectives on the use of

technology in the classroom. Findings related to the results of the interview schedule as discussed in Chapter 2, Section 2.6.4 are located in Chapter 5, Section 5.3.2.

According to Mathison (1988), triangulating methods (using multiple methods) improves the validity of the research findings and increases reliability. Creswell (2002) further indicates that one way to use the process of triangulation is "The researcher gathers both quantitative and qualitative data, compares results from the analysis of both data, and makes an interpretation as to whether the results from both data support or contradict each other" (p. 565). Through triangulating, the researcher attempted to evaluate students' attitude toward technology and the impact of technology integration on improving their academic achievement.

To maintain authenticity and follow the epistemology of Dewey, Anderson (1998) noted that John Dewey claimed that educational research should combine both the "experimental and natural" (p. 19). Therefore, the researcher is not only taking the approach of "teacher-researcher" (teachers under investigation), but incorporating the tenets of Dewey: "to study education by designing new practices of teaching and learning school subjects and examining the conditions and consequences of their implementation" (p. 20).

### 3.4 Sample Population

A large suburban school district in the United States of America, located in New York State, was examined in this study because of the sizeable investment both financially and in human resources to implement and integrate technology into the curriculum. A co-educational sample represented a diverse population of students. Participants were enrolled in the Regents Living Environment science course in the

high school. Because New York State mandates that all students must pass the Regents Living Environment science course for graduation, the sample contained students in grades 9 through 12. There are 11 Regents Living Environment science teachers at the high school covering 38 sections. The total number of students enrolled in the Regents Living Environment science course at the high school is 885.

All 11 Regents Living Environment science teachers and their students participated in the study. Teachers and students participated in the research using school-allocated laptops using a web-site called http://docs.google.com to respond to questions in the study. Due to time constraints related to end of the year examination preparations and activities, only 11 students from the large group volunteered to provide qualitative data for the interview sample. Results of student interviews are discussed in Chapter 5, Section 5.3.2. Limitations of the study are discussed in Chapter 6, Section 6.3.

### 3.5 Instruments for Data Collection

Technology implementation in teaching and learning and the effects of designing new practices using technology certainly warrant an examination into the effect on student achievement. Thus, a combination of two questionnaires was administered to students. Four district-specific items and one checklist were embedded in the students' questionnaire related to students' attitude toward technology use by their teachers in the Regents Living Environment science classroom. These four items were added to make the study more meaningful to the research district. Much time and effort was dedicated by the researcher in selecting the most appropriate questionnaires for the students which would capture students' attitude toward technology in improving learning and achievement in the Regents

Living Environment science classroom. Subsequently, previously validated and reliable questionnaires were used following adaptation and modification for the data collection. The data collection procedures are described in Section 3.6.

### *3.5.1 Pupils' Attitude Toward Technology Instrument - PATT- USA Instrument*

According to Bame and Dugger (1989), Ratt and DeVries began research in 1984 in the Netherlands to determine the attitude of students' toward technology in the science classroom. Students' ages ranged from 12-15 years. The results of the study were so significant that it was decided to open up the research to the international community. By 1989, more than 20 countries were involved in the study (Bame & Dugger, 1989) to investigate students' attitude toward the use of technology and technology concepts in improving learning. In the research conducted on the Regents Living Environment science classroom, the modified PATT-USA instrument was used.

After modifications were made by Bame and Dugger (1989) to the readability and wording, the PATT-USA instrument (Appendix A) was administered to five middle schools in the state of Virginia in the United States of America. The PATT-USA instrument consists of four parts: a short written description of technology, eleven questions to gather data on the technological climate of students' homes, 57 statements (items 12-69) with a five-part Likert-type scale to assess students' Attitudes Toward Technology. In the original PATT-USA instrument, response choices included: A= Agree, TA= Tend to Agree, N= Neutral, TD = Tend to Disagree Agree, and D = Disagree. An additional 31 statements (items 70-100) consisted of a three part Likert-type scale assesses students' Concept of Technology with A = Agree, D = Disagree, and DK = Don't Know (Boser, Daugherty, & Palmer,

1998). There are five Attitude Toward Technology sub-scales and one Concept of Technology sub-scale. A description of representative items from the PATT-USA is provided in Table 3.1.

Table 3.1: Description of Representative Items Sub-Scales: PATT-USA (Boser, et al., 1998)

| Item Number | Sub-Scales | Example of Item |
|---|---|---|
| 12 | Interest | When something new is discovered, I want to know more about it immediately. |
| 14 | Consequences | Technology is good for the future of our country. |
| 33 | Attitude | I do not understand why anyone would want a job in technology. |
| 43 | Difficult | To study technology you have to be talented. |
| 91 | Concept | Technology is meant to make our life more comfortable. |

### *3.5.2 The Teaching Technology scale from the modified Technology-Rich Outcomes–Focused Learning Environment Inventory (TROFLEI)*

The scale Technology Teaching (TT) (Gupta, 2007) from the modified form of TROFLEI was used in this study. The eight items selected from modified TROFLEI (questions 65-72) (Appendix B) were used to assess students' attitude toward a technology supported science classroom. Five representative items from the Technology Teaching scale are shown in Table 3.2.

Table 3.2: Technology Teaching (TT) Scale: modified TROFLEI (Gupta, 2007)

| Item Number | Example of the Item |
|---|---|
| 66 | I am able to learn faster through the technology classroom. |
| 67 | I am more attentive in the technology classroom. |
| 68 | I find the technology supported science class to be lively. |
| 71 | I am motivated to learn further in the technology classroom. |
| 72 | I look forward to learning science through technology classroom. |

### *3.5.3 District-Specific Items*

To identify the attitude of students toward the districts' implementation of technology into the science classroom, the researcher created and added four district-specific items about technology teaching (Table 3.3) to the conclusion of the PATT. These items are discussed in Chapter 4, Section 4.6. Two researcher-created, district-specific items were added to the TVTT. Discussion is provided in Chapter 5, Section 5.2.3. As part of a checklist, (Figure 3.1) students and teachers provided data concerning district allocated technology used in the classroom (IWB and SRS) and at home (Castle Learning) in an attempt to determine if a relationship exists between technology integration and improved student achievement in the Regents Living Environment science classroom. Results of students' and teachers' checklist responses is located in Chapter 5, Section 5.2.1.

In consultation with district administration the following is the rationale for the selection of technology items for the initial district-wide technology plan as mentioned in Chapter 1, Section 1.2:

- The Electronic Board (E-Board) was chosen as a product that would be user friendly to teachers to encourage them to create websites for students to access.
- In a pilot test with 8th grade students, Castle Learning proved to be a product that would be helpful for state assessment practice.
- In pilot classrooms, Student Response Systems proved to be effective in student engagement and improving achievement. Students felt more engaged in their learning.
- The Document Camera was chosen to be able to work with students collaboratively using original works including textbooks. The Document Camera is an effective tool for items that are not available digitally.
- The Interactive White Board provides an interactive tool that teachers can use to engage students in learning and collaboration activities. The IWB may also be used for PowerPoint to present lessons.
- EasiTeach is a software product that interacts with the IWB and is a tool that can be used to create and enhance lessons. EasiTeach allows flexibility when it comes to interactive lessons.

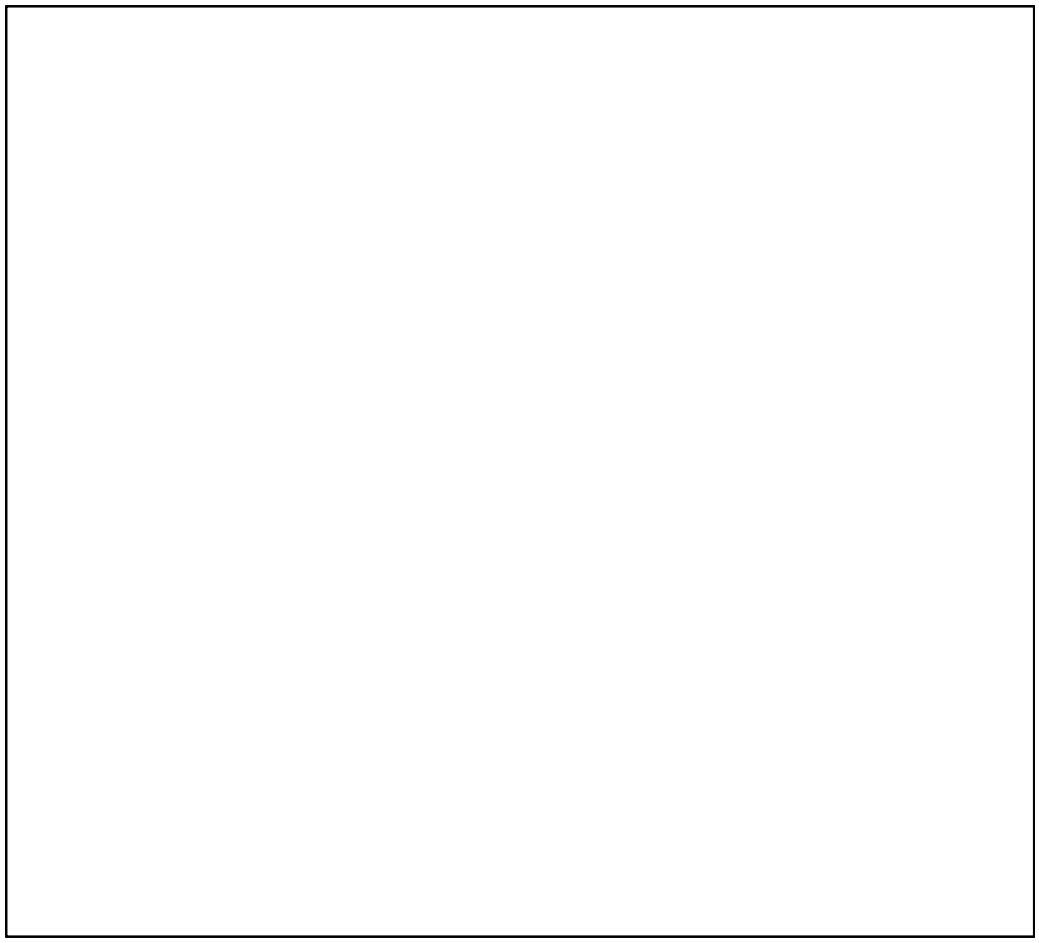

Figure 3.1 District-Specific Technology Usage Checklist for Students and Teachers

Table 3.3 Description of District-Specific Items about Technology Teaching for Students

| Scale | Scale Description | Example of the Item |
|---|---|---|
| General Interest in Technology | Interest | My teacher uses technology in his/her lessons. |
| Consequences of Technology | Consequences | Technology improves my understanding of science. |
| | | Using technology in science improves my grade. |
| Knowledge of Technology | Knowledge | Our school is doing a good job of putting technology into the classroom. |

### *3.5.4 Teachers' Views of Technology and Teaching Instrument (TVTT)*

To investigate teachers' views on technology integration, the Teachers' Views of Technology and Teaching Instrument (TVTT) was used. The original version can be found in Appendix C. The TVTT instrument was developed by Christensen (1997) and used a 30-question Likert-type scale to assess teachers' views about the impact of technology in the classroom. Instructions were given to select from a range of Strongly Agree, Disagree, Undecided, Agree, and Strongly Agree. Demographic data include gender, age, years of teaching experience and education level. The scales of the instrument and representative items as shown in Table 3.4 are those used by Christensen (1997). All 11 Regents Living Environment science teachers willingly agreed to complete the questionnaire. In addition to the TVTT, an addendum checklist (Figure 3.1) given to students was also given to teachers regarding technology available in school and for at home use by students in an attempt to correlate whether achievement is noted when technology is used in the Regents Living Environment science classroom. Results of the TVTT are discussed in Chapter 5, Section 5.2.3.

Table 3.4: Description of Scales and Representative Items: TVTT (Christensen, 1997)

| Scale Description | No of items per Scale | Example of the Item |
|---|---|---|
| Social Distance | 1 | Computers are valuable tools that can be used to improve the quality of education. |
| Support | 12 | Teachers are appreciated at my school. |
| Teaching | 7 | I provide individualized instruction to many of my students. |
| Open | 10 | I'm not afraid to let my students know I am still learning too. |

The researcher organized modification of the TVTT prior to administering the questionnaire to the teachers. Item 6: "Someday I will have a computer in my home," and Question 27: "I need access to the Internet," were omitted from the TVTT instrument by the researcher. For item 6, the researcher presumed that all of the teachers have a computer in their home and for question 27, the Internet is provided district-wide so it seemed irrelevant. Two items were added to the TVTT that were of interest to the researcher: Question 29: "Students learn better with technology," and item 30: "Technology improves student achievement." The modified version of TVTT can be found in Appendix E. As part of an analysis of technology tools used by teachers, Castle Learning (2001-2011) a software program provided by the district for teachers to assign work to students at home was assessed to determine whether it had any effect on student achievement. Additionally, as noted in the literature review, an investigation on the use of the Interactive White Board and Student Response Systems (Chapter 2, Section 2.2) was investigated. A description of the Castle Learning Software program was provided in Section 3.2.

### *3.5.5 Interview Questions*

Interviewing students is important in order to gain their insight when something new is implemented in their learning environment. Using open-ended questions is important so that students can "voice their experiences unconstrained by any perspectives of the researcher or past research findings" (Creswell, 2002, p. 204). In order to obtain qualitative data on the attitude of students toward learning and achievement when technology is implemented in the Regents Living Environment science classroom, the *Survey of Student' Reactions Towards Learning Science in a Technology-Supported Classroom* (Appendix D) (Gupta, 2007)

interview schedule was used. Students were asked to respond "Yes", "No", or "Doubtful". Questions were open-ended and students were free to elaborate on their answers. In order to be consistent with technology used in the research study district, the researcher adjusted the wording on items 5 and 9 from "television screen" to "SmartBoard" (IWB). The researcher clarified any vocabulary words or restated the question if students requested. Representative items are listed in Figure 3.2. Additionally, the researcher added an overarching question to the end of the interview schedule to summarize students' perspective on whether or not they believed technology helped them learn better. A summary of the interview process is located in Chapter 5, Section 5.3.3. A full transcription of student responses to the interview questions are located in Appendix F.

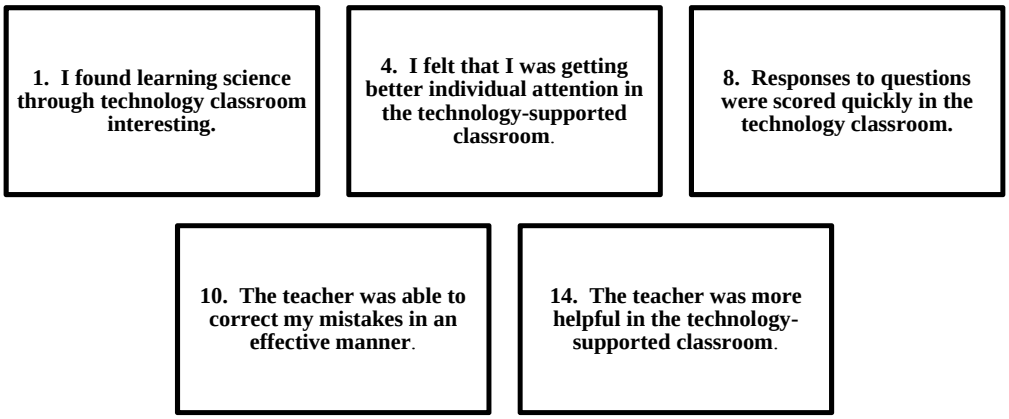


Figure 3.2 Sample Questions from the Survey of Students Reactions Towards Learning Science In A Technology-Supported Classroom

Interviews were conducted with students in order to discover their reaction toward learning science with technology. Furthermore, the researcher attempted to identify students' attitude towards technology to the extent to which technology was actually being implemented in the Regents Living Environment science classroom

and its impact on achievement. According to Anderson (1998) interviewing techniques are useful because through interviewing, the interviewer can engage the respondents in the questions. Furthermore, the interviewer had a chance to probe the respondent and clarify information, which provides information that is more complete. In this case, interviews were used to collect information that is more specific on how students react toward learning science in their technology-supported classroom. Results of interviews are located in Chapter 5, Section 5.3.2.

## 3.6 Data Collection Procedures

### *3.6.1 New York State Living Environment Regents Examination*

Once the results of the New York State Living Environment Regents Examination were tabulated, an administrative report of teacher assessment results was made available for the researcher to use. The report was provided by the district to identify the number of students who had written an examination and to compare results by teacher. A comparison of all 11 Regents Living Environment science teachers' results from the 2008-2009 and 2009-2010 school year was completed in an attempt to ascertain whether an improvement in results was obtained and whether those results would show a relationship to technology use in the district. Comparison of Living Environment Regents examination results by teacher is located in Chapter 5, Table 5.1.

### *3.6.2 Pilot Study of PATT-USA*

The pilot study was conducted to determine the reliability and validity of the questionnaires and to clarify any misconceptions in readability and language. As noted by Anderson (1998) pilot-testing questionnaires will "identify ambiguities in

the instructions" (p.179), and alert the researcher as to any "omissions or unanticipated answers in multiple choice or ranking questions" (p.179). Additionally, pilot studies "provide an excellent way of avoiding trivial or non-significant research" (Anderson, p. 12).

As noted in section 3.2, in March of 2010, the PATT-USA and the Technology Teaching (TT) scale of TROFLEI were administered to a sub-sample of 189 students (or 27%) from the larger group of 885 students to assess the readability, reliability and validity of the instruments. The researcher entered the original version of PATT-USA (Appendix A) with Technology Teaching (TT) scale of TROFLEI instrument (Appendix B) into an electronic document at www.http://docs.google.com database, which is an on-line survey tool. Included in the pilot study were the researcher-specific items and the technology checklist, which were discussed in Section 3.5. The link to the questionnaire was posted to the researcher's school allocated electronic board (e-board). Verbal instructions were given to teachers by the researcher on how to administer the questionnaire. Students logged-on to the school e-board to answer the questions which the researcher downloaded into an excel spread-sheet for data analysis.

Once the analysis was completed and items reduced, revisions were made to the PATT-USA and Technology Teaching (TT) scale of TROFLEI, which included four researcher-created items. The combination of these instruments was renamed the *Learning Environment Questionnaire - Assessing Students' Attitudes to Technology* (LEQ-ASAT) (Appendix K) which was administered to students between April and June of 2010. The researcher administered the instrument LEQ-ASAT via the on-line survey tool at http://www.docs.google.com via the school

allocated electronic e-board. The procedure for administration of the pilot study is located in Chapter 4, Section 4.3 and in Table 5.7.

### *3.6.3 Teachers View of Technology and Teaching*

In April of 2010, data were collected from teachers using the modified TVTT instrument. Items from the modified TVTT instrument were entered by the researcher into the http://www.docs.google.com data-base. Teachers responded to the questionnaire on school allocated laptops. Results can be found in Chapter 5, Section 5.2.3.

### *3.6.4 Interview Questions*

Collection of qualitative data was accomplished using the *Survey of Students' Reactions Towards Learning Science In A Technology-Supported Classroom* (Gupta, 2007) (Appendix D). Student volunteers came after school by appointment over the course of a week and sat in a quiet room with the researcher to respond to the 20 question interview schedule. In order to be consistent with technology used in the research study district, the researcher adjusted the wording on items 5 and 9 from "television screen" to "SmartBoard" (IWB). The researcher clarified any vocabulary words or restated the question if students requested. Question 15: "I could revise my lesson better in a technology-supported classroom" was not asked of students because students neither create nor revise lessons. As noted in Section 3.4.5, the researcher added an open-ended question: "Briefly explain how technology helps you learn better. If technology does not help you learn better, please state why." This question was added as a way to round-out the interview process questions.

Responses were recorded to ensure accurate transcription and evaluation of the responses. The results of the interview process are located in Chapter 5, Section 5.3.2.

## 3.7 Limitations of the Study

### *3.7.1 Student Sample*

In discussion with district administration (Section 3.4), recommendations were made to exclude special education students from the study. Administration was of the opinion that there were too many variables involved such as Individualized Education Programs (IEP's). The researcher agreed with this advice. Some middle school students take the Regents Living Environment science course in the 8th grade. The two middle schools are in different buildings and for convenience, the school Principal agreed with the science chairperson and the researcher to exclude those classes.

### *3.7.2 Teacher as Researcher*

A number of students are familiar with me. Students were encouraged to answer all questions as honestly as possible so that together, we may discover whether or not technology is helping them with achievement. Students were reassured that participation in the study (or lack thereof) would not affect their grades.

### *3.7.3 Time Constraints*

One teacher asked to exclude two classes due to time constraints. He was of the opinion that his classes were behind on the curriculum and he did not want to subject his students to the diversion of participating in the study. One teacher had to

exclude two classes because the technology was not working properly during the time allocated for her to administer the surveys to her students. Again, since time was running short, and with the Living Environment Regents Examination approaching, rescheduling was not an option.

### *3.7.4 Interview Sample*

In mid-May, the researcher requested that her colleagues ask their students to volunteer to be interviewed for the research study. As teachers (including the researcher) were in the middle of completing the final version of the modified PATT-USA with modified TROFLEI, and reviewing for the New York State Living Environment Regents Examinations, this request was overlooked. Students were also busy after school attending review sessions for other classes. Subsequently, only 11 students presented themselves to be interviewed comprising a 1% sample of students who participated in interview process.

Generalizations may be made from the results of the interviews insofar as the reasons students gave for the technology-supported science classroom helping them learn better. Technology supports strategies which help students learn such as differentiating learning and supporting a variety of learning styles. A summary of reasons are located in Chapter 5, Section 5.3.3.

## 3.8 Ethical Considerations

### *3.8.1 Permissions*

From the ethical standpoint, proper informed consent was obtained from the district administration to conduct the research at the high school (Appendix H). Teacher consents were obtained (Appendix I) and Parent/Guardian and student

consents were also acquired (Appendix J). Although consents were properly obtained, neither students nor teachers were coerced into participating in the study and all participants freely completed the questionnaires for quantitative data collection. Qualitative interview data were collected from students who volunteered to offer their services and time to be interviewed. Respect and dignity was maintained during student interviews and no coercion was involved during the interview process. Students benefited from the study as perceived by teachers and the researcher as evidenced by their inquiry about the study and the nature of research. Students who were interviewed were equally inquisitive as to how their interviews supplemented the quantitative data Respect for intellectual property was maintained and proper permissions were obtained regarding the usage of questionnaires. Attention was given in maintaining fairness and honesty in reporting data and findings.

### *3.8.2 Reporting of Research*

In accordance with the American Educational Research Association Code of Ethics (2011), full disclosure of the results from the pilot study and main study were reported including any and all errors and results of findings to the best ability of the researcher.

### *3.8.3 Anonymity*

According to Howe and Moses (1999) maintaining privacy and autonomy are essential to any research study. To maintain integrity and anonymity in the research, students were identified in the data collection by student identification number. Student interview were conducted privately between the researcher and student volunteers. Student interviews were solely of a voluntary nature. To maintain

teacher confidentiality, teachers were each assigned a letter code to gather data on their views when teaching with technology, their use of technology in the classroom, and to comment on their New York State Living Environment Regents test scores when discussing their results in Chapter 5.

### *3.8.4 Data Storage*

Original data (including tape recordings of student interviews) will be retained at Curtin University for at least five years. Students were kept anonymous and the information collected electronically was secured using a password known only to the researcher.

## 3.9 Summary of the Chapter

This study is particularly influenced by the research studies on technology-rich learning environments, which have illustrated the effectiveness of the use of technology in teaching science and its relationship with selected learner outcomes (Aldridge, et al., 2003; 2004). The inclusion of learning environment instruments and measures provide an effective methodology for investigating the impact of the use of technology in teaching science at the secondary level.

It has been aptly observed by Fraser (2003) that there is considerable optimism internationally that the integration of technology into learning environments will provide teachers with the means to manage efficiently the diverse educational provisions needed to optimize individual student's outcomes. In many educational settings, technology is becoming more commonplace and, in some cases, the integration of technology into the learning environment is becoming a major thrust. However, it is important that our optimism about the efficacy of technology

enhanced learning environments be accompanied by systematic research and evaluation.

To that end, a discussion of the instruments chosen for the research study is included. An introduction into the pilot study describes how a combination of two instruments: Pupils' Attitude Toward Technology-USA (PATT-USA) and the Technology Teaching scale of the modified Technology-Rich Outcomes-Focused Learning Environments instrument (TROFLEI) were administered to 189 students. An overview of the main study is described involving nearly 700 students to obtain data in an attempt to investigate students' attitude toward technology integration into the science classroom-learning environment. As a result of the pilot and main studies, a combination of instruments including researcher created items developed into an instrument renamed *Learning Environment Questionnaire - Assessing Students' Attitudes to Technology (LEQ-ASAT).*

Also included in this chapter are descriptions of the research method and research design. Discussion on data collection, data analysis and recording and reporting procedures are given. The research instrument for teachers, the TVTT, was explored. The method used for analysis of the Living Environment Regents Examination results is explained. Qualitative data using interviews were described. Limitations of the study and ethical issues were reflected upon.

Chapter 4 reports on the pilot study and how the new instrument *Learning Environment Questionnaire - Assessing Students' Attitude to Technology* (*LEQ-ASAT)* is arrived at to be used in future research as the basis for identifying information regarding the attitude of students toward technology integration in the Regents Living Environment science classroom. Chapter 5 reports on the results of

the study including quantitative and qualitative findings in response to the research questions.

# Chapter 4

# Pilot Study and Finalizing the Main Instrument

## 4.1 Introduction

This chapter describes the rationale for conducting the pilot study using the PATT-USA with the Technology Teaching "TT" scale of modified TROFLEI (Section 4.2). Administration of the pilot study (Section 4.3) and remarks regarding the pilot study (Section 4.4) are included. The method for modifying the PATT-USA with the Technology Teaching "TT" scale (Section 4.5) is discussed. Explanations of the development of the final version of PATT-USA with Technology Teaching "TT" scale (Section 4.6) and discussion of data analysis instruments used for validity and reliability are presented (Section 4.7). The new instrument *The Learning Environment Questionnaire - Assessing Students' Attitude to Technology*, (LEQ-ASAT) is introduced (Section 4.8). The chapter concludes with a summary (Section 4.9).

## 4.2 Rationale for Pilot Study: PATT-USA with Technology Teaching Scale of the modified TROFLEI

As mentioned in Chapter 3, in March of 2010, permission was granted by the Principal at the high school where the research was conducted to administer a pilot study to revalidate the original version of PATT-USA questionnaire (Appendix A) and a scale of Technology Teaching (TT) from TROFLEI instrument (Appendix B). Four researcher-created district-specific items (Table 3.3) were also added to make the study more meaningful to the research district. The combined instrument was administered to a 27% sampling of Regents Living Environment science students.

The pilot study was conducted to ensure that students were capable of understanding the questions, and to ensure readability and comprehensiveness of the items. Once the pilot test was completed, the instrument was analyzed for reliability using Cronbach's alpha. Upon completion of the data analysis, modifications were made to the questionnaire and some 21 items were deleted. This data analysis generated 77 items which showed validity and reliability for use in the research study. Thereafter, the *Learning Environment Questionnaire - Assessing Students' Attitudes to Technology* was administered to the large-group of Regents Living Environment science students. The optimal factor solution existed for the data set by retaining 54 items (Appendix K) of the 77 items (Appendix G). All items had a factor loading of at least 0.40 on the a-priori scale and less than 0.04 on all other scales. Discussion of the data analyses can be found in Chapter 4, Section 4.6.

### 4.3 Administration of the Pilot Study

The researcher completed data entry of the PATT-USA questionnaire and Technology Teaching scale of the modified TROFLEI instrument (including four researcher created district-specific items) into the on-line survey tool at http://www.docs.google.com. The questionnaire was posted to the research study school e-board. Teachers were instructed that only students who had a valid school allocated technology password would be permitted to participate in the study. No sharing of passwords was authorized.

In the pilot study, the researcher omitted items regarding demographics (1-11) believing that there would be no confusion addressing these items as they were basic queries and should not be problematic. Examples of these items relate to students' gender, grade level, age, family involvement in work and associations with

technology. Information regarding these questions is located in Chapter 5, Section 5.2.4. In the pilot study, the researcher also omitted the section where students were asked to write a short description of what they thought technology was in an effort to focus their attention on the Likert-scale questions. However, this section was included in the main study. A summary of the short description of what students thought technology was is located in Chapter 5, Section 5.3.3.

The researcher discovered data entry errors while students were participating in the pilot study. It should be noted that the researcher inadvertently excluded item 65 of the PATT-USA, "Girls think technology is boring." Furthermore, the items were unintentionally left unnumbered. In addition, to keep students focused, the researcher grouped all items that had five choices together, and all items that had three choices were grouped together. This means that the Technology Teaching (TT) items of the modified TROFLEI were embedded with the PATT-USA items. Thus, the questionnaire was administered as follows: items 12-69 were from the PATT-USA (excluding item 65 which was unintentionally left out), then all eight items from the Technology Teaching scale of TROFLEI were included and identified as "TT".

The remainder of the PATT-USA items (70-100) which only had three response choices were kept grouped together. Items 101-104 (Table 3.3) were researcher-specific items related to the district where the research was conducted and were added to make the study more meaningful to the research district. Additionally, the researcher added a checklist where students were asked to identify which technologies their teacher uses in the Regents Living Environment science classroom. These researcher-embedded items are discussed in Chapter 3, Section

3.5.3. Therefore, there were a total of 88 items from the PATT-USA, (12-69) and items 70-100; demographic items 1-11 were excluded – item 65 was unintentionally omitted) and eight items from Technology Teaching scale of the modified TROFELI identified as "TT" embedded between item 69 and 70. In total, 100 items were used in the pilot study.

Another problem that was noted in the data entry of the questionnaire by the researcher was the omission of choices for the items. The researcher noted this when visiting the first class that was taking the pilot study. Students were verbally instructed by the researcher in the three pilot study classrooms to choose one if they disagree and five if they agree. Three was neutral. For the three choice responses students were verbally instructed that one was "don't know", two was "disagree" and three was "agree".

### 4.4 Discussion on the Pilot Study

Feedback regarding the pilot study was elicited from the Regents Living Environment science teachers and their students. All participants mentioned that the questionnaire was easy to respond to and convenient using the on-line survey tool. Teachers in each of the three classrooms assured the researcher that the misstep with the directions for the responses to items were not problematic for students. Furthermore, teachers commented that the items appeared to ask pertinent information regarding technology use in the science classroom. Students verbalized that some items were discriminatory based on gender. An analysis of the results from the main study based on gender differences are located in Chapter 5, Section 5.2.2.

There was a spelling error on the checklist (Figure 3.1) ("Borad" instead of "Board") item created by the researcher. Problem word definitions in the PATT-USA were “seldom” and “prosperous”. The context of the word “industry” (item 99 of pilot study) confused students. Students did not understand item 37 on pilot study which read: “You have to be strong for most technological jobs”, nor did they understand item 38 on the pilot study: “Technology at home is something schools should teach about”. Figures 4.1 and 4.2 display items that were excluded from the administration of the *Learning Environment Questionnaire - Assessing Students' Attitudes to Technology* instrument (Appendix K) to the large group of 700 Regents Living Environment science students.

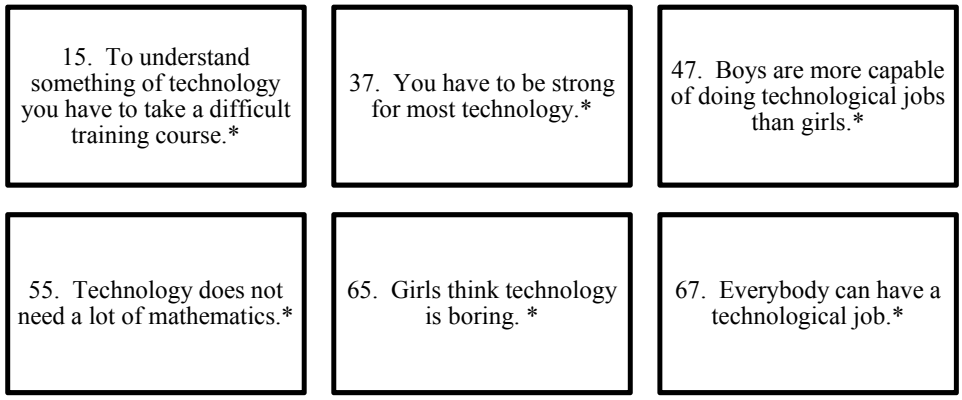


Figure 4.1 Excluded PATT-USA Questions – Attitude Toward Technology Scale*
*Note: These item numbers are the same on original version of the PATT-USA and the pilot study.

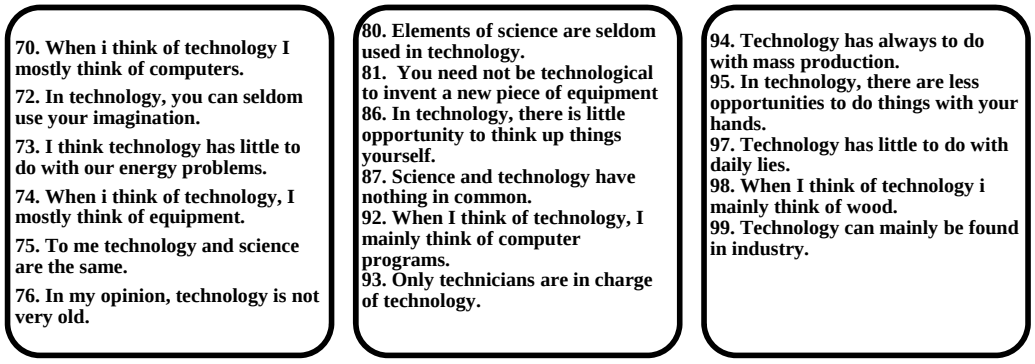


Figure 4.2 Excluded PATT USA Items: Concept of Technology

## 4.5 Modification of PATT-USA with TT scale of the modified TROFLEI

Typographical corrections were made and omissions addressed in Section 4.4 were easily remedied. Instructions for responses were added and items were numbered. As noted in section 4.3, response choices which were inadvertently omitted were added. Responses for items 1 – 53 ranges from Almost Never = 1 to Almost Always = 5. Three is neutral. For items 54 to 67, the choices are Agree, Disagree or Don't Know. Items 68 – 79 (Technology Teaching scale of TROFLEI - TT scale) revert to Almost Never = 1 to Almost Always = 5. Three is neutral. These corrections were made while the reliability analysis of the pilot study was being completed.

As noted in Section 4.3 demographic items (including the item asking students to write a short description of technology) from the original version of the PATT-USA which were initially excluded from the pilot study were added except for the exclusion of item six which asked about technical toys such as Tinkertoys, Erector Sets or LEGO's. In retrospect, the researcher noted that this item should have been edited to reflect changes in "toys." Perhaps the item should have been re-worded to

say video games or interactive games to get a more modern understanding of the word "toys."

Demographics item number 11 was re-phrased by the researcher from: "Are you taking or have you taken Technology Education/Industrial Arts?" to read, "Are you taking or have you taken technology classes?" The researcher believed that the students would have a misunderstanding with the words "Industrial Arts" since that phraseology is unfamiliar to students in the research district. The research district offers technology classes as elective courses and they are not required. Results of the analysis of the demographic items is located in Chapter 5, Section 5.2.4.

Items were examined from the pilot study for consistency and reliability using Cronbach's alpha. The items listed in Figure 4.1 and 4.2 were excluded from the finalized version *Learning Environment Questionnaire - Assessing Students' Attitudes to Technology* after a statistical reliability analysis resulting from the pilot study was completed. The results are located in Chapter 5. Due to the nature of the way the researcher entered the pilot study, the numbers do not coincide with the original PATT-USA. For simplicity, the researcher will refer to the original version of the PATT-USA to remark on omitted items.

The question from Scale 1, General Interest in Technology was used. Item 47 from Scale 2, Technology as an Activity for both Girls and Boys was omitted. All eight items from Consequences of Technology Scale 3 were used. One item (question 15) from Technology is Difficult (Scale 4) was excluded. Three items (37, 55, and 67) from Attitude Toward Technology (Scale 5) were excluded. All Technology Teaching items of modified TROFLEI (Scale 6) were included.

The new instrument the *Learning Environment Questionnaire - Assessing Students' Attitudes to Technology* (Appendix K) (which is a combination of the two instruments PATT-USA with the Technology Teaching scale of the modified TROFLEI questionnaire and the researcher-created district-specific items, which were discussed in Chapter 3, Section 3.5.3) consisting of 77 questions were administered to the Regents Living Environment students.

## 4.6 Final Version: the Learning Environment Questionnaire - Assessing Students' Attitude to Technology

Once the pilot test was conducted and items evaluated for reliability (Section 4.7), the researcher adjusted the PATT-USA and Technology Teaching scale of modified TROFELI as indicated in Section 4.5. Seventeen items from Technology Concepts Scale were omitted (Figure 4.2). Question 65 was added from its original omission, and the four researcher-created district-specific items discussed in Chapter 3, section 3.5.3 were included. Items were eliminated and the questionnaire was revised. The researcher completed another data entry of the questionnaire into the on-line survey tool at https://www.docs.google.com. The *Learning Environment Questionnaire- Assessing Students' Attitude to Technology*, (Appendix K) consisting of 77 items (including the four researcher-created items and one researcher-created checklist) were administered to nearly 700 Regents Living Environment students. As the researcher works in the district, the researcher spoke to and/or visited the teachers participating in the study to make certain that there were no misunderstandings regarding the administration of the questionnaire as mentioned in Section 4.3. During brief visits to the classrooms, and upon speaking with students

and teachers, it was verbalized that the questionnaires were straightforward and did not inconvenience or disrupt student learning.

When visiting classrooms, students who participated in the pilot study, (including the researcher's) commented that they had seen some of these items before. The researcher explained that the first time they answered the questionnaire, they were helping to test items and this was the final product of their participation. Other dialogue was initiated about the research. The small number of students who participated in the pilot study and the main study was not considered detrimental to the findings of the main study. It was encouraging to note that classroom teachers, the researcher and students have good rapport and curiosity and all appeared to be involved in the participation of the study.

### *4.6.1 Validation of the Learning Environment Questionnaire Assessing Students' Attitude to Technology* – LEQ-ASAT

Data collected from the main research study were analyzed to establish the validity and reliability of the LEQ-ASAT. A principal component factor analysis followed by varimax rotation confirmed a refined structure of the instrument comprising of 54 items in five scales. Figure 4.3 describes the 25 items with low-scale reliability that were excluded after the data analysis. The remaining 54 items had a loading of at least 0.30 on their a priori scales and are presented in Table 4.1

Although, 13 factors had eigen value of more than 1, it was decided to include factors with eigen values of two or more; Kline (1994) highlighted that determining all the factors with eigen values of more than one can overestimate the number of factors. All factors from the scree plot are shown in Figure 4.4. The percentage of the total variance extracted with each factor is also recorded at the bottom of Table 4.1.

The percentage of variance varies from 21.75% to 3.47% for different scales, with the total variance accounted for being 41.59%.

**Scale: General Interest in Technology:**

**12. When somethingnew is discovered I want to know more about it immediately**

**16. At school you hear a lot about technology.**

**22. I would not like to learn more about technology at school.**

**28. I will not consider a job in technology.**

**32. I would rather not have technology lessons at school.**

**38. Technology at home is something schools should teach about.**

**46. I am not interested in technology.**

**Scale: Attitude Toward Technology:**

**26. Technology is only for smart people.**

**27. Technology lessons are important.**

**29. There should be less TV and radio programs about technology.**

**40. I think visisting a factory is boring.**

**54. Technology causes large unemployment.**

**60. Because technology causes pollution, we should use less of it.**

**61. Everybody can study technoloby.**

**68. Not everyone needs technology lessons at school.**

**Scale: Consequence of Technology:**

**42. The world would be a better place without technology.**

**Scale: Technology as an Activity for both Boys and Girls:**

**13. Technology is as difficult for boys as it is for girls.**
**19. A girl can very well have a technical job.**
**24. A girl can become a car mechanic.**
**30. Boys are able to do practical things better than girls.**
**35. Girls are able to operate a computer.**
**41. Boys know more about technology than girls do.**
**47. Boys are more capable of doing technological jobs than girls.**
**53. More girls should work in technology.**
**59. Girls prefer not to go to a technical school.**

Figure 4.3 Excluded Items: Learning Environment Questionnaire – Assessing Students' Attitude To Technology LEQ-ASAT

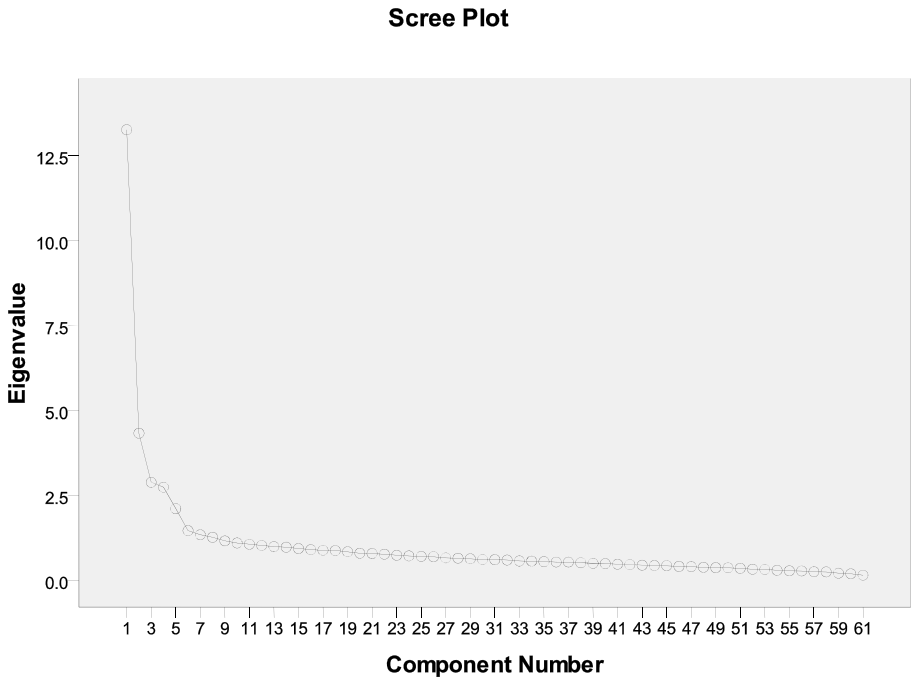


Figure 4.4 Scree plot for the factor analysis of the data

Table 4.1 Factor Loadings for the Learning Environment Questionnaire Assessing Students Attitude to Technology LEQ-LEQ-ASAT

| Item No | Interest in Technology | Consequences of Technology | Attitude Towards Technology | Teaching Technology | Knowledge of Technology |
|---|---|---|---|---|---|
| 1 | 0.65 | | | | |
| 2 | 0.44 | | | | |
| 3 | 0.52 | | | | |
| 4 | 0.65 | | | | |
| 5 | 0.77 | | | | |
| 6 | 0.48 | | | | |
| 7 | 0.80 | | | | |
| 8 | 0.53 | | | | |
| 9 | 0.49 | | | | |
| 10 | 0.41 | | | | |
| 11 | 0.68 | | | | |
| 12 | 0.42 | | | | |
| 13 | | 0.70 | | | |
| 14 | | 0.71 | | | |
| 15 | | 0.69 | | | |
| 16 | | 0.56 | | | |
| 17 | | 0.53 | | | |
| 18 | | 0.41 | | | |
| 19 | | 0.42 | | | |
| 20 | | | 0.41 | | |
| 21 | | | 0.52 | | |
| 22 | | | 0.5 | | |
| 23 | | | 0.43 | | |
| 24 | | | 0.46 | | |
| 25 | | | 0.45 | | |
| 26 | | | 0.51 | | |
| 27 | | | 0.41 | | |
| 28 | | | 0.40 | | |
| 29 | | | | 0.53 | |
| 30 | | | | 0.63 | |
| 31 | | | | 0.57 | |
| 32 | | | | 0.66 | |
| 33 | | | | 0.58 | |
| 34 | | | | 0.53 | |
| 35 | | | | 0.62 | |
| 36 | | | | 0.66 | |
| 37 | | | | 0.42 | |
| 38 | | | | 0.41 | |
| 39 | | | | 0.63 | |
| 40 | | | | 0.56 | |
| 41 | | | | | 0.55 |
| 42 | | | | | 0.47 |
| 43 | | | | | 0.48 |
| 44 | | | | | 0.41 |
| 45 | | | | | 0.64 |
| 46 | | | | | 0.56 |
| 47 | | | | | 0.47 |
| 48 | | | | | 0.42 |
| 49 | | | | | 0.46 |
| 50 | | | | | 0.47 |
| 51 | | | | | 0.50 |
| 52 | | | | | 0.49 |
| 53 | | | | | 0.55 |
| 54 | | | | | 0.64 |
| % Variance | 21.75 | 7.11 | 4.74 | 4.50 | 3.47 |
| Eigen Value | 13.27 | 4.33 | 2.89 | 2.74 | 2.11 |

These converged five factors (Table 4.1) were identified as five scales namely Interest in Technology, Consequence of Technology, Attitude to Technology, Technology Teaching (TT) which consists of 12 items (4 of which are researcher created district-specific items), and Knowledge of Technology. Description and example of items for each scale of the new instrument *Learning Environment Questionnaire - Assessing Students' Attitude to Technology* and representative items are provided in Table 4.2. The complete 54-item instrument is shown in Appendix M. Results of the administration of *Learning Environment Questionnaire - Assessing Students' Attitude to Technology* are discussed in Chapter 5.

Table 4.2 Description and Example of Items for Each Scale of the Learning Environment Questionnaire Assessing Students' Attitude to Technology

| Scale | No of items | Description | Item |
|---|---|---|---|
| Interest in Technology | 12 | Extent to which students find technology interesting. | I would like to know more about computers. |
| Consequences of Technology | 7 | Extent to which technology is important. | Technology is the subject of the future. |
| Attitude To Technology | 9 | Extent to which students find technology relevant and useful. | To study technology you have to be talented. |
| Technology Teaching (TT) | 12 | Extent to which students are interested in, enjoy and look forward to lessons in that subject. | I am able to learn faster through the technology classroom. |
| Knowledge of Technology | 14 | Extent to which students have knowledge of the use of technology. | I think science and technology are related. |

## 4.7 Scale Reliabilities

Further to the factor analyses, three more indices of scale reliability were generated for *Learning Environment Questionnaire - Assessing Students' Attitude to Technology* instrument. To determine the degree to which items in the same scale

measure the same aspects of students' perceptions and attitude to computers a measure of internal consistency, the Cronbach alpha reliability coefficient (Cronbach, 1951) was used. The Cronbach alpha reliability coefficient is an index of scale internal consistency of the test items relative to other test items, which are designed to measure the same construct of interest. Analysis of variance (ANOVA) results were used as evidence of the ability of each scale to differentiate between the perceptions of students in different classrooms. A discriminant validity index (namely, the mean correlation of a scale with other scales) was used as evidence that each *Learning Environment Questionnaire Assessing Students' Attitude to Technology* instrument measures a separate dimension that is distinct from the other scales in this questionnaire. Table 4.3 reports the Cronbach alpha coefficient for the each of the five scales of the *Learning Environment Questionnaire Assessing Students' Attitude to Technology*. As a consequence of the factor analysis, the four researcher created items about teaching with technology (Table 3.3) were factored in with the Technology Teaching scale of modified TROFLEI. This scale has a Cronbach's alpha coefficient 0.90. Scale reliability estimates for different scales range from 0.78 to 0.90 suggesting that all scales of the *Learning Environment Questionnaire - Assessing Students' Attitude to Technology* Instrument are reliable for use (De Vellis, 1991).

Item means and standard deviations were computed to determine the nature of *Learning Environment Questionnaire - Assessing Students' Attitude to Technology* (LEQ-ASAT). Knowledge of Technology was scored on a three-point Likert scale (as in the original PATT) and all other scales on a five-point Likert scale. Mean scores above three (Table 4.3) for the scales of LEQ-ASAT – Consequences of Technology and Technology Teaching - show overall positive student perceptions of

technology. The mean score for Knowledge of Technology (1.67) indicates that students believed that they were somewhat confident regarding their knowledge of technology. However, for the scales General Interest in Technology and Attitudes to Technology the mean results were less than three indicating a less that positive perception of technology. Results confirm that students perceive technology as very important in life and that technology is a subject of the future.

Table 4.3 Scale Mean, Standard Deviation, Internal Consistency (Cronbach Alpha Reliability) and Ability to Differentiate Between Classrooms (ANOVA Results) for the Learning Environment Questionnaire Assessing Students' Attitude to Technology

| Scale | No of Items | Mean | S D | Alpha Reliability | Eta² | Mean Correlation |
|---|---|---|---|---|---|---|
| General Interest in Technology | 12 | 2.96 | 0.76 | 0.88 | 0.00 | 0.23 |
| Consequences of Technology | 7 | 3.73 | 0.72 | 0.80 | 0.00 | 0.18 |
| Attitude Towards Technology | 9 | 2.68 | 0.65 | 0.78 | 0.00 | -0.28 |
| Technology Teaching | 12 | 3.30 | 0.79 | 0.90 | 0.03*** | 0.24 |
| Knowledge of Technology | 14 | 1.67 | 0.36 | 0.83 | 0.07*** | 0.44 |

***$P<0.001$ $N$=697 students

An analysis of variance (ANOVA) was used to determine the ability of the each scale of LEQ-ASAT to differentiate between the perceptions of students in different classes. The one-way ANOVA for each scale involved class membership as the independent variable and the individual student as the unit of analysis. The ANOVA results show that two scales Technology Teaching and Knowledge of Technology used in this study differentiate significantly between classes ($p<0.001$, see Table 4.3). Thus, students within the same class perceive the classroom

environment in a relatively similar manner. The *eta²* statistic (an estimate of the strength of association between class membership and the dependent variable ranges from 0.00 to 0.07 for different scales of LEQ-ASAT. The results obtained for the internal consistency (alpha reliability) and the ability of each scale to differentiate between the perceptions of the students in different classrooms (*eta²* statistic from ANOVA) can be considered acceptable. The data presented in Table 4.3 support the contention that *Learning Environment Questionnaire - Assessing Students' Attitude to Technology* (LEQ-ASAT – Appendix K) is a valid and reliable classroom environment instrument for assessing students' perceptions of their technological environments at the high school level in the USA.

Using the individual as the unit of analysis, the discriminant validity results (mean correlation of a scale with other scales) for the scales of LEQ-ASAT ranged from 0.18 for the Consequence of Technology scale to 0.44 for the Knowledge of Technology. Only the scale of Attitude Towards Technology demonstrated negative mean correlation with the other four scales (Table 4.3).

## 4.8 The new instrument produced from this study: *The Learning Environment Questionnaire Assessing Students' Attitude to Technology* - LEQ-ASAT

As mentioned previously, a pilot study using a 27% sampling of the research participants was conducted to validate the reliability of the modified PATT with Technology Teaching scale of modified TROFLEI. Additionally, the four researcher created items were included in the Technology Teaching scale. Once the data were analysed, modifications were made, and items with low-scale reliability were eliminated. This resulted in the new instrument produced from this study: *Learning Environments Questionnaire – Assessing Students' Attitude to Technology*, used to

conduct the main study. Results gleaned from the administration of the *Learning Environment Questionnaire Assessing Students' Attitude to Technology* instrument such as investigating differences between students' perceptions of attitude toward technology based on grade level and gender are located in Chapter 5, Section 5.2.2. The new instrument: the *Learning Environment Questionnaire - Assessing Students' Attitude to Technology,* contains 54 questions (Appendix K) and was validated and found reliable to monitor the attitude of students toward technology in the Regents Living Environment Regents science classroom.

## 4.9 Summary of the Chapter

Although there were some typographical errors and omissions with the numbering of the items from the pilot PATT-USA and Technology Teaching scale of TROFLEI these typographical errors were easily corrected. A modified version of PATT with Technology Teaching scale of the modified TROFLEI consisting of 77 items was administered on nearly 700 Regents Living Environment high school students in an attempt to uncover whether students attitude toward technology impacts achievement. To make the study more meaningful to the district, the researcher incorporated district-specific items regarding technology use in the Regents Living Environment science classroom. The four items found in Table 3.3 ask students about the teacher use of school provided technology and their perception of the use of technology in improving their understanding of science. These four items also ask students about their perception of technology and achievement in the Regents Living Environment science classroom. These items were found to be reliable for use and were included in the LEQ-ASAT. Furthermore, a checklist was added for students and teachers to comment on

concerning district provided technology for use in school and at home in an effort to notice any effect of using technology on achievement. Results can be found in Chapter 5, Section 5.2.1.

Because of the administration of the pilot study and subsequent modifications, a new instrument containing 54 questions was prepared called: *The Learning Environment Questionnaire - Assessing Students' Attitudes to Technology* (Appendix K). The results of assessing students' attitudes and teachers' views toward technology interventions and whether an increase in student achievement is noted is discussed in Chapter 5.

# Chapter 5

# Results

## 5.1 Introduction

The purpose of this chapter is to report on the findings as a result of data analysis of the instruments discussed in Chapter 3 and the pilot study in Chapter 4. This chapter also reports on the findings of the qualitative data obtained from interview questions. An examination and comparison of the Regents Living Environment results (Section 5.2) is presented followed by results of students' perceptions of attitude toward technology based on grade level and gender (section 5.3) and an examination of the results of teachers' views of teaching science when technology is implemented (Section 5.4). An examination of results of the *Learning Environment Questionnaire Assessing Students' Attitudes to Technology* is provided (Section 5.5 and 5.6) which investigates the effect of technology on the learning of science in the Regents Living Environment classroom. A discussion examining the results of student interviews using the Survey of Students' Reactions Towards Learning Science in a Technology-Supported Classroom (Section 5.7) are provided. The chapter concludes with a summary (Section 5.8).

## 5.2 Examination of Results as Related to the Research Questions

### *5.2.1* Research Question 1: *Does technology integration in the science classroom improve student achievement on the Living Environment Regents Examination?*

In the 2008-2009 school years, technology resources provided by the district were introduced in a significant way for teachers to share with their students. Teachers began implementing technology into the Regents Living Environment

science curriculum as one of the strategies for learning. As part of the district-wide technology plan, at the start of the 2009-2010 school year, all Regents Living Environment science teachers had access to the Interactive White Board, Castle Learning software and Student Response Systems to make use of at their discretion. Since it was the expectation of the district that teachers implement technology as a strategy to improve teaching and learning, an examination of achievement when implementing technology were necessary. Therefore, students from 11 Regents Living Environment teachers' New York State Regents examination results were compared (Table 5.1) for 2008-2009 and 2009-2010 school years. The comparison was made by subtracting 2009 failures from 2010 failures.

Table 5.1: Comparison of Regents Results by Teacher for School Years Ending 2009 and 2010

| Teacher | 2008-2009 | | | | 2009-2010 | | | | Comparison |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mastery | Average | Fail | N | Mastery | Average | Fail | |
| A | 64 | 43.8% | 54.7% | 1.6% | 62 | 32.3% | 58.1% | 9.7% | - 8.1% |
| B | 69 | 84.1% | 15.9% | 0.0% | 71 | 73.2% | 21.1% | 5.6% | - 5.6% |
| C | 83 | 38.6% | 59.0% | 2.4% | 67 | 13.4% | 73.1% | 13.4% | - 11.0% |
| D | 99 | 48.5% | 51.5% | 0.0% | 73 | 27.4% | 68.5% | 4.1% | - 4.1% |
| E | 93 | 28.0% | 68.8% | 3.2% | 78 | 24.4% | 60.3% | 15.4% | - 12.2% |
| F | 19 | 0.0% | 89.5% | 10.5% | 37 | 40.5% | 40.5% | 18.9% | - 8.4% |
| G | 93 | 33.3% | 65.6% | 1.1% | 56 | 32.1% | 51.8% | 16.1% | - 15.0% |
| H | 17 | 17.6% | 76.5% | 5.9% | 59 | 33.9% | 61.0% | 5.1% | + 0.8% |
| I | 67 | 25.4% | 61.2% | 13.4% | 72 | 23.6% | 65.3% | 11.1% | + 2.3% |
| J | 22 | 4.5% | 81.8% | 13.6% | 39 | 12.8% | 74.4% | 12.8% | + 0.8% |
| K | 15 | 0.0% | 66.7% | 33.3% | 67 | 26.9% | 52.2% | 20.9% | + 12.4% |

As mentioned in Chapter 3, a checklist was included in both students' and teachers' quantitative questionnaires to uncover whether technology provided by the research district for use in school and at home to improve and supplement the learning and achievement of students in the Regents Living Environment science classroom was

noted. Table 5.2 provides the analysis of student reported district-provided technology use by teacher while Table 5.3 and Figure 5.1 present the analysis of teacher reported use of district-provided technology. Table 5.4 provides the analysis of teachers who reported using district provided technology at home and in their classroom and the changes in Regents Examination scores comparing the 2008-2009 and the 2009-2010 school years as related to Table 5.1.

Table 5.2: Student-Reported Teacher Use of District Provided Technologies

| Technology Used | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E-Board to Assign Lessons | 50 | 11 | 25 | 45 | 18 | 24 | 59 | 17 | 0 | 12 | 39 |
| Castle Learning | 10 | 4 | 14 | 4 | 14 | 15 | 27 | 25 | 0 | 29 | 55 |
| SRS- Practice | 0 | 0 | 0 | 0 | 0 | 0 | 59 | 0 | 65 | 19 | 59 |
| SRS - Tests | 0 | 0 | 0 | 0 | 0 | 0 | 59 | 0 | 0 | 4 | 55 |
| DocCam | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 30 |
| IWB- PPT | 90 | 41 | 51 | 55 | 81 | 54 | 59 | 36 | 65 | 24 | 54 |
| IWT - Hands-On | 85 | 33 | 32 | 23 | 50 | 27 | 59 | 36 | 65 | 23 | 52 |
| Video Clips | 100 | 41 | 0 | 41 | 85 | 35 | 59 | 36 | 65 | 28 | 54 |
| Music Video | 0 | 8 | 40 | 2 | 7 | 0 | 17 | 7 | 0 | 4 | 33 |
| Other: Photostory | 0 | 10 | 3 | 0 | 16 | 0 | 59 | 11 | 47 | 8 | 36 |
| Total Number of Students | 100 | 41 | 58 | 94 | 91 | 54 | 63 | 36 | 65 | 30 | 65 |

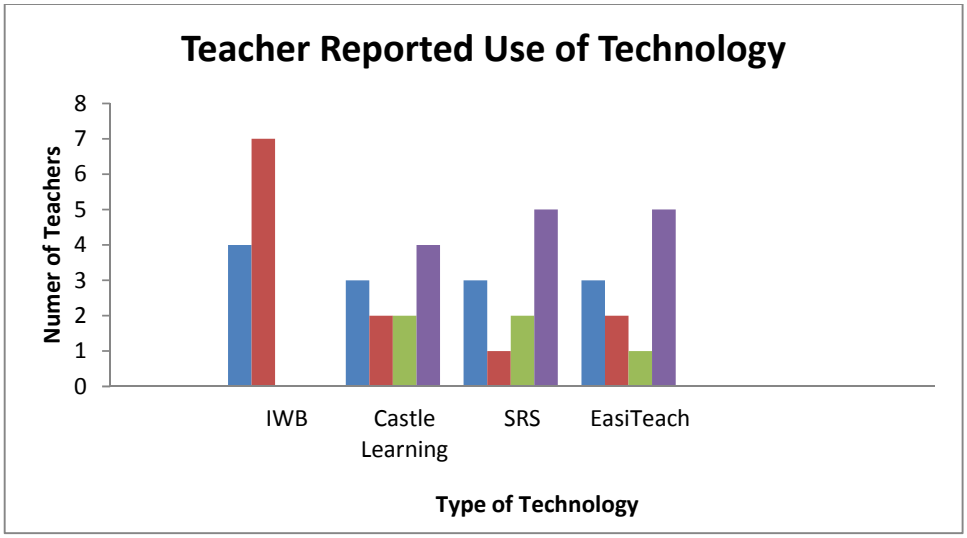


Figure 5.1: Teacher Reported Use of District-Provided Technology

Table 5.3: Teacher Reported Classroom Use of District Provided Technology

| Technology Used | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E-Board to assign lessons | - | - | + | - | - | - | - | + | - | - | + |
| Castle Learning | - | - | - | + | - | - | + | + | - | + | + |
| SRS for test practice | - | - | - | - | - | - | + | - | + | + | + |
| SRS for Tests | - | - | - | - | - | - | - | - | + | - | + |
| Document Camera | - | - | - | - | - | - | - | - | - | - | + |
| IWB for PPT | + | + | + | + | + | + | + | + | + | + | + |
| IWB – hands-on | + | - | + | - | + | + | + | + | + | + | + |
| Video Clips | + | + | + | + | + | - | + | + | + | + | + |
| Music Video | - | - | - | - | - | - | - | - | - | - | + |
| Other: EasiTeach Software | + | - | + | - | - | - | + | + | - | + | + |

(+ means used technology, - means not used)

Table 5.4: Technology Use and Changes in Examination Scores 2008-2009 and 2009-2010

| | Teacher Used the Technology | | Teacher Did Not Use the Technology | |
|---|---|---|---|---|
| | Increased Scores | Decreased Scores | Increased Scores | Decreased Scores |
| IWB | H, I, J, K | A-G | 0 | 0 |
| Castle Learning | H, J, K | D, G | I | A, B, C, E, F |
| SRS | I, J, K | G | 0 | A, B, C, D, E, F, H |
| Other: EasiTeach | H, J, K | A, C, G | I | B, D, E, F |

Teachers instruct students using the same curriculum as indicated under the guidance of the Core Curriculum (Chapter 1, Section 1.3) for the Regents Living Environment science students with variations in their lessons. Naturally, students' levels of aptitude vary from year to year. Issues in attendance affect students' eligibility to meet New York State mandated Regents Examination Requirements as discussed in Chapter 1, Section 1.3; therefore, attendance of students affects their learning and achievement. Additionally, laboratory eligibility (Chapter 1, Section 1.3) also

affects whether students are able to take the Living Environment Regents Examination. In general, the New York State Regents Living Environment Examinations maintain continuity of difficulty level of test questions from year to year. However, as mentioned in Chapter 1, Section 1.3, the tests are continually revised to assess knowledge of the Regents Living Environment curricula in a variety of ways. Questions are pre-tested and piloted for use in future examinations. Wording of questions and concepts being examined may be ambiguous. Misconceptions and difficulty with the way some subject matter is presented to students by teachers may also be an issue.

There is no conclusive evidence to support the contention that those teachers whose students were exposed to increased technology had better test scores. A comparison of the analysis of the 11 Living Environment science teachers Regents Examination test scores showed that of the 11 teachers, only four teachers (36%) had increased test scores. Two of the increases were minimal at 0.8%, one had and 2.3% increase and one had a 12.4% increase.

The four teachers with increased test scores were interviewed to gain understanding into how they utilized technology in their classroom settings. Table 5.3 reports on classroom use of district provided technology and while Table 5.4 describes the change in examination scores between 2008-2009 and 2009-2010 when technology is used. Teacher H, J, and K assigned Castle Learning for homework on a weekly basis. Teacher I did not use Castle Learning. Teacher I, J, and K used SRS for practice tests. Teacher H did not use SRS for test practice or tests. However, Teacher I used SRS as a "Do Now" to assess prior knowledge of the previous day's lesson and to clarify misconceptions from the prior days lesson, and for weekly

practice tests. Teacher J used SRS embedded in her lessons for practice questions and to clarify meaning of material taught. Teacher J did not use SRS for tests.

As noted in comparison of Table 5.2 and Table 5.3, and Figure 5.1, student reported use of district-provided technology and teacher use of district-provided technology do not coincide. In discussion with teachers C, D, and F, it was suggested that perhaps students misread the instructions on the check-list which stated "My teacher uses…Check all that apply" (Figure 3.1). Students may have just checked all technologies they use in school in general. Another reason students and teachers responses may not coincide is that perhaps students were bored at the end of the survey and just checked arbitrary responses.

All students and teachers agreed on 100% use of the Interactive White Board for Presentation Technology (PowerPoint). Nine of 11 teachers reported using the IWB with a hands-on approach - Teachers B and D did not. However, all students said that their teachers used IWB with a hands-on approach. What remains consistent with the literature review in Chapter 2, Section's 2.2.2 and 2.5.1 is that students' qualitative data concurs that they have a positive attitude toward the use of Interactive White Board as it relates to fostering group learning. Additionally, these students are more attentive, interested and find the use of the IWB enjoyable.

An interesting finding regarding district-provided technology shows that 45% of teachers (A, B, C, E and F) who did not use Castle Learning and 100% of teachers (A, B, C, D, E, F, H) who did not use SRS in the classroom had decreased test scores. However, in an analysis of "other technologies" (Table 5.3 and Table 5.4) provided by the district such as the technologies utilized by teachers in the 2009-2010 school year, students' whose teachers used "other technology" had an almost

two to one margin of decreased test scores. These teachers were A, C, G, H, J, and K. Teachers B, D, E, F, and I reported not using other technologies. Included under the grouping of "other technologies" is the EasiTeach software program provided by the district to create lesson on the Interactive White Board. In regards to both students' and teachers responses to the use of Video Clips and Music Videos, the researcher did not ask teachers to specify what type of videos or music they may have provided to increase learning and achievement. Discussion on the findings (Section 6.2) and limitations of the study (Section 6.3) are located in Chapter 6.

As mentioned in Chapter 2, Section 2.2, types of technology used effects student attitude toward that technology when it comes to gender and grade level. As far as gender, males have a more positive attitude when it comes to technology usage than do females. Technology tools made available by the district may not be grade-level appropriate for the Regents Living Environment curriculum, and may not be presented in a fashion that correlates to the make-up of the Living Environment Regents examination. A comparison between males and females passing the New York Regents examination for the two years that the technology program was implemented in the classroom showed no statistical differences (Chi-square = 2.25 ($p = 0.139$ and 3.32 ($p = 0.069$).

As noted in Section 2.5.1, teachers may need more time to effectively incorporate challenging, authentic, real-world collaborative lessons. However, as mentioned in Chapter 2, Section 2.5.1, there is no link to the use of IWB increasing student achievement. An hypothesis that can be made related to technology usage finds that teachers may not have achieved the comfort level (Chapter 2, Section 2.5.3) to incorporate technology successfully into their lessons within the curriculum

and therefore, technology as a strategy for increasing student achievement has not been successful thus far.

### *5.2.2* Research Question 2: *Is there a difference between the attitudes of students toward technology in the Regents Living Environment science classroom based on grade level and gender?*

#### *Grade Level Differences*

One of the aims of the study was to investigate the differences in the responses of students' to the scales of LEQ-ASAT instrument from different grade levels. This was explored by splitting the students in their grade level groups (Year 9 = 85, Year 10 = 435, Year 11 =131, Year 12 = 46). The results of the analyses are shown in Table 5.5. In the data analysis, mean scores for each of the four grade groups were computed. Table 5.5 shows the scale item means and F values of the scales of the LEQ-ASAT instrument based on students' responses from the four grade or year groups in the study. The purpose of this analysis is to establish whether there are significant differences in the perceptions of students according to their grade levels. As can be seen in Table 5.5, the differences in responses of students' on the scales of LEQ-ASAT show that only two scales have statistically significant differences confirming that student attitude towards knowledge of technology changes with grade levels.

The Tukey's *post hoc* test ($p<0.001$) revealed that, students from grade 12 had consistently higher means for both statistically significant LEQ-ASAT scales.

Table 5.5: Item Mean, Item Standard Deviation and Ability to Differentiate Between Levels (ANOVA Results) for Grade Differences in Students' Perceptions Measured by the LEQ-ASAT Instrument

| Scale | | Grade Level | | | | | |
|---|---|---|---|---|---|---|---|
| | | 9th N=85 | 10th N=435 | 11th N=131 | 12th N=46 | F-value | Eta² |
| General Interest in Technology | Mean | 2.85 | 2.96 | 3.00 | 3.04 | 0.87 | 0.00 |
| | St. Dev | 0.82 | 0.73 | 0.82 | 0.69 | | |
| Consequences of Technology | Mean | 3.60 | 3.76 | 3.73 | 3.66 | 1.31 | 0.00 |
| | St. Dev | 0.70 | 0.67 | 0.81 | 0.91 | | |
| Attitude Towards Technology | Mean | 2.79 | 2.68 | 2.60 | 2.67 | 1.56 | 0.00 |
| | St. Dev | 0.61 | 0.63 | 0.70 | 0.71 | | |
| Technology Teaching | Mean | 2.93 | 3.33 | 3.38 | 3.41 | 7.26*** | 0.03*** |
| | St. Dev | 0.86 | 0.75 | 0.80 | 0.84 | | |
| Knowledge of Technology | Mean | 1.42 | 1.71 | 1.72 | 1.61 | 17.39*** | 0.07*** |
| | St. Dev | 0.50 | 0.32 | 0.31 | 0.38 | | |

Total Sample Size = 697 ***$p<0.001$

***Gender Differences***

The associations between the students' perceptions on the scales of the LEQ-ASAT instrument and the gender of the students were analyzed. The gender differences in students' perceptions of attitude to technology were examined by splitting the total number into male (357) and female (340) students involved in the study. To examine the gender differences in students' perceptions of the classes, the within-class gender subgroup mean was chosen as the unit of analysis in order to eliminate the effect of class differences due to males and females being unevenly distributed in the sample. In the data analysis, male and female students' mean scores for each class were computed, and the significance of gender differences in students' perceptions of the Regents Living Environment science classroom culture were analysed using an independent t-test. As can be seen in Table 5.6, the gender differences in the responses of males and females were found to be statistically

significantly different on all the five scales. According to the results, male students generally perceived technology positively.

Gender differences in attitude towards technology were further confirmed by computing the effect sizes for the scales of the LEQ-ASAT instrument, which are in the range of 0.22 for the scale of Knowledge of Technology to 0.77 for the scale of General Interest in Technology, demonstrating medium to high-level differences in two gender attitudes. Cohen (1998) has defined the effect size as being small when $d = 0.2$, medium when $d = 0.5$ and large when $d = 0.8$. Therefore, the results show that males have a greater general interest in technology and prefer teacher use of technology to females. These two scales: General Interest in Technology and Technology Teaching have an effect size with a value of $r>0.37$. Therefore, the data indicates that there are significant differences between male and female student's perception of technology on their learning environment, including consequences of, attitude toward and knowledge of technology.

Table 5.6: Item Mean, Item Standard Deviation and Gender Differences in Students' Perceptions Measured by the LEQ-ASAT instrument

| Scale | Mean | | Standard Deviation | | Difference | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | t | Effect Size (*r*) |
| General Interest in Technology | 3.23 | 2.68 | 0.73 | 0.68 | 10.24*** | 0.77 |
| Consequences of Technology | 3.83 | 3.62 | 0.69 | 0.73 | 3.83*** | 0.29 |
| Attitude Towards Technology | 2.58 | 2.78 | 0.65 | 0.63 | -4.01*** | 0.31 |
| TT Scale | 3.44 | 3.14 | 0.77 | 0.78 | 2.74*** | 0.38 |
| Knowledge of Technology | 1.71 | 1.63 | 0.35 | 0.37 | 5.16*** | 0.22 |

Sample Size = 697(Males =357) and (Females =340) ***p<0.01*

*5.2.3* Research Question 3: *How does the use of technology affect teachers' views of teaching science in the Living Environment science classroom?*

Part of the research study was to obtain teachers' views on the use of technology and teaching in school. The teacher population sampled consisted of 11 Regents Living Environment teachers. The majority of the participants were female 73% (eight teachers) and 27% were males (three teachers). The median age for teachers was 47 years. Seven teachers were between 40 and 60 years of age, while four teachers were between 25 and 40 years of age. All 11 teachers have earned a Master's Degree in teaching.

Table 5.7 provides the results of the teachers' responses to the modified TVTT questionnaire. For Item 1, 100% of teachers agree/strongly agree that computers are valuable tools that can improve the quality of education; they also strongly agree that they need more access (72.7%) to computers (Item 25) for their students in this district. Most teachers (81.8%) strongly agree that they should know how to use computers in their classroom (Item 3) and are not afraid (Item 8) (72.7%) to let their students know that they are still learning. Ninety percent of teachers (Item 15)

strongly agree/agree that they enjoy using new tools for instruction and over 80% agree/strongly agree that they are better teachers with technology (Item 19).

Teachers agree/strongly agree that they need more time to learn to use computers and the Internet (Item 21) (81.8%) and more time to change the curriculum to better incorporate technology (Item 22) (90%). Additionally, teachers agree/strongly agree (90%) that they need more training with technology (Item 23) and that they need more software that is curricular-based (Item 26) (100%). Teachers were evenly divided (36.4% respectively) where they responded agree and strongly agree to the Item 24: "I need more training with curriculum and teaching strategies that integrate technology". However, no teachers strongly agreed with the Item 28: "Student time on the Internet is time well spent," Item 29: "Students learn better with technology," or Item 30: "Technology improves student achievement."

Section 3.5.4 described the modified TVTT instrument. In response to the researcher embedded questions, 81.8% of teachers agree that students learn better with technology (Item 29) and 63.4% agree that technology improves student achievement (Item 30). A full summary of teacher responses is located in Table 5.7.

Table 5.7: Teacher Responses to modified Teachers View of Technology Teaching (TVTT) Results

| | Percentage | | | | |
|---|---|---|---|---|---|
| Item | SD | D | NS | Af | SA |
| 1. Computers are valuable tools that can be used to improve the quality of education. | 0 | 0 | 0 | 27.3 | 72.7 |
| 2. Computers can teach reading. | 0 | 0 | 36.4 | 54.5 | 9.1 |
| 3. Teachers should know how to use computers in their classrooms. | 0 | 9.1 | 0 | 9.1 | 81.8 |
| 4. If there was a computer in my classroom, it would help me be to be a better teacher. | 9.1 | 0 | 0 | 27.3 | 63.6 |
| 5. I would like to have a computer for use in my classroom. | 0 | 0 | 0 | 27.3 | 72.7 |
| 6. I provide individualized instruction to many of my students. | 0 | 18.2 | 0 | 54.5 | 27.3 |
| 7. Cooperative learning works well in my classroom. | 0 | 27.3 | 9.1 | 27.3 | 36.4 |
| 8. I'm not afraid to let my students know I am still learning too. | 0 | 0 | 0 | 27.3 | 72.7 |
| 9. My students feel free to come to me with their problems. | 0 | 0 | 0 | 45.5 | 54.5 |
| 10. My classes act up less than most. | 0 | 0 | 36.4 | 27.3 | 36.4 |
| 11. I believe teachers are appreciated at my school. | 9.1 | 27.3 | 27.3 | 27.3 | 9.1 |
| 12. Teachers get adequate support from the administration. | 36.4 | 54.5 | 9.1 | 0 | 0 |
| 13. Parents support teachers in this school. | 9.1 | 18.2 | 27.3 | 45.5 | 0 |
| 14. I can get most materials that I need. | 18.2 | 18.2 | 9.1 | 54.5 | 0 |
| 15. I enjoy using new tools for instruction. | 0 | 0 | 9.1 | 63.6 | 27.3 |
| 16. I believe that textbooks will be replaced by electronic media within 5 years. | 0 | 18.2 | 27.3 | 27.3 | 27.3 |
| 17. I believe that the roles of schools will be dramatically changed because of the Internet within 5 years. | 0 | 9.1 | 9.1 | 72.7 | 9.1 |
| 18. I believe that the role of the teacher will be dramatically changed because of the Internet within 5 years. | 0 | 18.2 | 18.2 | 54.5 | 9.1 |
| 19. I believe that I am a better teacher with technology. | 0 | 18.2 | 0 | 63.6 | 18.2 |
| 20. I believe that the Internet will help narrow the societal gap between the "haves" and the "have-nots". | 18.2 | 18.2 | 45.5 | 18.2 | 0 |
| 21. I need more time so I can learn to use computers and the Internet. | 0 | 0 | 18.2 | 54.5 | 27.3 |
| 22. I need more time to change the curriculum to better incorporate the technology. | 0 | 0 | 9.1 | 54.5 | 36.4 |
| 23. I need more training with technology. | 0 | 9.1 | 0 | 54.5 | 36.4 |
| 24. I need more training with curriculum and teaching strategies that integrate technology. | 0 | 27.3 | 0 | 36.4 | 36.4 |
| 25. I need access to more computers for my students. | 0 | 0 | 0 | 27.3 | 72.7 |
| 26. I need more software that is curricular-based. | 0 | 0 | 0 | 63.6 | 36.4 |
| 27. I need more technical support to keep the computers working. | 0 | 9.1 | 0 | 72.7 | 18.2 |
| 28. Student time on the Internet is time well spent. | 0 | 18.2 | 45.5 | 36.4 | 0 |
| 29. Students learn better with technology. | 0 | 0 | 18.2 | 81.8 | 0 |
| 30. Technology improves student achievement. | 0 | 0 | 36.4 | 63.4 | 0 |

### *5.2.4 Research Question 4: Are there any relationships between student' and teachers' attitudes toward technology and student achievement in the Regents Living Environment science classroom?*

*Associations between Knowledge of Technology and other Scales of the LEQ-ASAT instrument*

Students' attitude to technology, and how their attitude toward technology affects their knowledge of technology was investigated. Associations between the perceptions of the four scales of the LEQ-ASAT instrument and students' knowledge of technology were explored using simple and multiple correlation analyses. The results of the analyses are shown in Table 5.8. The results of simple correlation analysis indicate that three out of the four scales of the LEQ-ASAT instrument (General Interest in Technology, Consequences of Technology and Technology Teaching) are positively and significantly associated with knowledge scale ($p<0.01$).

The multiple correlations ($R$) between the set of the four scales of the LEQ-ASAT instrument and Knowledge of Technology was 0.39. The $R^2$ values which indicate the proportion of variance in that can be attributed to students' knowledge of technology class was 15%.

To determine which of the scales of the LEQ-ASAT instrument contributed most to this association, the standardized regression coefficient (β) was examined for each scale. It was found that three out of four scales of the LEQ-ASAT instrument retained their significance with Knowledge of Technology. Scales of Consequence of Technology and Technology Teaching were positively associated. On the other hand, Attitude Towards Technology had negative significant association.

Table 5.8: Associations Between the four Scales of the LEQ-ASAT instrument and Knowledge of Technology Scale in terms of Simple Correlations (r), Multiple Correlation (R) and Standardised Regression Coefficient (β)

| Scale | Knowledge of Technology | |
|---|---|---|
| | r | β |
| General Interest in Technology | 0.26** | -0.04 |
| Consequences of Technology | 0.27** | 0.12* |
| Attitude Towards Technology | -0.29** | -0.16*** |
| Technology Teaching | 0.32** | 0.23*** |
| Multiple Correlation | $R$ 0.39<br>$R^2$ 0.15 | |
| $^{**}p<0.01$, $^{***}p<0.001$ | | |

***The LEQ-ASAT instrument – Descriptive Statistics***

Prior to answering the questionnaire, nearly 700 students were asked to respond to the short answer question: "Please give a short description of what you think technology is?" In summary, a large majority of students responded that "technology is computers and electronic" 17%, "technology makes life easier" 14%, "makes life better", "useful", or "advances society and the future" 11%." Eight precent of students states that technology "improves life" and 3% stated that technology is "science."

Following the short answer responses, students were asked a variety of demographic questions regarding their thoughts on the use of technology in their homes. Responses regarding parent's use of technology can be found in Table 5.9. Of those, 357 were males, and 340 were females (Table 5.6). Questions regarding the technological climate in the home dealt with father and mother's jobs, and a computer in the home; 58.2% of respondents stated that their father's job had much

or very much to do with technology (Table 5.10). In contrast, 47.8% of respondents believed that their mother's job had much or very much to do with technology (Table 5.10). An overwhelming of 94% of students stated that they had a personal computer in their home (Table 5.10). Most students stated that they were taking or have taken technology classes and responded positively with 73%. This finding is significant because almost three quarters of students take technology classes.

Table 5.9: The LEQ-ASAT Instrument. Descriptives: Parent use of Technology

| Question | Response % | | | |
|---|---|---|---|---|
| | Nothing | Little | Much | Very Much |
| How much technology your father uses | 13.6 | 28.3 | 31.9 | 26.3 |
| How much technology your mother uses | 21.7 | 3.06 | 28.0 | 19.8 |

When asked if they would choose a technological profession, there is a slight difference between the positive and negative response with the slight majority stating that they would not choose a technological profession 54% (Table 5.10).

Table 5.10: The LEQ-ASAT Instrument: Descriptives: Technological Climate in Students' Homes

| Questions | Response % | |
|---|---|---|
| | Yes | No |
| Do you have a PC | 94 | 6 |
| Will you choose a technological profession | 46 | 54 |
| Are any of your siblings in a technology related profession | 24 | 76 |
| Are you taking or taken technology classes | 73 | 27 |

When asked if any brothers or sisters have a technological profession or are studying for it, the results are consistent with Bame and Dugger (1989) with only

24% stating positively (Table 5.10). As noted by Bame and Dugger (1989), this most likely has to do with the ages of the respondents as 75% are between the ages of 14 and 15 years (in grades 9 and 10) (Table 5.6) and may not have siblings who are much older or working.

*Students' attitude and Teachers' views toward technology and increasing achievement*

The results indicate that both students and teachers have positive attitude and views toward technology. Both students and teachers agree that technology is a valuable tool for learning and that the use of technology in the classroom improves achievement. However, New York State Regents Living Environment examination results do not show a positive relationship with the responses of quantitative and qualitative results of student responses toward the technology- supported science classroom. Only four teachers had increased test scores since the inclusion of technology into the Regents Living Environment science classroom. Two of the four teachers (Teacher J & K) worked collaboratively to incorporate IWB lessons daily into their lessons including hands-on activities using the IWB with a program called Easiteach. Furthermore, these two teachers embedded hyper-links into their lessons, and used Castle Learning. They regularly used SRS in their classrooms. Teacher I used the IWB daily in lessons including hands-on activities using the IWB. This teacher used SRS daily. This teacher also used photostories, and content specific video clips. The final teacher, Teacher H, used IWB daily with Castle Learning and content specific video clips.

## 5.3 Qualitative Data Obtained from Interviews

### *5.3.1 Overview*

As part of Research Question 4, the purpose of interviewing students in the research study was to illicit their attitude toward learning and achievement in a technology-supported classroom. To obtain qualitative data, eleven students were interviewed using the *Survey of Students' Reaction Towards Learning Science In A Technology-Supported Classroom* (Appendix D) interview schedule from an addendum to the modified TROFLEI. A total of twenty questions were asked of each student. As noted in Chapter 3, Section 3.5.4, item 15 was omitted, and the wording on items 5 and 9 were changed from television screen to SmartBoard. A question asking students about whether technology helps them learn better was added. A description of how data from interview items was collected (3.5.4) and representative items (Figure 3.2) are located in Chapter 3. Appendix D provides the interview schedule and a transcription of students' interview responses is located in Appendix F. Interview responses represent a 1.5% sample of the total student population. Students of three different teachers volunteered to be interviewed. There were nine females and two males interviewed. All of the students interviewed were in the grade ten.

### *5.3.2 Results of Student Interviews*

To gain further information in response to Research Question 4, students' attitude toward the learning of science in the technology-supported classroom was examined using the *Survey of Student' Reactions Toward Learning Science In A Technology-Supported Classroom* interview schedule. Ten of eleven students (Item 3) agreed that they were more attentive while learning in a technology-supported

classroom than in the regular classroom. Nine of 11 students responded that they found learning science more interesting (item 1) and they learned science faster (item 2) when technology was used.

When questioning students they were directed to think about the types of technology used in the classroom such as the teacher use of the interactive white board and student response systems. Further, they were asked to consider all types of technology used including those describe in the student/teacher checklist described in section 3.4.5, Figure 3.1. Students were directed to answer "Yes", "No" or "Doubtful" to the questions. If a student didn't understand the word "Doubtful" they were instructed to answer "I don't know." Students were also asked to elaborate on their answer if they chose to do so. A summary of the responses is located in Table 5.11 with a full transcription of student responses is located in Appendix F.

As noted in the research by Gupta (2007), student responses above 60% indicate significance in responses for positive reactions toward a technology-supported science classroom. Results of the students in the research study coincided with results obtained by Gupta (2007). For items 7 and 11, students responded 100% positively in that teaching by the teacher was livelier, and learning was more enjoyable in the technology-supported classroom.

Table 5.11 Summary of Responses: Survey of Students' Reaction Towards Learning Science In A Technology-Supported Classroom

| No. | Item | Yes | % | No | % | Doubtful | % |
|---|---|---|---|---|---|---|---|
| 1 | I found learning science in a technology-supported classroom interesting. | 9 | 82 | 0 | 0 | 2 | 18 |
| 2 | I was able to learn faster through technology-supported classroom. | 9 | 82 | 0 | 0 | 2 | 18 |
| 3 | I was more attentive while learning in technology classroom that what I am in the classroom. | 10 | 91 | 0 | 0 | 1 | 9 |
| 4 | I felt that I was getting better individual attention in the technology-supported classroom. | 8 | 73 | 1 | 9 | 2 | 18 |
| 5 | I could follow the subject matter on the SmartBoard more easily than the text book. | 10 | 91 | 1 | 9 | 0 | 0 |
| 6 | I found remembering facts in science easier after studying in the technology classroom. | 7 | 63 | 3 | 27 | 1 | 0 |
| 7 | I found teaching of science by the teacher to be livelier in technology classroom. | 11 | 100 | 0 | 0 | 0 | 0 |
| 8 | Responses to questions were scored quickly in the technology classroom. | 10 | 90 | 1 | 10 | 0 | 0 |
| 9 | The knowledge of results was very motivating for me to study science in the technology classroom. | 10 | 90 | 0 | 0 | 1 | 10 |
| 10 | The teacher was able to correct my mistakes in an effective manner. | 10 | 90 | 1 | 10 | 0 | 0 |
| 11 | Learning through technology class was an enjoyable activity as compared to regular classroom teaching. | 11 | 100 | 0 | 0 | 0 | 0 |
| 12 | The atmosphere while studying science through the technology classroom was more relaxed than in the regular classroom. | 7 | 63 | 4 | 36 | 0 | 1 |
| 13 | There was a feeling of group learning in the technology classroom than in the regular classroom. | 11 | 100 | 0 | 0 | 0 | 0 |
| 14 | The teacher was more helpful in the technology-supported classroom. | 7 | 63 | 3 | 36 | 1 | 1 |
| 15 | I could revise my lesson better in a technology-supported science classroom. ** | N/A | | | | | |
| 16 | I found the questions asked at the end of the topic easy to answer. | 9 | 81 | 1 | 10 | 1 | 10 |
| 17 | Learning science through technology classroom was very boring. | 0 | 0 | 10 | 90 | 1 | 10 |
| 18 | I was not afraid of answering questions asked on the SmartBoard as compared to when teacher asks questions. | 10 | 90 | 1 | 10 | 0 | 0 |
| 19 | I found learning science through the technology classroom to be a waste of time and effort. | 1 | 10 | 10 | 90 | 0 | 0 |
| 20 | I would look forward to learning science through technology-supported classroom. | 9 | 80 | 1 | 10 | 1 | 10 |

The researcher concluded the interview process by asking students to briefly explain how technology helped or hindered their learning. If students believed technology did not help them learn better, the researcher prompted them to explain why. This last question was added by the researcher in order evaluate the integration of technology in the learning process. One very insightful student stated: "It does help me get better grades, but not sure if technology or teacher." Only one student expressed that they would rather not use technology stating: "I like more natural and hands-on experiences without technology." Student responses generally describe that they like the visual and interactive nature of technology. Interaction with technology and their classmates kept them interested in the subject matter. Regarding the immediacy of using the student response system, one student stated: "I know whether it is right or wrong right away, I don't have to wait for the next day or next class." One student stated: "Technology helps you learn better because learning about science with technology is helping us with our future because we [not only] learn about science, but technology too."

### *5.3.3 Summary of Student Interviews*

In general, students appreciated the interactive and visual nature of the technology provided by the school district. They believed that the interactive nature along with the visual component captured their attention more than just lecture in the science classroom (Items 5 and 18). The group learning aspect (Item 13) in the use of technology tools and SRS kept students all focused on the same activity at the same time. Students believed that they "help each other with what we are learning" and they worked together more like a "team." Regarding the teacher use of technology, seven of 11 students stated that the teacher was more helpful in the

technology-supported classroom (Item 11). Nine students stated they look forward to learning science through the technology-supported classroom (Item 20); one did not, and one stated: "Sometimes, depend on what we were learning; watching a video was boring, but doing research was interesting and helpful." All students thought that their teacher was livelier with technology (Item 7). Ten of eleven students stated that the teacher was able to correct their mistakes effectively (SRS) when using technology (Item 10). One student stated that their teacher "did not use technology for anything that had to be graded," and one student said "if you chose to ask about them." All students stated that the technology-supported classroom was more enjoyable (Item 11).

In response to the researcher added question: Briefly explain how technology helps you learn better. If technology does not help you learn better, please state why, 10 of 11 students interviewed agreed that teacher use of Interactive White Boards, (IWB's) facilitated group learning which helped them learn better. Examples of some responses include: "more group learning with technology...we worked together a lot.... the whole class participated...we worked together like a team," which helped them learn better. Other students felt that the IWB's helped them by directly speaking to them about the question they were answering or information they were learning about. Responses included, "when you go up to the board, it's just you then everyone answers," and, ..."if I got the answer wrong, the teacher would go over it and I feel like she was going over it with me instead of the entire class." A transcription of student responses is located in Appendix F.

Although all of the student responses were positive toward the technology-supported classroom at over 60%, Item 6, "I found remembering facts in science

easier after studying in the technology classroom", Item 12, "The atmosphere while studying science through the technology classroom was more relaxed than in the regular classroom", and Item 14, "The teacher was more helpful in the technology-supported science classroom" only received 63% positive response (<60% or above indicate positive reaction toward technology-supported science classroom). These findings will be discussed in Chapter 6, Section 6.5.2

Results of the interview questions correlate to the literature review and the results of quantitative data insofar as the type of technology used and the way the teacher used the technology had a positive effect on learning science. Students are engaging in 21st century learning regarding collaboration, communication and their belief that technology is a future skill they will need to know about and be familiar with.

However, as noted in Table 5.12, in this study, although the sample was small, females had a more positive attitude toward learning than results of the literature review indicated in Chapter 2, Section 2.2.3. What does correlate with the literature review is the fact that boys are evenly divided and two-thirds of girls respond that technology does not support them when it comes to learning science facts better (Item 6). The findings related to gender differences are located in Chapter 6, Section 6.2.2. Perhaps, it is not the technology, but the subject matter itself that causes difficulty. A discussion of the implications and recommendations are found in Chapter 6.

Table 5.12 Summary of Responses: Survey of Students' Reactions Towards Learning Science In A Technology-Supported Classroom – Results by Gender

| | Yes | | No | | Doubtful (I don't know) | |
|---|---|---|---|---|---|---|
| Question | Male | Female | Male | Female | Male | Female |
| 1. I found learning Science through technology classroom interesting. | 2 | 7 | 0 | 0 | 0 | 2 |
| 2. I was able to learn faster through technology-supported classroom. | 1 | 8 | 0 | 0 | 1 | 1 |
| 3. I was more attentive while learning in technology classroom than when I was in a regular classroom. | 2 | 8 | 0 | 0 | 0 | 1 |
| 4. I felt that I was getting better individual attention in the technology-supported classroom. | 1 | 7 | 0 | 1 | 1 | 1 |
| 5. I could follow the subject matter on the Smart Board more easily than in the textbook. | 2 | 8 | 0 | 1 | 0 | 0 |
| 6. I found remembering facts in science easier after studying in the technology classroom. | 1 | 6 | 0 | 3 | 1 | 0 |
| 7. I found teaching of science by the teacher to livelier in the technology classroom. | 2 | 9 | 0 | 0 | 0 | 0 |
| 8. Responses to questions were scored quickly in the technology classroom. | 2 | 8 | 0 | 1 | 0 | 0 |
| 9. The knowledge of results was very motivating for me to study science in the technology classroom. | 2 | 8 | 0 | 0 | 0 | 1 |
| 10. The teacher was able to correct my mistakes in an effective manner. | 2 | 8 | 0 | 1 | 0 | 0 |
| 11. Learning through technology class was an enjoyable activity as compared to the regular classroom. | 2 | 9 | 0 | 0 | 0 | 0 |
| 12. The atmosphere while studying science through the technology classroom was more relaxed than in the regular classroom. | 1 | 6 | 1 | 3 | 0 | 0 |
| 13. There was a feeling of group learning in the technology classroom than in the regular classroom. | 2 | 9 | 0 | 0 | 0 | 0 |
| 14. The teacher was more helpful in the technology-supported classroom. | 1 | 6 | 0 | 3 | 1 | 0 |
| 15. I could revise my lesson better in a technology-supported science classroom. **Not appropriate for students…they don't revise lessons. | - | - | - | - | - | - |
| 16. I found the questions asked at the end of the topic easy to answer. | 1 | 8 | 0 | 1 | 1 | 0 |
| 17. Learning science through technology classroom was very boring. | 0 | 0 | 2 | 8 | 0 | 1 |
| 18. I was not afraid of answering questions asked on the Smart Board as compared to when the teacher asks questions. | 2 | 8 | 0 | 1 | 0 | 0 |
| 19. I found learning science through the technology to be a waste of time and effort. | 0 | 1 | 2 | 8 | 0 | 0 |
| 20. I would look forward to learning science through technology-supported classroom. | 2 | 7 | 0 | 1 | 0 | 1 |

## 5.4 Summary of the Chapter

An examination of how the data were analysed to support the contention that the instruments are consistent, reliable and valid for the purpose of this research was discussed.

The results of this research attempted to determine whether the technology-supported classroom affects learning and achievement in the Regents Living Environment science classroom in a large suburban school district in the state of New York in the United States of America. In an attempt to identify the effect of technology integration, the results of the Living Environment Regents examination were compared from 2008-2009 to 2009-2010. The results were then compared in an effort to determine if technology integration and the use of district-provided technology improved outcomes by increasing student examination scores on the Living Environment Regents. Quantitative data in response to students' attitude toward and teachers' view of the effect of the technology-supported classroom on learning and achievement were discussed. Findings related to students' perception of the technology-supported classroom based on gender and grade level were presented. Results of qualitative data from student interviews were provided. Chapter 6 reports on the findings, implications and recommendations discovered the outcomes of the study.

# Chapter 6

# Summary of Findings, Implications and Recommendations

## 6.1 Introduction

The present study is concerned with students' attitude and teachers' views toward the infusion of technology in the Regents Living Environment science classroom and the effect on learning and achievement. The main purpose of this chapter is to report on the findings obtained in the research study as discussed in Chapters 4 and 5 (Section 6.2). Limitations of the study are discussed in Section 6.3. A discussion of the implications (Section 6.4) and recommendations (Section 6.5) are provided. The chapter concludes with a summary (Section 6.6).

## 6.2 Main Findings and Discussion

As previously discussed the following key points were summarized in Chapter 2, Section 2.7 and were to be addressed at the conclusion of the research study. These points were as follows:

- 1. A reassessment of the most appropriate ways to assess student achievement with technology without relying on standardized tests must be conducted.
- 2. Increasing the use of technology in the classroom warrants more authentic assessment to assess academic achievement and educators at all levels must begin to identify strategies to address this issue.
- 3. Students and teachers generally respond positively to technology integration into their lessons and believe that technology engages students and motivates students to improve learning.
- 4. Technology integration into the curriculum will continue to pervade classrooms as educators struggle to determine the effects of that integration on academic achievement.

- 5. Determining the most suitable technologies to integrate into the classroom learning environment that is beneficial for academic growth for both gender and grade level will be a significant challenge.
- 6. Integration of appropriate technology to increase student success in 21st century skills in preparation for the workforce is imperative.

These six points will be discussed as they relate to the research questions examined in the study.

### *6.2.1* Research Question 1: *Does technology integration in the science classroom improve student achievement on the Living Environment Regents Examination?*

In the early stages of technology implementation in the research district, only 4 of the 11 teachers examined (36%) had an increase in standardized test scores on the Living Environment Regents examination. Key point one suggests that standardized testing is not the most appropriate way to assess whether technology affects student achievement. The Regents Living Environment Examination does not mirror the technology tools used to practice Regents examination questions. The use of Student Response Systems and Castle Learning to practice test questions is visual and electronic where the Regents Examination is a standardized paper and pencil test. Furthermore, standardized testing does not reflect authentic assessment (Key point 2). Perhaps as was discussed in Section 5.2.2, the aptitude level of students which vary from year to year may impact upon achievement results. As discussed in Chapter 3, Section 3.3.2 attendance issues can impact learning and therefore, although eligible to take the Regents Examination, students may not have had enough consistency in classroom learning on their part. Laboratory ineligibility (Chapter 3, Section 3.3.2) can further impact students taking the examination.

Key point 4 discusses the struggle with technology integration and the effect on academic achievement. This study has grappled with determining the effect of technology integration on academic achievement. As discussed in Chapter 3, Section 3.2, teachers were able to make use of Castle Learning, a technology tool which provides content-related practice tests. Of the 5 teachers who used Castle Learning, 60% saw an increase in their student's test scores. Of the 6 teachers who did not use Castle Learning, 5 teachers or 83% had decreased test scores.

Although it is difficult to determine to what extent the use of Student Response Systems (SRS) affected achievement, what is significant is that 75% of teachers who used SRS in their classroom had increased scores while 100% of teachers who did not use SRS had decreased scores. As noted in the literature review, although SRS systems have a positive effect on student learning, perhaps they are not the most effective technology to implement based on grade level and gender when it comes to improving student achievement. Additionally, as mentioned in Chapter 5, Section 5.2.1, Table 5.3, 100% of teachers reported use of the IWB and 100% of students (Table 5.2) reported that their teacher used the IWB, there is no link to an increase in achievement.

There is only one teacher who had a significant increase (12.4%) in test scores. This teacher used Student Response Systems daily, and in addition to using the Interactive White Board to present lessons on a daily basis, hands-on activities using the IWB were incorporated a variety of on-line activities including educational science video and web-links were embedded into lessons.

Key point 5 addresses the most suitable technology to integrate into the learning environment that is beneficial to academic growth for both gender and grade

level. As mentioned in the literature review, and discussed in Chapter 2, Section 2.2.3, teachers do not necessarily follow International Society for Technology in Education National Educational Technology Standards guidelines for including technology in a significant way into the curriculum. As discussed in Chapter 5, Section 5.2.3, in response to the modified TVTT, teachers believe they need more time and training to implement technology tools into the curriculum. These issues certainly impact upon achieving positive results when it comes to implementing technology strategies effectively.

Although teachers who used technology may not directly increase students' test scores, students' computer literacy would be effectively enhanced. On the other hand, the effect of using technology in classes may not be detected by standardized tests. It is necessary to examine students' achievement by authentic assessment which allows students to demonstrate their knowledge and skills learned from classes taught by using technology. Based on the literature review, the success of students now and in the future will be based on how effectively they can adapt to and apply 21st century learning through the use of technology to collaborate, problem solve and apply critical thinking skills ([P21], 2004).

### *6.2.2* Research Question 2*: Is there a difference between students' attitude toward technology in the Regents Living environment science classroom based on grade level and gender?*

According to the quantitative results, (Chapter 3, Table 5.6) male students generally perceived technology more positively and indicated that they had more interest in technology. However, as mentioned in Chapter 5, Section 5.3, qualitative data on two-thirds of girls reported positive attitudes towards and interest in technology. Although these data are conflicting, the data indicate there are no

significant differences between male and female students' attitude toward technology in improving learning and achievement in the Regents Living Environment science classroom. Conceivably, teachers have the ability to positively affect learning with technology regardless of their students' gender through consistent integration of technology into their lessons and varying types of technologies used. This evidence is supported in the qualitative data found in Chapter 5, Section 5.3.2, which finds that girls have as much as a positive attitude toward technology in helping them learn, and that they find the technology use in the Regents Living Environment classroom to be interesting and that they look forward to learning with technology.

Regarding grade levels, (Chapter 5, Table 5.5) older students (grade 12) were more interested in technology (General Interest in Technology - 3.04), than younger students – grade nine (2.85). Furthermore, grade 12 students had a more positive attitude toward Technology Teaching (Table 5.5). Younger students – grade 9 have the most positive Attitude Towards Technology (2.79). Eleventh graders believe that they have a higher knowledge of technology, with the highest variation of knowledge of technology between 9th and 10th grades (Table 5.5). Results confirm that student attitude towards technology changes with grade levels.

### *6.2.3* Research Question 3: *How does the use of technology affect teachers' views of teaching science in the Regents Living Environment classroom?*

Key point 3 reflects positively in that teachers view technology as a strategy that they can use to enhance learning and improve the quality of education. Furthermore, teachers believe that technology can positively impact learning and achievement as discussed in Chapter 5, Section 5.2.1. Teachers also responded that they enjoy using new tools for instruction (90% Chapter 5, Section 5.2.3). However,

teachers believe that to better infuse technology into their curriculum, they need more training (90% - Table 5.7) to be better able to manage the technology more effectively. Additionally, 75% of teachers agree they need more training with curriculum teaching strategies to better incorporate technology and more curriculum-based software (100%).

Teachers affirm their need to improve their own learning when it comes to technology integration. 100% of the teachers indicated that they are not afraid to let students know they are still learning.

In view of the connection between the 21st century learner and technology as discussed in Chapter 2, Section 2.2.1, only 63% of teachers are of the opinion that they use cooperative learning and it works well in their classroom.

### *6.2.4 Research Question 4 Are there any relationships between students and teachers attitudes toward technology and student achievement in the Regents Living Environment science classroom?*

The LEQ-ASAT instrument was shown to be a valid and reliable instrument for assessing students' attitudes toward technology integration in the classroom. Furthermore, the TVTT was deemed effective in measuring teachers views of technology and its value in teaching and learning. Overall, students and teachers perceived technology positively as a tool for learning now and in the future and student interviews corresponded with these results (Key point 3). Table 5.7 which represents teachers' views on technology in the classroom support the fact those teachers believe that technology improves the quality of education. These results are in agreement with the results of student qualitative data represented in Table 5.11 in Chapter 5. Students responded that they learn faster and are more attentive when

technology was used. Furthermore, 100% of students stated that they found the technology-supported classroom more enjoyable, and 85% of students stated that they look forward to learning science in the technology-supported classroom.

However, there are some discrepancies in the quantitative and qualitative data. Only the scale of Attitude Toward Technology (Chapter 5, Table 5.5) demonstrated negative mean correlation with the other four scales. This result indicates that girls may have an unfavourable attitude or difficulty with technology in the classroom. These results correlate to the qualitative data found in Chapter 5, Table 5.12 in that girls reported that while they have a positive attitude toward technology, they do not believe that it helped them learn science facts better. Conversely, the qualitative data shown in Table 5.10 finds that the school district appears to be providing and using technologies that girls find useful in general in helping them succeed in the science classroom.

Despite positive attitudes toward technology use by both students and teachers to improve learning and achievement, the results of the Living Environment Regents Examination indicated that only 36% of teachers had an increase in achievement on their examination scores since the implementation of technology in 2008. Reasons for the variation in results are discussed in the following section on limitations.

## 6.3 Limitations

Limitations of the study were introduced in Chapter 3, Section 3.7. Some students take the Living Environment Regents science course in the eighth grade. As per the request of the administration at the school district, those students' and teachers' responses to the integration of technology in the science Regents Living Environment classroom and Regents Living Environment examination grades were

excluded. Furthermore, because of the variability in learning needs and specialized Individual Education Programs (IEP's) Special Education students were also excluded. This additional data may have shown that technology integration shows promise in increased examination scores for younger students and students with specialized learning needs.

Due to time constraints, three classes of students at the high school did not provide data for the research study. One teacher stated that one of his classes was behind in the curriculum, and he did not want the students in that class to be diverted away from their studies. One teacher had technological difficulty with two of her classes during her assigned time to complete the questionnaire. Unfortunately, these classes were unable to be rescheduled as the laptop cart used by the science department must be shared between the eleven teachers. Teachers were not only using the laptop cart to participate in the study, but for their curriculum lessons as well.

In regards to the interview sample, it is unfortunate that the end of school year came upon the researcher quickly and therefore, a greater number of students were not recruited to participate in the interview process. In retrospect, the researcher should have organized several volunteers from each of the eleven teachers' classes and engaged more teachers to employ more students to participate in the interview process.

In response to the District-Specific Technology Usage Checklist for Students and Teachers in Chapter 3, Figure 3.1, neither students nor teachers were asked to report on the type of video that was used in their classes. In response to Castle Learning (Chapter 3, Section 3.2), neither teachers nor students were asked how

often they used or were assigned (respectively) assignments. Perhaps the frequency with which this tool is used may have had an impact on achievement.

With regard to Presentation Technology, 100% of students reported that their teacher used the IWB for PowerPoint. Teachers were not asked what type of content-based activities or lessons they embedded into their PowerPoint's to engage their students in with the use of the IWB.

An analysis of the use of the Student Response Systems (SRS) as indicated in Chapter 5, Section 5.2.1 noted that 100% of teachers who did not use SRS had decreased test scores, while 75% of teachers who used SRS had increased test scores.

As noted in Chapter 1, Section 1.3, teachers are teaching the Core Curriculum for their Living Environment Regents science class, however, they use their own discretion on how to present or teach the material. This is the same case for the integration of technology. While teachers have the availability of technology and may implement that technology into their lessons, it is at their own discretion. This coincides with the literature review of technology in Chapter 2, Section 2.3 in that while teachers may have access to and knowledge of the technology available to them, they may not make the most use of or integrate that technology effectively into their curriculum in a way that improves learning and achievement in the Living Environment Regents science classroom.

## 6.4 Implications

This study has suggested that presently, technology integration in the Regents Living Environment science classroom in one school district in New York State in

the United States of America has not improved student achievement on the standardized test for the Living Environment Regents science course.

If policy makers and educators aspire to construct a 21st century learning environment, then changes must continue to be made which include overhauling the use of standardized testing with pencil and paper. Teachers are employing technology into their lessons and curriculum including infusing technological tools, while assessment of student knowledge remains outdated (Chapter 2, Section 2.2.1). Technology tools which teachers use to teach their lessons and perhaps even assess student learning and achievement such as using SRS do not coincide with the way students are assessed according to state and federal guidelines using paper and pencil standardized testing (Chapter 1, Section 1.3). Key point 2 relates to this issue insofar as increasing the use of technology into the classroom warrants more authentic assessment to assess academic achievement and not just rely on paper and pencil tests. Furthermore, teachers may not be taking advantage of employing technology that is effective for increasing learning and achievement if they believe they need more time and training to implement technology effectively into their curriculum.

Key point 3 suggests that students and teachers generally have a positive attitude toward technology. The research conducted in this study supports the contention that both students and teachers believe technology is an engaging and motivating strategy to improve learning and achievement in the Regents Living Environment science classroom. However, the research conducted in this study does not show a positive relationship toward technology use and improved student achievement in the Regents Living Environment science classroom. As educational institutions are continuing to immerse technology into their district, technologies

must be evaluated for efficacy based on gender and grade levels. Teachers must be given time to make use of educational technology in an effort to determine which technological tools would most benefit their students in terms of increased learning and achievement. Teachers must be provided time to investigate technology for age appropriateness and that the technology used promotes assimilation of higher-order thinking skills. Furthermore, technology integration must be used consistently across all grade levels.

As teachers begin to understand more about the variety of technology available to them, they can in-turn educate their students who although may be more adept (in some cases) regarding the latest technologies, may not be proficient in determining which technologies would benefit their learning and achievement.

It is imperative that school administrators provide teachers with sufficient time for training on the integration of technology into their curriculum and the particular types of technology tools that would help them increase learning and achievement. As noted in Chapter 2, Section 2.2, the effective use of technology by teachers supports student learning and achievement. For Key point 4, the use of Interactive White Boards has the potential to increase learning and achievement while meeting the guidelines of 21$^{st}$ century learning if utilized more efficiently and effectively by teachers to embed collaborative science learning activities into the curriculum. Furthermore, Key point 4 suggests that educators must re-assess the way they evaluate and assess student achievement based on standardized tests. If educators continue to integrate technology into the learning environment, then the use of SRS to increase and assess achievement deserves merit. Since teachers agree, and students concur that technology improves student learning and achievement, school

districts and administrators must make available time for teachers to work collaboratively in assimilating technology and technology teaching strategies into their lessons and into curriculum. Results confirm that student attitude toward technology changes with grade levels and that technologies used must be age appropriate while assimilating higher-order thinking skills. Furthermore, technology integration must be used across all grade levels. Since the financial investment in technology is substantial, choices of which technology to make use of must be considered in terms of grade level and gender for teachers to have a greater impact on learning when using technology tools. To that end, the effect of the integration of technology into the science classroom would have more positive results on student learning and in all probability; achievement would be more positively affected.

## 6.5 Recommendations

### *6.5.1 Recommendations for Teaching*

Going forward, the revalidated instrument *The Learning Environment Questionnaire- Assessing Students' Attitude to Technology* may be used by educators to assess how students perceive their learning environment in terms of their attitude to technology when it is integrated into the curriculum. Interested teachers and school districts can use this information to identify the effect of technology integration on student learning and achievement in the science classroom in an effort to bring about the desired changes in the educational system.

Furthermore, as mentioned in Chapter 2, Sections 2.2.1 and 2.3, teaching students to use technology in a way that benefits their learning is part of a change teachers must make in order to synthesize 21$^{st}$ century learning into their curriculum. Changing teachers beliefs regarding the effectiveness of the use of technology in

terms of helping their students learn and achieve will bring about the necessary changes in pedagogy through the infusion of technology into the curriculum.

If school districts incorporate National Educational Technology Standards for Students and National Educational Technology Standards for Teachers ETS-S and NETS-T guidelines into their core curriculum more efficiently, this knowledge would contribute valuable information in terms of the types of technology being utilized and how it affects student learning and achievement by grade level and gender. Teachers need to be part of the active decision making process within their schools to best implement strategies and technology tools that are available in their subject areas that meet the learning needs of both males and females. Administrators need to allow time for teachers to collaborate and develop lessons within their curricula that maximize technology integration. By affording ample time toward lesson development teachers will be able to effectively make the most use of technology available to them within their districts. While this task may seem dubious, because school administrators may not provide teachers time to collaborate, or provide enough training time on technology, the inherent results would improve student learning and achievement. In terms of meeting the objective of 21st century learning, Key point 6, communication, collaboration, critical thinking, creativity and technological literacy within the learning environment will improve for students as teachers infuse technology into their curriculum.

### *6.5.2 Recommendations for Future Research*

As the education system in the United States of America begins the immersion of implementing electronic achievement testing and phasing out traditional paper and pencil tests, more studies are necessary to make a correlation in terms of how

technology can be used to improve achievement, and the best technology tools to implement across grade levels. One suggestion is to see how teachers use technology through classroom observations. The information gathered could correlate the improvement of students' achievement and the reason, which may cause the instructional effect on students' achievement.

As noted in Section 5.3.3, Items 6, 12, and 13 only received 63% positive results for the science content material, atmosphere, and teacher helpfulness respectively. These results correlate the literature review in Chapter 2, Section 2.2 in terms of the use of technology in the science classroom learning environment and the effective use of technology that best supports learning and achievement in the science classroom. More robust studies would be warranted to examine the science classroom learning environment when technology is infused into the curriculum.

Furthermore, as discussed in Chapter 2, Section 2.4, creating assessments of achievement that incorporate more authentic assessment such as performing scientific experiments and applying scientific concepts in a virtual setting rather than assessing student knowledge via paper and pencil testing will be instrumental as technology-mediated learning in science pervades the educational system.

Educational technology designers and providers would benefit from investigating students' attitude towards technology in terms of gender when constructing new technology tools. This investment would facilitate gender inclusiveness and would maximize learning by investigating which technology tools and strategies would be effective in achieving positive learning goals and outcomes without unintended bias.

## 6.6 Summary

Technology is not a panacea for improving learning and achievement, but if used effectively technology can be a vehicle in a teacher's toolbox that helps to engage and motivate students. Findings from both quantitative and qualitative data reflect that students' and teachers' respond positively to the use of technology in the Living Environment science classroom. In the research district studied, positive improvement has been noted in closing the gender-gap in the attitude of females toward learning with technology. Further investigation is warranted in terms of making a connection between the use of technology and improved student achievement. Consequently, discovering how best to incorporate technology and effectively utilize technology to realize the optimum effect on student learning and achievement must continue to be explored within the research district. Effective use of and increasing achievement with district-provided technology will remain on-going as technology pervades the research district studied and teachers discover the best ways to incorporate technology into their lessons.

As educational policy changes to include globalizing learning to prepare students to enter the workforce through communication, collaboration, creativity, innovation and using critical thinking skills, phasing in varieties of technology to improve student learning and achievement within their scope of learning is an ambitious task. Changes in teaching and pedagogy must reflect these future trends by eliminating standardized testing as the sole indicator of achievement and approach to moving to the next grade level. Technology is an effective tool to promote more authentic assessment as a way to measure student success and

therefore learning and achievement in a more universal way to prepare students for the real world they will be facing.

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# Appendix A: Pupils' Attitude Towards Technology (PATT- USA)

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## PUPILS' ATTITUDE TOWARDS TECHNOLOGY

Developed by: Virginia Tech - Technology Education and Eindhoven University, The Netherlands

We are interested in your opinion on technology. Therefore, we would like you to answer some questions on this subject. This is not a test. There are no right or wrong answers. You are not to be graded on this. Do not take too much time for one question. You should only need about 25 minutes for the whole questionnaire. The first set of questions are about you so we can get to know you better. These are followed by statements about technology. Indicate to what extent you agree or disagree with them. In the last set of statements you only have to indicate agree, disagree or don't know.


Please give a short description of what you think technology is:

WRITE ONLY INSIDE THIS BLOCK



USE NO. 2 PENCIL ONLY

WRONG 1 (A) (B) (N) (TD) (D)
WRONG 2 (A) (X) (N) (TD) (D)
WRONG 3 (A) (SA) (N) (TD) (D)
RIGHT 4 (A) (●) (N) (TD) (D)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Are you a boy or a girl? | 1. (B) Boy (G) Girl | | | | | | | | |
| 2. | How old are you? | 2. (12) or younger (13) (14) (15) (16) or older | | | | | | | | |
| 3. | What is your grade in school? | 3. (6) (7) (8) | | | | | | | | |
| 4. | If your father has a job, indicate to what extent it has to do with technology. | 4. (VM) (M) (L) (N) | | | | | | | | |
| 5. | If your mother has a job, indicate to what extent it has to do with technology. | 5. (VM) (M) (L) (N) | | | | | | | | |
| 6. | Do you have technical toys, like Tinkertoy, Erector Set or LEGO at home? | 6. (Y) Yes (N) No | | | | | | | | |
| 7. | Is there a technical workshop in your home? | 7. (Y) Yes (N) No | | | | | | | | |
| 8. | Is there a personal computer in your home? | 8. (Y) Yes (N) No | | | | | | | | |
| 9. | Do you think you will choose a technological profession? | 9. (Y) Yes (N) No | | | | | | | | |
| 10. | Do you have brothers or sisters that have a technological profession or that are studying for it? | 10. (Y) Yes (N) No | | | | | | | | |
| 11. | Are you taking or have you taken Technology Education/Industrial Arts? | 11. (Y) Yes (N) No | | | | | | | | |

| | | Very Much | Much | Little | Nothing | AGREE | TEND TO AGREE | NEUTRAL | TEND TO DISAGREE | DISAGREE |
|---|---|---|---|---|---|---|---|---|---|---|
| 12. | When something new is discovered, I want to know more about it immediately. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 13. | Technology is as difficult for boys as it is for girls. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 14. | Technology is good for the future of this country. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 15. | To understand something of technology you have to take a difficult training course. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 16. | At school you hear a lot about technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 17. | I will probably choose a job in technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 18. | I would like to know more about computers. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 19. | A girl can very well have a technological job. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 20. | Technology makes everything work better. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 21. | You have to be smart to study technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 22. | I would not like to learn more about technology at school. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 23. | I like to read technological magazines. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 24. | A girl can become a car mechanic. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 25. | Technology is very important in life. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 26. | Technology is only for smart people. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 27. | Technology lessons are important. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 28. | I will not consider a job in technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 29. | There should be less TV and radio programs about technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 30. | Boys are able to do practical things better than girls. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 31. | Everyone needs technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 32. | I would rather not have technology lessons at school. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 33. | I do not understand why anyone would want a job in technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 34. | If there was a school club about technology I would certainly join it. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 35. | Girls are able to operate a computer. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 36. | Technology has brought more good things than bad. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 37. | You have to be strong for most technological jobs. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 38. | Technology at home is something schools should teach about. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 39. | I would enjoy a job in technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 40. | I think visiting a factory is boring. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 41. | Boys know more about technology than girls do. | | | | | (A) | (TA) | (N) | (TD) | (D) |
| 42. | The world would be a better place without technology. | | | | | (A) | (TA) | (N) | (TD) | (D) |

Over Please

43. To study technology you have to be talented. ..... 43 (A) (TA) (N) (TD) (D)
44. I should be able to take technology as a school subject. ..... 44 (A) (TA) (N) (TD) (D)
45. I would like a career in technology later on. ..... 45 (A) (TA) (N) (TD) (D)
46. I am not interested in technology. ..... 46 (A) (TA) (N) (TD) (D)
47. Boys are more capable of doing technological jobs than girls. ..... 47 (A) (TA) (N) (TD) (D)
48. Using technology makes a country less prosperous. ..... 48 (A) (TA) (N) (TD) (D)
49. You can study technology only when you are good at both mathematics and science. ..... 49 (A) (TA) (N) (TD) (D)
50. There should be more education about technology. ..... 50 (A) (TA) (N) (TD) (D)
51. Working in technology would be boring. ..... 51 (A) (TA) (N) (TD) (D)
52. I enjoy repairing things at home. ..... 52 (A) (TA) (N) (TD) (D)
53. More girls should work in technology. ..... 53 (A) (TA) (N) (TD) (D)
54. Technology causes large unemployment. ..... 54 (A) (TA) (N) (TD) (D)
55. Technology does not need a lot of mathematics. ..... 55 (A) (TA) (N) (TD) (D)
56. Technology as a subject should be taken by all pupils. ..... 56 (A) (TA) (N) (TD) (D)
57. Most jobs in technology are boring. ..... 57 (A) (TA) (N) (TD) (D)
58. I think machines are boring ..... 58 (A) (TA) (N) (TD) (D)
59. Girls prefer not to go to a technical school. ..... 59 (A) (TA) (N) (TD) (D)
60. Because technology causes pollution, we should use less of it. ..... 60 (A) (TA) (N) (TD) (D)
61. Everybody can study technology. ..... 61 (A) (TA) (N) (TD) (D)
62. Technology lessons help to train you for a good job. ..... 62 (A) (TA) (N) (TD) (D)
63. Working in technology would be interesting. ..... 63 (A) (TA) (N) (TD) (D)
64. A technological hobby is boring. ..... 64 (A) (TA) (N) (TD) (D)
65. Girls think technology is boring. ..... 65 (A) (TA) (N) (TD) (D)
66. Technology is the subject of the future. ..... 66 (A) (TA) (N) (TD) (D)
67. Everybody can have a technological job. ..... 67 (A) (TA) (N) (TD) (D)
68. Not everyone needs technology lessons at school. ..... 68 (A) (TA) (N) (TD) (D)
69. With a technological job your future is promised. ..... 69 (A) (TA) (N) (TD) (D)

**FROM NOW ON YOU ONLY HAVE THREE CHOICES:**

| | AGREE | DISAGREE | DON'T KNOW |
|---|---|---|---|
| 70. When I think of technology I mostly think of computers. ..... | 70. (A) | (D) | (DK) |
| 71. I think science and technology are related. ..... | 71. (A) | (D) | (DK) |
| 72. In technology, you can seldom use your imagination. ..... | 72. (A) | (D) | (DK) |
| 73. I think technology has little to do with our energy problem. ..... | 73. (A) | (D) | (DK) |
| 74. When I think of technology, I mostly think of equipment. ..... | 74. (A) | (D) | (DK) |
| 75. To me technology and science are the same. ..... | 75. (A) | (D) | (DK) |
| 76. In my opinion, technology is not very old. ..... | 76. (A) | (D) | (DK) |
| 77. In technology, you can think up new things. ..... | 77. (A) | (D) | (DK) |
| 78. Working with information is an important part of technology. ..... | 78. (A) | (D) | (DK) |
| 79. Technology is as old as humans. ..... | 79. (A) | (D) | (DK) |
| 80. Elements of science are seldom used in technology. ..... | 80. (A) | (D) | (DK) |
| 81. You need not be technological to invent a new piece of equipment. ..... | 81. (A) | (D) | (DK) |
| 82. Technology has a large influence on people. ..... | 82. (A) | (D) | (DK) |
| 83. I think technology is often used in science. ..... | 83. (A) | (D) | (DK) |
| 84. Working with your hands is part of technology. ..... | 84. (A) | (D) | (DK) |
| 85. In everyday life, I have a lot to do with technology. ..... | 85. (A) | (D) | (DK) |
| 86. In technology, there is little opportunity to think up things yourself. ..... | 86. (A) | (D) | (DK) |
| 87. Science and technology have nothing in common. ..... | 87. (A) | (D) | (DK) |
| 88. The government can have influence on technology. ..... | 88. (A) | (D) | (DK) |
| 89. I think the conversion of energy is also part of technology. ..... | 89. (A) | (D) | (DK) |
| 90. In technology, you use tools. ..... | 90. (A) | (D) | (DK) |
| 91. Technology is meant to make our life more comfortable. ..... | 91. (A) | (D) | (DK) |
| 92. When I think of technology, I mainly think of computer programs. ..... | 92. (A) | (D) | (DK) |
| 93. Only technicians are in charge of technology. ..... | 93. (A) | (D) | (DK) |
| 94. Technology has always to do with mass production. ..... | 94. (A) | (D) | (DK) |
| 95. In technology, there are less opportunities to do things with your hands. ..... | 95. (A) | (D) | (DK) |
| 96. Working with materials is an important part of technology. ..... | 96. (A) | (D) | (DK) |
| 97. Technology has little to do with daily life. ..... | 97. (A) | (D) | (DK) |
| 98. When I think of technology I mainly think of working with wood. ..... | 98. (A) | (D) | (DK) |
| 99. Technology can mainly be found in industry. ..... | 99. (A) | (D) | (DK) |
| 100. There is a relationship between technology and science. ..... | 100. (A) | (D) | (DK) |

## Appendix B: Technology Teaching - Modified TROFLEI Items (8 items 65-72)

**SECTION B (Continued)**

| | | ACTUAL | | | | | PREFERRED | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SN | EQ | Almost Never | Seldom | Some times | Often | Almost Always | Almost Never | Seldom | Some times | Often | Almost Always |
| 49 | The teacher gives as much attention to my questions as to other students' questions. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 50 | I get the same amount of help from the teacher as do other students. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 51 | I have the same amount of say in this class as other students. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 52 | I am treated the same as other students in this class. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 53 | I receive the same encouragement from the teacher as other students do. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 54 | I get the same opportunity to contribute to class discussions as other students. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 55 | My work receives as much praise as other students' work. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 56 | I get the same opportunity to answer questions as other students. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| SN | DI | Almost Never | Seldom | Some times | Often | Almost Always | Almost Never | Seldom | Some times | Often | Almost Always |
| 57 | I work at my own speed. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 58 | Students who work faster than me move onto the next topic. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 59 | I am given a choice of topics. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 60 | I am given tasks that are different from other students' tasks. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 61 | I am given work that suits my ability. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 62 | I use different materials from those used by other students. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 63 | I am assessed in a different manner from other students. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 64 | I do work that is different from other students' work. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| SN | T T | Almost Never | Seldom | Some times | Often | Almost Always | Almost Never | Seldom | Some times | Often | Almost Always |
| 65 | I find learning science in the technology classroom interesting. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 66 | I am able to learn faster through the technology classroom. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 67 | I am more attentive in the technology classroom. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 68 | I find the technology supported science class to be lively. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 69 | I am able to get additional information and update my knowledge in the technology classroom. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 70 | I find the audio and visual effects in the content matter to be appealing. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 71 | I am motivated to learn further in the technology classroom. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 72 | I look forward to learning science through technology classroom. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |

# Appendix C: Teachers' View of Technology and Teaching (TVTT)

Instructions: select one for each item to indicate how you feel.

SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Computers are valuable tools that can be used to improve the quality of education. | SD | D | U | A | SA |
| 2 | Computers can teach reading. | SD | D | U | A | SA |
| 3 | Teachers should know how to use computers in their classrooms. | SD | D | U | A | SA |
| 4 | If there was a computer in my classroom, it would help me to be a better teacher. | SD | D | U | A | SA |
| 5 | I would like to have a computer for use in my classroom. | SD | D | U | A | SA |
| 6 | Someday I will have a computer in my home. | SD | D | U | A | SA |
| 7 | I provide individualized instruction to many of my students. | SD | D | U | A | SA |
| 8 | Cooperative learning works well in my classroom. | SD | D | U | A | SA |
| 9 | I'm not afraid to let my students know I am still learning, too. | SD | D | U | A | SA |
| 10 | My students feel free to come to me with their problems. | SD | D | U | A | SA |
| 11 | My classes act up less than most. | SD | D | U | A | SA |
| 12 | I believe teachers are appreciated at my school. | SD | D | U | A | SA |
| 13 | Teachers get adequate support from the administration. | SD | D | U | A | SA |
| 14 | Parents support teachers in this school. | SD | D | U | A | SA |
| 15 | I can get most materials that I need. | SD | D | U | A | SA |
| 16 | I enjoy using new tools for instruction. | SD | D | U | A | SA |
| 17 | I believe that textbooks will be replaced by electronic media within 5 years. | SD | D | U | A | SA |
| 18 | I believe that the roles of schools will be dramatically changed because of the Internet within 5 years. | SD | D | U | A | SA |
| 19 | I believe that the role of the teacher will be dramatically changed because of the Internet within 5 years. | SD | D | U | A | SA |
| 20 | I believe that I am a better teacher with technology. | SD | D | U | A | SA |
| 21 | I believe that the Internet will help narrow the societal gap between the "haves" and the "have-nots". | SD | D | U | A | SA |
| 22 | I need more time so I can learn to use computers and the Internet. | SD | D | U | A | SA |
| 23 | I need more time to change the curriculum to better incorporate the technology. | SD | D | U | A | SA |
| 24 | I need more training with technology. | SD | D | U | A | SA |
| 25 | I need more training with curriculum and teaching strategies that integrate technology. | SD | D | U | A | SA |
| 26 | I need access to more computers for my students. | SD | D | U | A | SA |
| 27 | I need access to the Internet. | SD | D | U | A | SA |
| 28 | I need more software that is curricular-based. | SD | D | U | A | SA |
| 29 | I need more technical support to keep the computers working. | SD | D | U | A | SA |
| 30 | Student time on the Internet is time well spent. | SD | D | U | A | SA |

## Appendix D: Survey of Students' Reactions Towards Learning Science in a Technology-Supported Classroom

1) I found learning Science through technology classroom interesting.
Yes/No/Doubtful.

2) I was able to learn faster through technology-supported classroom.
Yes/No/Doubtful.

3) I was more attentive while learning in technology classroom that what I am in the classroom. Yes/No/Doubtful.

4) I felt that I was getting better individual attention in the technology-supported classroom. Yes/No/Doubtful.

5) I could follow the subject matter on the television screen easily than the text book.
Yes/No/Doubtful

6) I found remembering facts in science easier after studying in the technology classroom. Yes/No/Doubtful

7) I found teaching of science by the teacher to be livelier in technology classroom.
Yes/No/Doubtful

8) Responses to questions were scored quickly in the technology classroom.
Yes/No/Doubtful

9) The knowledge of results was very motivating for me to study science in the technology classroom Yes/No/Doubtful

10) The teacher was able to correct my mistakes in an effective manner.
Yes/No/Doubtful

11) Learning through technology class was an enjoyable activity as compared to regular classroom. Yes/No/Doubtful

12) The atmosphere while studying science through the technology classroom was more relaxed than in the regular classroom. Yes/No/Doubtful

13) There was a feeling of group learning in the technology classroom than in the regular classroom. Yes/No/Doubtful

14) The teacher was more helpful in the technology-supported classroom. Yes/No/Doubtful

15) I could revise my lesson better in a technology-supported science classroom. Yes/No/Doubtful

16) I found the questions asked at the end of the topic easy to answer. Yes/No/Doubtful

17) Learning science through technology classroom was very boring. Yes/No/Doubtful

18) I was not afraid of answering questions asked on the television screen as compared to when teacher asks questions. Yes/No/Doubtful

19) I found learning science through the technology classroom to be a waste of time and effort. Yes/No/Doubtful

20) I would look forward to learning science through technology-supported classroom. Yes/No/Doubtful

# Appendix E: Modified Teachers' View of Technology in Teaching (modified TVTT)

Instructions: select one for each item to indicate how you feel.

SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Computers are valuable tools that can be used to improve the quality of education. | SD | D | U | A | SA |
| 2 | Computers can teach reading. | SD | D | U | A | SA |
| 3 | Teachers should know how to use computers in their classrooms. | SD | D | U | A | SA |
| 4 | If there was a computer in my classroom, it would help me to be a better teacher. | SD | D | U | A | SA |
| 5 | I would like to have a computer for use in my classroom. | SD | D | U | A | SA |
| 6 | I provide individualized instruction to many of my students. | SD | D | U | A | SA |
| 7 | Cooperative learning works well in my classroom. | SD | D | U | A | SA |
| 8 | I'm not afraid to let my students know I am still learning, too. | SD | D | U | A | SA |
| 9 | My students feel free to come to me with their problems. | SD | D | U | A | SA |
| 10 | My classes act up less than most. | SD | D | U | A | SA |
| 11 | I believe teachers are appreciated at my school. | SD | D | U | A | SA |
| 12 | Teachers get adequate support from the administration. | SD | D | U | A | SA |
| 13 | Parents support teachers in this school. | SD | D | U | A | SA |
| 14 | I can get most materials that I need. | SD | D | U | A | SA |
| 15 | I enjoy using new tools for instruction. | SD | D | U | A | SA |
| 16 | I believe that textbooks will be replaced by electronic media within 5 years. | SD | D | U | A | SA |
| 17 | I believe that the roles of schools will be dramatically changed because of the Internet within 5 years. | SD | D | U | A | SA |
| 18 | I believe that the role of the teacher will be dramatically changed because of the Internet within 5 years. | SD | D | U | A | SA |
| 19 | I believe that I am a better teacher with technology. | SD | D | U | A | SA |
| 20 | I believe that the Internet will help narrow the societal gap between the "haves" and the "have-nots". | SD | D | U | A | SA |
| 21 | I need more time so I can learn to use computers and the Internet. | SD | D | U | A | SA |
| 22 | I need more time to change the curriculum to better incorporate the technology. | SD | D | U | A | SA |
| 23 | I need more training with technology. | SD | D | U | A | SA |
| 24 | I need more training with curriculum and teaching strategies that integrate technology. | SD | D | U | A | SA |
| 25 | I need access to more computers for my students. | SD | D | U | A | SA |
| 26 | I need more software that is curricular-based. | SD | D | U | A | SA |
| 27 | I need more technical support to keep the computers working. | SD | D | U | A | SA |
| 28 | Student time on the Internet is time well spent. | SD | D | U | A | SA |
| 29 | Students learn better with technology.** | SD | D | U | A | SA |
| 30 | Technology improves student achievement.** | | | | | |

*Item 6 and 27 deleted from original.
**Items 29 and 30 are researcher-added items.

## Appendix F: Transcription of Student Responses to Survey of Students' Reactions Towards Learning Science In A Technology-Supported Classroom Interview Schedule

1. **I found learning Science through technology classroom interesting.**

   Male: Yes, it allows students to be more inter-active in the lesson.

   Female: I guess it's interesting, depends on exactly what we are doing; I don't really know…my learning is the same either way…if I am more interested I might learn better.

   Female: Yes, I did.

   Female: Yes

   Female: Yes, I think it helps make things much easier, especially in Science, like you use microscopes and stuff.

   Female: I agree

   Female: I disagree; technology doesn't have to do with natural things.

   Female: Yes

   Female: Yes, you are more involved in what you are doing

   Male: Yes

2. **I was able to learn faster through technology-supported classroom.**

   Male: I do not know because I have nothing to compare it with.

   Female: I don't really know.

   Female: Yes, I found it more interesting.

   Female: Yes

   Female: Easier and quicker; like short videos describing it better and showing you things.

   Female: Yes

   Female: It does teach us a lot

   Female: Yes, because you have to interact with what you're doing, so you are actually doing things. I could see what was actually right or wrong and the teacher would go over it.

Female: I was able to learn faster because the demonstrations on the board help me understand better, instead of the teacher doing it one-on – one with me, I was able to connect sooner.

Male: Yes, because there's more resources for us to use to explain everything.

**3. I was more attentive while learning in technology classroom than when I was in a regular classroom.**

Male: Yes, the lesson is more vivid, detailed, and more visual.

Female: Sometimes, yeah, more interesting visual makes me more attentive.

Female: I would be bored without technology, technology is fun, Smart Board is fun, and I can participate in lesson and get more involved.

Female: Yes

Female: Yes, because sometimes you are allowed to up and interact with things, you can learn better and more exciting.

Female: Yes, because it's faster and easier to understand

Female: I don't know

Female: Yes

Female: Well, it's a cool board, a new technology; everyone wants to look at it instead of a regular chalkboard.

Male: Yes, because it is more interesting, it caught my attention my than just reading out of a textbook.

**4. I felt that I was getting better individual attention in the technology-supported classroom.**

Male: If you choose to have attention drawn to you

Female: I guess so, I can go to the board and click on things…challenges you more.

Female: When you go up to the board it's just you and then everyone answers

Female: Yes, because when we do the boards and the individual things like the pop-quiz, it's more individualized.

Female: Yes, you get to act one-on-one on your own answering certain things, and I felt that helped me.

Female: Yes

Female: Can't give your own opinion

Female: Yes, because if I got the answer wrong the teacher would go over it and I feel like she was going over it with me instead of the entire class.

Female: I felt like it was more directed toward me because I was able to understand it better.

Male: Yes, because the teacher had more time to individually talk to everyone.

**5. I could follow the subject matter on the Smart Board more easily than in the textbook.**

Male: Yes, as opposed to a textbook which is rather dull, the Smart Board is a little more action.

Female: Textbook really boring gives you more notes, than having to read and pick out what's important.

Female: I find it more interesting.

Female: Yes, because it is right in front of the classroom, I don't have to look down.
You tell me where everything is and its right in front of the board. I like visuals. More individual to myself.

Female: Yes, because it gets right to the point, in textbooks, it's a whole bunch of stuff you confuse easier.

Female: Yes, because the teacher would explain it and the textbook uses more complicated words.

Female: I can, I think a textbook is better with more information, but sometimes technology is better.

Female: Yes, I don't like to read, I would rather do it on the board, it makes you think more, and if I sit with a textbook I feel bored.

Female: Definitely. They are both good resources, but the smart board is easier; a textbook has a lot more, but with the new technology these days it is easier to find what you are looking for.

Male: Yes, because you could do a lot more with it; Power Points, easier explaining, and interacting with everyone; more interactive and hands on.

**6. I found remembering facts in science easier after studying in the technology classroom.**

Male: I don't know because I have nothing to compare it with.

Female: Yeah, pictures help you memorize better, seeing it helps you.

Female: Yes, when having fun, people want to remember it.

Female: I don't like reading out of textbooks and papers, I'm more a computer person.

Female: Yes, it's easier studying with technology in Science; it gets more to the point.

Female: No.

Female: I don't think so

Female: I don't think it really mattered; I got the same information

Female: Yes, it was easier, in the classroom, you put it up, and it's easier.

Male: Yes, easier to keep in my head.

**7. I found teaching of science by the teacher to livelier in the technology classroom.**

Male: Yes, more movement, getting into the lesson, Smart Board as a safety net.

Female: Yeah, I guess, I don't know how to explain it.

Female: You are lively either way!

Female: Yes, always up in front of classroom and entertaining.

Female: He shows us what to do using the technology during the science lesson.

Female: Yes

Female: Not so much

Female: Yes

Female: I think so, yeah

Male: Yes, she made it more fun and just a lot easier to learn.

**8. Responses to questions were scored quickly in the technology classroom.**

Male: I'd say yes.

Female: Sometimes I like doing it on paper better, on clicker; I focus more on the time than on the question.

Female: Yes.

Female: Yes.

Female: True

Female: Yes

Female: Yes, I did like that

Female: It was the same

Female: Yes, because everyone want to go up and touch the board.

Male: Yeah

**9. The knowledge of results was very motivating for me to study science in the technology classroom.**

Male: Yes.

Female: Yes, knowing I got the question right helps me and I want to see how the next question was.

Female: Yes it was, you want to try harder, it helps me because next time I see it I know the answer.

Female: Yes, I think the clickers are fun because it's on the board and no-one knows if you get it wrong, you don't get embarrassed, if you get it right you feel good right away. You went over it right away.

Female: Yes, it's quicker, I feel like when it's quicker, it's easier for me.

Female: Did not use clickers; no test taking using technology

Female: I liked using the clickers.

Female: Yes.

Female: I do a lot better with the technology, so it encourages me to do more at home.

Male: I got the answers more quickly, then it helped me if I didn't know it, I needed to know what I needed to go home and study

**10. The teacher was able to correct my mistakes in an effective manner.**

Male: If I so chose to ask about them.

Female: Yes, you would go over it and why it was right or wrong.

Female: Yes, yes! Technology on clickers is fun, so I want to do it better than pencil and paper, I feel more stressed, I get bored quicker.

Female: Yes.

Female: Yes, helps me study and understand what we are learning better.

Female: Teacher did not use technology for anything that had to be graded

Female: Yes, she would talk about it right after and it helped because I learn what my mistake was and understand it more.

Female: She was more effective when using technology because she can see firsthand which students are getting what wrong, and instead of looking over papers, it's hard to do with a whole class what is being done.

Female: Yes, because, it was easier when I went up and she saw that I was doing it wrong, so then she knew right away what was wrong.

Male: Yes, because it showed what you got wrong right away and she could help you.

**11. Learning through technology class was an enjoyable activity as compared to the regular classroom.**

Male: Certainly. It inquires more to the lesson, better visuals.

Female: I'd say so, more interaction.

Female: Very, the questions wouldn't be as fun without technology.

Female: Yes.

Female: Yes, it's more enjoyable, more exciting and easier, keeps my attention better, microscopes, Smart Board, you interact…

Female: Sometimes, like when we are doing worksheets and going on line, you can have a partner.

Female: It was fun.

Female: Yes, I don't like just sitting in a classroom reading in a textbook or a worksheet, it's better to attract the entire class with every child in every classroom. I like videos with quizzes, fill in blank notes, touching and interacting with the Board.

Female: Definitely more fun

Male: Yes, a lot more fun this year than last year, and I like Science a lot more this year.

**12. The atmosphere while studying science through the technology classroom was more relaxed than in the regular classroom.**

Male: No difference.

Female: About the same.

Female: I was more motivated to participate.

Female: Yes, the regular classroom is sitting being bored, I get stressed all the time; technology helps you remember more things.

Female: About the same.

Female: About the same.

Female: Technology makes you more relaxed, but some people don't pay attention especially if the lights go out, the teacher can see that better.

Female: Yes

Female: Yes, the lights get turned off and it's more mellow, but you are still doing work

Male: Yes, it was relaxing, it makes me feel at home and more comfortable and easier to learn.

**13. There was a feeling of group learning in the technology classroom than in the regular classroom.**

Male: Yes. All students were given the same visuals as every other student and all do the same thing and ask the same questions, more interactive.

Yes: I think so.

Female: Yes, whole class participated.

Female: Yes, we worked together a lot; I prefer working in a group better.

Female: Yes, because we all discuss things in a group when we use technology and it is more helpful to me.

Female: Yes, because you get to know people and help each other with what we are learning.

Female: More group learning without technology

Female: Yes

Female: I think that you are not individually working like in a textbook, and that everybody is focused on one thing at the same time and we are all doing it like a team.

Male: Yes, everyone could interact and give opinions.

**14. The teacher was more helpful in the technology-supported classroom.**

Male: Not sure.

Female: Yes, if something would come up, pictures, you tell us what it is hearing it quickly helps me understand.

Female: Yes.

Female: Yes. Because she walks around and corrects us; instantaneous corrections.

Female: Yes, more helpful, directly explains instead of waiting

Female: No, not really

Female: She was helpful both ways.

Female: Same

Female: Yea, she has to do it on the Smart Board and we are all looking at her at the same time.

Male: Yes, more stuff for her to use and explain everything.

**15. I could revise my lesson better in a technology-supported science classroom. **Not appropriate for students…they don't revise lessons.**

**16. I found the questions asked at the end of the topic easy to answer.**

Male: I do not know, depends on topic.

Female: I don't really think so.

Female: Yes.

Female: Yes.

Female: Yes

Female: Yes

Female: Easy, at the end helped me review

Female: Yes

Female: I think so because when we learn something, we are going over the questions multiple times and it's easier because we are all paying attention.

Male: Yes, because we got to review more because we got done faster.

**17. Learning science through technology classroom was very boring.**

Male: No, it was exciting, I'd say.

Female: No.

Female: No.

Female: No

Female: No

Female: No

Female: I see no point to it…you can go on line and see new things, but I would rather not.

Female: No

Female: No, it was fun

Male: No

**18. I was not afraid of answering questions asked on the Smart Board as compared to when the teacher asks questions.**

Male: Yes, I was more comfortable answering questions with the Smart Board…I do not know why…a sense of security…the visuals helped better…all senses of learning.

Female: Answer erased.

Female: I love answering questions either way.

Female: Yeah, it's easier to answer on Smart Board, sometimes the Smart Board helps me remember; when I see it it's easier.

Female: I wasn't afraid, it is easier when I use the Smart Board, you can go up and interact on your own.

Female: Teacher didn't use this

Female: I wasn't afraid.

Female: No, not afraid at all. It's hard to answer questions on the spot. But if someone got it right it's so easy to say well, I got picked that too, why is it wrong. I like the group learning.

Female: I don't think I was scared, I am fine answering questions, a little nervous going up to the board.

Male: It was easier, I felt more comfortable with the Smart Board.

**19. I found learning science through the technology to be a waste of time and effort.**

Male: HAHAHAHA…NO!

Female: Answer erased.

Female: No.

Female: No.

Female: No

Female: Helpful to me; laptops, Smart Board, did not touch Smart Board, no questions in the lessons using the Smart Board, just asked them out loud, did not touch the board

Female: It depends, if it doesn't work and isn't loaded correctly, yes.

Female: No

Female: No, because it's going toward our education which is a big goal in the end.

Male: Not at all

**20. I would look forward to learning science through technology-supported classroom.**

Male: Of course.

Female: Answer erased.

Female: Yes.

Female: Yes.

Female: Yes

Female: Sometimes, depend on what we were learning; watching a video was boring, but doing research was interesting and helpful.

Female: No, Science is about nature, and not technology, I like going outdoors.

Female: Yes

Female: Yes

Male: Yes

**Researcher Added Question:**

**Briefly explain how technology helps you learn better. If technology does not help you learn better, please state why.**

**Male:** Going back to all senses of learning, helps you tap into whichever learning is subject to you. If you like visual, you can watch, if you like kinaesthetic, you can go touch the board…More involved in lesson, more engaged. It does help me get better grades, but not sure if technology or teacher.

**Female:** Answer erased.

**Female:** No, I think it helps me, it gets you interested, it makes you focus more, if you have games, it gets you more involved, review games and lessons, watching and doing the lesson. Doing something helps a lot like watching and doing quizzes.

**Female:** It helps us better, Smart Board and computers, and it shows us more visually and gets into a persons' mind better, than sometimes lecturing can be boring, I don't like many lectures, I am more visual…say and see at the same time. I like the interaction. Science is all up on the board, if I don't understand I can research on the computer, if I know whether its right or wrong right away, I don't have to wait for the next day or the next class.

**Female:** Technology helps me learn better, it's a quicker way, it's more exciting, it helps you interact, it keeps you having fun so you are interested in it more, you are interested in what you are learning about instead of it being boring, interacting is much more better.

**Female:** It helps me learn better, I am not only learning about the technology, but the subject as well, and you can work with other people and be more social and improve your grade, and do group work and encourage each other to do better.

**Female:** I would rather not using technology, I liked brain pop and clickers, but I would prefer to be more natural and hands on experience without technology.

**Female:** It does help me learn better because I can interact and when I interact it like, imprints on my brain quicker and I remember things rather than reading I get very bored from the textbook easily and I don't realize that I am reading something and I should know it and when we are doing clickers it is so much easier to learn.

**Female:** Technology helps you learn better because it's like the future so like when we are getting older technology is getting better and us learning about technology in school is helping us with our future, so like learning about science with technology is easier because as we grow up we will learn about technology too. Technology benefits my learning, the more we use technology, the more I will learn about technology. I am more attentive.

**Male:** I think it does because if one thing doesn't work, you can always go to another thing, like the Smart Board, different programs, software and lessons and a lot more options. I learn better with hands on.

# Appendix G: Learning Environment Questionnaire – Assessing Students' Attitude To Technology (LEQ-ASAT) – 77 items

| **77 ITEM PATT-USA**<br><br>**Interest in Technology** | | AGREE | TEND TO AGREE | NEUTRAL | TEND TO DISAGREE | DISAGREE |
|---|---|---|---|---|---|---|
| 12 | When something new is discovered, I want to know more about it immediately. | 5 | 4 | 3 | 2 | 1 |
| 16 | In school you hear a lot about technology. | 5 | 4 | 3 | 2 | 1 |
| 17 | I will probably choose a job in technology. | 5 | 4 | 3 | 2 | 1 |
| 18 | I would like to know more about computers. | 5 | 4 | 3 | 2 | 1 |
| 22 | I would not like to learn more about technology at school. | 5 | 4 | 3 | 2 | 1 |
| 23 | I like to read technological magazines. | 5 | 4 | 3 | 2 | 1 |
| 28 | I will not consider a job in technology. | 5 | 4 | 3 | 2 | 1 |
| 32 | I would rather not have technology lessons at school. | 5 | 4 | 3 | 2 | 1 |
| 34 | If there was school club about technology I would certainly join it. | 5 | 4 | 3 | 2 | 1 |
| 38 | Technology at home is something schools should teach about. | 5 | 4 | 3 | 2 | 1 |
| 39 | I would enjoy a job in technology. | 5 | 4 | 3 | 2 | 1 |
| 44 | I should be able to take technology as a school subject. | 5 | 4 | 3 | 2 | 1 |
| 45 | I would like a career in technology later on. | 5 | 4 | 3 | 2 | 1 |
| 46 | I am not interested in technology. | 5 | 4 | 3 | 2 | 1 |
| 50 | There should be more education about technology. | 5 | 4 | 3 | 2 | 1 |
| 52 | I enjoy repairing things at home. | 5 | 4 | 3 | 2 | 1 |
| 56 | Technology as a subject should be taken by all pupils. | 5 | 4 | 3 | 2 | 1 |
| 63 | Working in technology would be interesting. | 5 | 4 | 3 | 2 | 1 |
| 69 | With a technological job your future is promised. | 5 | 4 | 3 | 2 | 1 |
| **Technology As An Activity for Girls and Body** | | | | | | |
| 13 | Technology is as difficult for boys as it is for girls. | 5 | 4 | 3 | 2 | 1 |
| 19 | A girl can very well have a technological job. | 5 | 4 | 3 | 2 | 1 |
| 24 | A girl can become a car mechanic. | 5 | 4 | 3 | 2 | 1 |
| 30 | Boys are able to do practical things better than girls. | 5 | 4 | 3 | 2 | 1 |
| 35 | Girls are able to operate a computer. | | | | | |
| 41 | Boys know more about technology than girls do. | 5 | 4 | 3 | 2 | 1 |
| 53 | More girls should work in technology. | 5 | 4 | 3 | 2 | 1 |
| 59 | Girls prefer not to go to a technical school. | 5 | 4 | 3 | 2 | 1 |
| **Consequences of Technology** | | | | | | |
| 14 | Technology is good for the future of this country. | 5 | 4 | 3 | 2 | 1 |
| 20 | Technology makes everything work better. | 5 | 4 | 3 | 2 | 1 |
| 25 | Technology is very important in life. | 5 | 4 | 3 | 2 | 1 |
| 31 | Everybody needs technology. | 5 | 4 | 3 | 2 | 1 |
| 36 | Technology has brought more good things than bad. | 5 | 4 | 3 | 2 | 1 |
| 62 | Technology lessons help train you for a good job. | 5 | 4 | 3 | 2 | 1 |
| 66 | Technology is the subject of the future. | 5 | 4 | 3 | 2 | 1 |
| | **Technology is Difficult** | | | | | |
| 21 | You have to be smart to study technology. | 5 | 4 | 3 | 2 | 1 |
| 43 | To study technology you have to be talented. | 5 | 4 | 3 | 2 | 1 |
| 49 | You can study technology only when you are good at mathematics and science. | 5 | 4 | 3 | 2 | 1 |
| | | 5 | 4 | 3 | 2 | 1 |
| 61 | Everybody can study technology. | 5 | 4 | 3 | 2 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Attitude Towards Technology** | | | | | |
| 27 | Technology lessons are important. | 5 | 4 | 3 | 2 | 1 |
| 29 | There should be less TV and radio programs about technology. | 5 | 4 | 3 | 2 | 1 |
| 33 | I do not understand why anyone would want a job in technology. | 5 | 4 | 3 | 2 | 1 |
| 40 | I think visiting a factory is boring. | 5 | 4 | 3 | 2 | 1 |
| 48 | Using technology makes a country less prosperous. | 5 | 4 | 3 | 2 | 1 |
| 51 | Working in technology would be boring. | 5 | 4 | 3 | 2 | 1 |
| 54 | Technology causes large unemployment. | 5 | 4 | 3 | 2 | 1 |
| 57 | Most jobs in technology are boring. | 5 | 4 | 3 | 2 | 1 |
| 58 | I think machines are boring. | | | | | |
| 60 | Because technology causes pollution, we should use less of it. | | | | | |
| 64 | A technological hobby is boring. | | | | | |
| 68 | Not everybody needs technology lessons at school. | | | | | |
| **Modified TROFLEI WITH DISTRICT-SPECIFIC ITEMS** | | | | | | |
| 1 | I find learning science in the technology classroom interesting | 5 | 4 | 3 | 2 | 1 |
| 2 | I am able to learn faster through the technology classroom | 5 | 4 | 3 | 2 | 1 |
| 3 | I am more attentive in the technology classroom | 5 | 4 | 3 | 2 | 1 |
| 4 | I find the technology supported science class to be lively. | 5 | 4 | 3 | 2 | 1 |
| 5 | I am able to get additional information and update my knowledge in the technology classroom | 5 | 4 | 3 | 2 | 1 |
| 6 | I find the audio and visual effects in the content matter to be appealing | 5 | 4 | 3 | 2 | 1 |
| 7 | I am motivated to learn further in the technology classroom. | 5 | 4 | 3 | 2 | 1 |
| 8 | I look forward to learning science through the technology classroom. | 5 | 4 | 3 | 2 | 1 |
| 9 | My teacher uses technology in his/her lessons. | 5 | 4 | 3 | 2 | 1 |
| 10 | Our school is doing a good job of putting technology into the classroom | 5 | 4 | 3 | 2 | 1 |
| 11 | Technology improves my understanding of science. | 5 | 4 | 3 | 2 | 1 |
| 12 | Using technology in science improves my grades | 5 | 4 | 3 | 2 | 1 |

| **Knowledge of Technology** | | Agree | Disagree | Don't Know |
|---|---|---|---|---|
| 71 | I think science and technology are related | 2 | 1 | 0 |
| 77 | In technology, you can think up new things | 2 | 1 | 0 |
| 78 | Working with information is an important part of technology | 2 | 1 | 0 |
| 79 | Technology is as old as humans | 2 | 1 | 0 |
| 82 | Technology has a large influence on people | 2 | 1 | 0 |
| 83 | I think technology is often used in science | 2 | 1 | 0 |
| 84 | Working with hands is part of technology | 2 | 1 | 0 |
| 85 | In everyday life, I have a lot to do with technology | 2 | 1 | 0 |
| 88 | The government can have influence on technology | 2 | 1 | 0 |
| 89 | I think the conversion of energy is also a part of technology | 2 | 1 | 0 |
| 90 | In technology, you use tools | 2 | 1 | 0 |
| 91 | Technology is meant to make our life more comfortable | 2 | 1 | 0 |
| 96 | Working with materials is an important part of technology | 2 | 1 | 0 |
| 100 | There is a relationship between technology and science | 2 | 1 | 0 |

## Appendix H: Curtin University Science and Mathematics Education Centre Principal Information Letter

# Curtin University of Technology
# Science and Mathematics Education Centre
# Principal Information Sheet

April 14, 2010

Dear Principal:

My name is Lisa Incantalupo, and as you know, I am a teacher in your building. I am also a graduate student completing my PhD at Curtin University of Technology. In partial fulfilment of my studies, it is necessary for me to complete a research study. I respectfully request to administer the enclosed questionnaires to the Living Environment teachers and their students in your building.

**Purpose of the Research**

My intent is to investigate teachers and students attitudes toward technology integration in their classrooms, and the effect of technology on student achievement. Furthermore, I am seeking to discover to what extent school based technology is used at home and its effect on student achievement. I would be glad to provide you with a summary of the results of the surveys so that you may share them with your teachers. The results of the survey will reveal both teachers' and students' attitudes toward technology integration in the classroom as well as uncover whether or not the implementation of technology is having an effect on student achievement in the Living Environment classroom.

**Consent to Participate**

I realize that you, your staff, and students have schedules that are very full of work to accomplish, but I hope the 30 minutes that it will take to complete the surveys on-line will benefit the district, teachers, and students and will be valuable in discovering the effect that technology integration is having on student achievement.

**Confidentiality**

The information does not require students' and teachers' personal details, and only myself and my supervisor will have access to the data. Interview transcripts will not have any name or any other identifying information on it and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least five years, before a decision is made as to whether it should be destroyed.

**Further Information**

This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number **SMEC-05-10**). Thank you in advance for your participation. If you have any questions, please contact me. I am prepared to administer my surveys immediately, and would like to be done with collecting my data by June 1, 2010. I hope that you and your staff can accommodate this request. Thank you in advance for your participation

Sincerely,

Lisa P. Incantalupo

cc: Science Department Chairperson

## Appendix I: Curtin University Science and Mathematics Education Centre Teacher Information Letter

# Curtin University of Technology
# Science and Mathematics Education Centre
# Teacher Information Sheet

April 14, 2010

Dear Colleagues:

**Purpose of Research**

My name is Lisa Incantalupo, and as you know, I am a teacher in your building. I am also a graduate student completing my PhD at Curtin University of Technology. In partial fulfilment of my studies, it is necessary for me to complete a research study.

**Your Role**

I respectfully request your assistance in completing the questionnaire "Teachers' Views of Technology and Teaching." Furthermore, I respectfully request your cooperation in having your students complete the questionnaires titled Pupils Attitude Toward Technology (PATT – USA), and Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI). The results of the surveys will reveal both teachers' and students' attitudes toward technology integration in the classroom as well as investigate whether or not the implementation of technology is having an effect on student achievement in the Living Environment classroom. I would be glad to provide you with a summary of results.

**Consent to Participate**

I realize that you, your staff, and students have schedules that are very full of work to accomplish, but I hope the 30 minutes that it will take to complete the surveys will benefit the district, teachers, and students and will be valuable in discovering the effect that technology integration is having on student achievement.

**Confidentiality**

The information does not require students' and teachers' personal details, and only myself and my supervisor will have access to the data. Interview transcripts will not have any name or any other identifying information on it and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least five years, before a decision is made as to whether it should be destroyed.

**Further Information**

This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number **SMEC-05-10**). Thank you in advance for your participation. If you have any questions, please contact me. I am prepared to administer my surveys immediately, and would like to be done with collecting my data by June 1, 2010. I hope that you and your staff can accommodate this request. Thank you in advance for your participation

Sincerely,

Lisa P. Incantalupo

cc: Science Department Chairperson

## Appendix J: Curtin University Science and Mathematics Education Centre Parent and Student Information Letter


# Curtin University of Technology
# Science and Mathematics Education Centre
# Parents' Information Sheet

April 14, 2010

Dear Parents, Guardians, and Students,

**Purpose of Research**

My name is Lisa Incantalupo, and I am a Living Environment teacher at the high school. I am a graduate student completing my PhD at Curtin University of Technology. In partial fulfilment of my studies, it is necessary for me to complete a research study.

**Your Role**

I respectfully request to administer a questionnaire to your child who is currently enrolled in the Living Environment course at our school. In addition to asking your child to participate in the research study, their teachers are participating as well. My intent is to investigate teachers' and students' attitudes toward technology integration in their classrooms, and the effect of technology on student achievement. Furthermore, I am seeking to investigate to what extent school based technology is used at home and its effect on student achievement. I would be glad to provide you with a summary of the results of the surveys so that you may share them with your student. Hopefully the results of the survey will reveal both teachers' and students' attitudes toward technology integration in the classroom as well as uncover whether or not the implementation of technology is having an effect on student achievement in the Living Environment classroom.

**Consent to Participate**

I realize that your student has a full schedule that is chock-full of work to accomplish, but I hope the 30 minutes that it will take to complete the surveys on-line will benefit the district, teachers, and students and will be valuable in discovering the effect that technology integration is having on student achievement.

**Confidentiality**

The information does not require students' and teachers' personal details, and only myself and my supervisor will have access to the data. Interview transcripts will not have any name or any other identifying information on it and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least five years, before a decision is made as to whether it should be destroyed.

**Further Information**

This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number **SMEC-05-10**). If you have any questions, please contact me. I am prepared to administer my surveys immediately, and would like to be done with collecting my data by June 1, 2010. I hope that you and your staff can accommodate this request. Thank you in advance for your participation

Sincerely,

Lisa P. Incantalupo

cc: Science Department Chairperson

# Appendix K: Learning Environment Questionnaire – Assessing Students' Attitude to Technology (LEQ-ASAT) – 54 Items

| | INTEREST IN TECHNOLOGY | AGREE | TEND TO AGREE | NEUTRAL | TEND TO DISAGREE | DISAGREE |
|---|---|---|---|---|---|---|
| 1 | I will probably choose a job in technology | 5 | 4 | 3 | 2 | 1 |
| 2 | I would like to know more about computers | 5 | 4 | 3 | 2 | 1 |
| 3 | I like to read technological magazines | 5 | 4 | 3 | 2 | 1 |
| 4 | If there was a school club about technology I would certainly join it | 5 | 4 | 3 | 2 | 1 |
| 5 | I would enjoy a job in technology | 5 | 4 | 3 | 2 | 1 |
| 6 | I should be able to take technology as a school subject | 5 | 4 | 3 | 2 | 1 |
| 7 | I would like a career in technology later on | 5 | 4 | 3 | 2 | 1 |
| 8 | There should be more education about technology | 5 | 4 | 3 | 2 | 1 |
| 9 | I enjoy repairing things at home | 5 | 4 | 3 | 2 | 1 |
| 10 | Technology as a subject should be taken by all pupils | 5 | 4 | 3 | 2 | 1 |
| 11 | Working in technology would be interesting | 5 | 4 | 3 | 2 | 1 |
| 12 | With a technological job your future is promised | 5 | 4 | 3 | 2 | 1 |
| | **CONSEQUENCES OF TECHNOLOGY** | | | | | |
| 1 | Technology is good for the future of this country | 5 | 4 | 3 | 2 | 1 |
| 2 | Technology makes everything work better | 5 | 4 | 3 | 2 | 1 |
| 3 | Technology is very important in life | 5 | 4 | 3 | 2 | 1 |
| 4 | Everyone needs technology | 5 | 4 | 3 | 2 | 1 |
| 5 | Technology has brought more good things than bad | 5 | 4 | 3 | 2 | 1 |
| 6 | Technology lessons help you to train for a job | 5 | 4 | 3 | 2 | 1 |
| 7 | Technology is the subject of the future | 5 | 4 | 3 | 2 | 1 |
| | **ATTITUDE TOWARDS TECHNOLOGY** | | | | | |
| 1 | You have to be smart to study technology | 5 | 4 | 3 | 2 | 1 |
| 2 | I do not understand why anyone would want a job in technology | 5 | 4 | 3 | 2 | 1 |
| 3 | To study technology you have to be talented | 5 | 4 | 3 | 2 | 1 |
| 4 | You can study technology only when you are good at both mathematics and science | 5 | 4 | 3 | 2 | 1 |
| 5 | Using technology makes a country less prosperous | 5 | 4 | 3 | 2 | 1 |
| 6 | Working in technology would be boring | 5 | 4 | 3 | 2 | 1 |
| 7 | Most jobs in technology are boring | 5 | 4 | 3 | 2 | 1 |
| 8 | I think machines are boring | 5 | 4 | 3 | 2 | 1 |
| 9 | A technological hobby is boring | 5 | 4 | 3 | 2 | 1 |
| | **TECHNOLOGY TEACHING** | | | | | |
| 1 | I find learning science in the technology classroom interesting | 5 | 4 | 3 | 2 | 1 |
| 2 | I am able to learn faster through the technology classroom | 5 | 4 | 3 | 2 | 1 |
| 3 | I am more attentive in the technology classroom | 5 | 4 | 3 | 2 | 1 |
| 4 | I find the technology supported science class to be lively. | 5 | 4 | 3 | 2 | 1 |
| 5 | I am able to get additional information and update my knowledge in the technology classroom | 5 | 4 | 3 | 2 | 1 |
| 6 | I find the audio and visual effects in the content matter to be appealing | 5 | 4 | 3 | 2 | 1 |
| 7 | I am motivated to learn further in the technology classroom. | 5 | 4 | 3 | 2 | 1 |
| 8 | I look forward to learning science through the technology classroom. | 5 | 4 | 3 | 2 | 1 |
| 9 | My teacher uses technology in his/her lessons. | 5 | 4 | 3 | 2 | 1 |
| 10 | Our school is doing a good job of putting technology into the classroom | 5 | 4 | 3 | 2 | 1 |
| 11 | Technology improves my understanding of science. | 5 | 4 | 3 | 2 | 1 |
| 12 | Using technology in science improves my grades | 5 | 4 | 3 | 2 | 1 |

| KNOWLEDGE OF TECHNOLOGY | Agree | | Disagree Don't Know |
|---|---|---|---|
| I think science and technology are related | 2 | 1 | 0 |
| In technology, you can think up new things | 2 | 1 | 0 |
| Working with information is an important part of technology | 2 | 1 | 0 |
| Technology is as old as humans | 2 | 1 | 0 |
| Technology has a large influence on people | 2 | 1 | 0 |
| I think technology is often used in science | 2 | 1 | 0 |
| Working with hands is part of technology | 2 | 1 | 0 |
| In everyday life, I have a lot to do with technology | 2 | 1 | 0 |
| The government can have influence ontechnology | 2 | 1 | 0 |
| I think the conversion of energy is also a part of technology | 2 | 1 | 0 |
| In technology, you use tools | 2 | 1 | 0 |
| Technology is meant to make our life more comfortable | 2 | 1 | 0 |
| Working with materials is an important part of technology | 2 | 1 | 0 |
| Thereis a relationship between technology and science | 2 | 1 | 0 |