EXPLORING CLASSROOM TECHNOLOGY: THE ENGAGEMENT OF ABORIGINAL STUDENTS IN A 1:1 WIRELESS LAPTOP PROGRAM

by

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Abstract

In this research, I explored 1:1 computing with Grade 4 and 7 Nisga'a School District students over a one-year period. Using the BC Performance Standards, I examined writing samples from 14 students, when they were in Grade 4, and then again in Grade 7 after four years of using laptops in the classroom. In this research project, I discuss the influences of 1:1 computing on students' writing, and focus on the growth of their writing over a four-year period. My research used a mixed-method approach to examine the Performance Standards data using quantitative data analysis and interviews with 14 students, using qualitative data analysis. My findings demonstrated that writing performance improved over the four-year period and that the students felt more empowered and more motivated to learn when using 1:1 computing. Finally, this research project presents conclusions and recommendations for supporting students in a 1:1 computing classroom.

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CHAPTER 1

INTRODUCTION

School District 92 (Nisga'a) is unique. The schools are small and rural and are spread out over hundreds of kilometres. In September 2001, School District 92 (hereafter, the school district) began a long-term literacy initiative, which involved teachers and administrators discussing the question: How can we improve success for students in the Nisga'a School District? With consistent efforts in improving student success, classroom technology soon became the focus of a new committee, Nisga'a on Wireless (NOW). The mandate of this committee was to support this long-term literacy initiative by examining the effects of a 1-to-1 computing project. In particular, the NOW committee wanted to investigate the effectiveness of a wireless writing program.

The wireless writing program was implemented in School District 92 (Nisga'a) in January, 2005. It focused on three areas: (a) increasing the percentage of intermediate students who met or exceeded expectations in writing according to the BC Ministry of Education Performance Standards in Writing; (b) increasing the technological literacy of students; and, (c) increasing the capacity of teachers to teach writing and integrate technology into their instruction.

The implementation of the wireless writing program was supported by a group of professionals implementing technical and instructional in-services for teachers two to three times per year. These workshops were facilitated by Dr. Sharon Jeroski (Horizon Research); Mr. John Maschak (Apple Computer); Ms. Elizabeth Wilson (Literacy Coordinator for the Nisga'a School District), and Mr. Rob Wahl (former District Principal for Technology of School District 92). In 2003, Rob Wahl had attended the wireless writing program in Fort St. John, B.C. and initiated a wireless writing program as an important addition to the literacy initiative in the area of writing. The wireless laptop program was a new program to the school district so Rob Wahl arranged for inservices with Sharon Jeroski and John Maschak. Sharon focused more on the instructional aspects of using computers for writing tasks and John was more involved in the computer/technical aspects. Simultaneously, the technology department was heavily involved with the inservices. From 2001 to 2011, Elizabeth Wilson has continued to support the school district as a literacy consultant.

If teachers are to be successful in leading the 1:1 computing in their classrooms, they need to be creative and motivated, and possess the ability to focus the energy of students and to create a nurturing learning environment for the students. To this end, the central research question for this study was: *To what degree does 1:1 computing improve Aboriginal students' writing achievement?* Extended sub-questions include, "What strategies do beginning 1:1 students use?"; "Do these strategies improve over three years?"; and, "What are the students' perceptions of their writing skills using 1:1 computing?"

This research included exploring the 1:1 laptop technology in classrooms related to student engagement using Grades 4 and 7 students. This proposed research project utilized specific research mixed-method methodologies (Creswell, 2009; Thomas, 2003), which will be discussed further in the methodology section of this project.

The Problem

There is a dearth of 1:1 computing research that addresses Aboriginal students utilizing technology in the classroom (Kitchenham, 2006, 2008, 2009). The intent of this research project was not to predict the future of computer use for Aboriginal students but rather to explore student motivation and engagement, which revealed the way Nisga'a students thought about learning within their own epistemologies (Livingston, 2009; Tileston, 2004).

Statement of the Problem

Livingston (2009) stressed that students today are innately multi-taskers; most teachers are uni-taskers. She further argued that most teachers view multimedia environments as being distracting and not conducive to learning. Muir, Manchester, and Moulton (2005) argued that if teachers do not understand the minds of students, they risk using the cognitive, knowledge delivery, approach in teaching students.

Similar to Livingston and Muir et al.'s findings, in my experience as an Aboriginal teacher and principal, most Aboriginal learners exposed to 1:1 computing are more engaged in touching laptop technology with their fingertips (i.e., tactile-kinesthetic learning style) rather than following in-class lessons (i.e., visual-auditory learning style). There is evidence in School District 92 that many intermediate students have demonstrated the abilities to explore, learn, analyze, and demonstrate communication skills utilizing 1:1 computing in the classroom. Teachers today have an obligation to provide students with 21st Century, 1:1 computing compared to those of earlier generations. This obligation has led to in-services for new 1:1 computing school districts across the province.

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Sharon Jeroski had facilitated 1:1 computing in-services with several teachers and students in our school district; her support has helped teachers and students in grasping the concept of 1:1 computing. It seems that teachers teaching rural Aboriginal students 1:1 computing in the classroom may have a different approach in delivering lessons compared to teaching students in an urban classroom setting. The intention of having Dr. Sharon Jeroski and Mr. John Maschak facilitate 1:1 computing in-service was to cultivate a new mindset for beginning teachers launching 1:1 laptop computers in their classrooms for the first time.

There are many professional educators supporting the 1:1 laptop program in School District 92 (Nisga'a), so it is paramount to address the importance of the research question. There have been many research studies completed on 1:1 computing but none have investigated the impact on Aboriginal children with one possible exception (Kitchenham, 2006). This research study focused on how well students learn through 1:1 computing, and what strategies were demonstrated. From the perspective of working with Aboriginal students and the need to look at the world from an Aboriginal point of view rather than accepting only the dominant culture's viewpoint, the answers to the research questions revealed an understanding of how Nisga'a students learn from participating in the 1:1 computing program.

Limitations of the study

Researching in a rural geographical setting draws much attention to limitations uncontrolled by the researcher. This field study encompassed the Nass Valley, School District 92 (Nisga'a), north of Terrace, B.C. Because of the timeline of this research project, there was a possibility of road closures due to landslides or bridge washouts that

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would have impacted specific days set aside for possible observations and data collecting. Because of this possibility, the research took place in the months of April-May of 2010, due to better weather conditions for travelling and collecting data.

The theoretical research limitations are a set of guidelines indicating the conflict and resolution in supporting this research project. If road closures had been a concern during data collecting, the researcher would have commenced the first operational day with school administrator approval. If the researcher was unable to collect student artifacts on a specific day during the research, then he made alternative arrangements with the school administrator to meet with the teacher. If parents were unwilling to give authorization to collect student artifacts or consent to the researcher's interviewing their children, the researcher contacted the administrator to set up an appointment with the parent. If teachers were uneasy about the collecting of student artifacts, the researcher stressed to the teacher the importance of this 1:1 computing research project and, how this research project would support the 1:1 computing for all schools in School District 92. If any person did not sign the informed consent form, they were excluded from the data collection and if any person withdrew for whatever reason, his or her data were excluded from data analysis and all his or her data were destroyed.

Definition of Terms

Throughout this research project, the following terms were used.

1:1 computing: places where every child in the class has a laptop computer with wireless Internet and within a wireless environment for half of the learning day or might have access to the laptops during school hours only (Kitchenham, 2008).

Aboriginal students: students who are collective original peoples of North America and their school-aged descendants of the Nisga'a Nation.

Differentiating instruction: an approach to planning so that one lesson is taught to the entire diverse level of classroom learners, meeting the students' individual needs.

Epistemology: the branch of philosophy concerned with the nature and origin of knowledge. Epistemology asks the question, How do we know what we know?

Mixed-method research: is an approach to inquiry that combines or associates both qualitative and quantitative forms of research. It involves philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both approaches in a study (Creswell, 2009).

Nisga'a On Wireless (NOW): a team that supports 1:1 wireless Laptop initiative and 21st century learning in the Nisga'a School District. The NOW team met annually to plan district 1:1 wireless laptop professional and staff development activities for the subsequent year.

Conclusion

This research project continued the foundational work of the wireless writing program implemented in School District 92 (Nisga'a) since it focussed on three main areas: increasing the percentage of intermediate students who met or exceeded expectations in writing according to the BC Ministry of Education Performance Standards in writing; increasing the technological literacy of students; and, increasing the capacity of teachers to teach writing and integrate technology into their instruction. My research also augmented the Nisga'a on Wireless (NOW) program begun in 2003 as it actually collected data over a four-year period and asked the students themselves how they felt about their using 1:1 computing and its impact on their learning.

CHAPTER 2

LITERATURE REVIEW

Chapter 1 provided an introduction to the study, articulated the research question, outlined the problem, and defined key terms. This chapter reviews the literature related to 1:1 computing in educational settings. The review begins with a discussion of key studies on 1:1 computing with kindergarten to Grade 12 students. Then, the review moves to a discussion of the professional literature on using laptops on shared carts versus in-classroom laptops all the time for all students. Next, one longitudinal study (Bebell, 2005) is outlined in depth as an example of a study similar to this one. Then the literature review concludes with research conducted by one key researcher on the use of 1:1 computing with adults. The chapter ends with a summary of the research studies discussed in this chapter.

One-to-One Computing in K-12 Classrooms

Jeroski (2003) conducted research on a 1:1 computing program in School District 60 (Peace River North). This initial research explored classroom -based programs with laptop technology integration. The focus of Jeroski's research was the examination of Grade 6 and 7 student achievement in written expression.

Her research focused on the use of wireless laptop computers, long-term systemic implementation planning, professional development, and systemic monitoring of the 1:1 wireless writing program. These four areas of interest guided the research question, "What effects do classroom and home use of wireless technology have on student writing achievement at Grades 6 and 7?" and the results were significant to other 1:1 computing programs across British Columbia and elsewhere (Jeroski, 2003). The rationale supporting Jeroski's (2003) research was related to the concern that many students were not acquiring the specific writing skills at their respective grade levels. In fact, she argued that the males' writing proficiencies were low and that the boys experienced low confidence in their writing abilities and exhibited low levels of commitment while entering high school. She noted, however, that their interests in using the 1:1 laptops as a tool appeared to improve student achievement in the male students.

Jeroski (2003) chose Grades 6 and 7 students for her research on 1:1 computing as she argued that students with low writing skills tend to fail to improve after Grade 7. Her findings indicated that improving writing skills in one area could result in improving other areas like reading.

Jeroski (2003) planned the study for three years, with the implementation of two classrooms, Grade 6 and 7 with iBooks. Jeroski (2003) argued, by pilot testing these two classrooms, it allowed for trouble shooting and long-term planning supporting the implementation process. During the implementation process, the BC Performance Standards were used as a common expectation for writing instruction and assessments.

During the implementation process of this research, teachers had collected student samples, journals, regular classroom assessment tools, and student attitude surveys. Electronically, teachers had their Grade 7 students write the provincial writing test, Foundational Skills Assessment. The results as measured by BC Performance Standards Writing rubrics and a review of the Foundational Skills Assessment results, showed increasing levels of achievement. Comparing the pre- and post-test results, there was an increase in exceeding expectation (18% of students) in writing in June compared to the pre-test (0%). Peace River North School District students had used the 1:1 computing to write the Foundational Skills Assessment. Overall, 73% of students had met or exceeded in the provincial standards for writing.

Jeroski (2003) argued that teachers, students, and parents believed that the students' writing had improved while using the 1:1 computing laptop project. She also stated that most Grade 6 and 7 students believed that their achievement in writing had improved. Students were feeling more competent as learners, they were able to produce quality work and demonstrate editing skills and strategies, which all led students to become responsible for their own work.

Cavanaugh, Dawson, and Ritzhaupt (2010) conducted research on the conditions, processes, and consequences of 1:1 computing programs in K-12 classrooms. Cavanaugh et al. examined 47 K-12 schools in 11 Florida districts that were funded by the Florida Department of Education's Leveraging Laptop Program. The research focused on 1:1 computing technology and teacher professional development, which supported teacher practices and influenced student achievement.

The rationale supporting Cavanaugh et al. (2003) research was the argument for implementing a new learning style, student-centred instructions, which supported engaging students and increasing academic achievement. In fact, Cavanaugh et al. argued that student-centred instructions in the classroom, with the integration of 1:1 computing, was one of the main supporting goals that supported the development of effective models for enhancing student achievement.

Cavanaugh et al. focused on three guiding questions: (1) what are the conditions of the 1:1 computing initiatives in each school district? ; (2) what are the processes of 1:1

computing initiatives in each school district?; and, (3) what are the consequences of the 1:1 computing initiatives in each school district?

Multiple methods of data collections were used to answer these research questions. Document analysis encompassed grant proposals, artifacts, and interviews with grant coordinators. First, school observations examined instructional teaching practice and classroom observations; teacher inquiry led to action research; and teacher surveys led to triangulated data collection. Cavanaugh et al. argued that their research design enabled them to study and document the integration of 1:1 computing in schools.

Cavanaugh et al. used a mixed-method approach in collecting data which was analyzed independently across all 11 school districts. In analyzing the observation data, repeated measures interpreted the pre- and post-treatment differences using Analysis of Variance (ANOVA) for each category and strategies investigated. Cavanaugh et al. argued that the results supported their findings of conditions, processes, and consequences of these independent analyses; in particular, 1:1 computing in each district.

Schools were observed twice a year by trained observers. In this case, Cavanaugh et al. focused more on the students' abilities to access and use the laptops rather than teacher use of technology. The researchers reported statistically-significant differences between the Fall and Spring observations in the age and type of computers combined with Internet availability, the number of computers used by each student, and the number of students who were computer literate.

Additionally, Cavanaugh et al. argued that their results indicated a positive change from traditional teaching to more student-centred learning. Teachers reported higher levels of student achievement including test scores and higher level thinking skills and a definite increase in conditions that supported learning in key areas of enjoyment, engagement, and on-task behaviour.

One-to-One Sharing and Permanent 1:1 Carts

Bebell, Higgins, and Russell (2004) conducted research on the comparison of two types of 1:1 computing classrooms. The first classroom engaged students with laptops on a temporary basis, while the second classroom engaged students with laptops on a fulltime basis. The goal of their research was to compare teaching and learning in both temporary and permanent 1:1 laptop environments.

During the beginning of the study, the 1:1 laptop program was voluntary for parents who could afford to purchase laptops. For the parents who could not afford laptops but wanted to participate, they received a free laptop through a specific fund, which was implemented shortly after the 1:1 laptop program was established.

Bebell et al. examined 209 students in nine classrooms in their comparison of instructional practice and the learning activities in which the students participated. The data collection criteria consisted of student engagement levels, the number of students working with technology, students working independently or in large or small groups, and students working in pairs. These data collected were then analyzed examining the differences between the students by group (part-time and on carts versus full-time and in the classroom), and the different levels of student engagement. For each category of data collected, the mean value for each criterion was calculated within each classroom.

The researchers' observation notes indicated a variety of ways in which teachers and students used the laptops, which mainly focused on curriculum. Student surveys also indicated that students in the full-time access group engaged with the 1:1 laptops and were using this technology more frequently compared to the students who shared laptops. For example, Bebell et al. argued, students who shared laptops only used the laptops once a month for science compared to the other students who used laptops on a more regular basis, from once a week to everyday use.

Basing their argument on their teacher interviews, Bebell et al. indicated that for the students who used 1:1 laptops on a more regular basis, technology use became much more detailed. Students were using the laptops for classroom presentations, note taking, PowerPoint and word processing. Through the teacher interview data, Bebell al el. argued that teachers who were engaged with the laptops on a more continuous basis, agreed that the Internet gave a new meaning for research for their students.

Motivation and engagement supported students in the 1:1 laptop classrooms through these technological applications. Bebell et al. reported that students using the 1:1 laptops on a more permanent basis were more engaged. During the teacher interviews, teachers indicated that their students appeared to be more engaged and motivated. During the teacher interview, one teacher stated that special education students were also more engaged in using the 1:1 laptops daily; another teacher pointed out that the 1:1 laptops had actually equalized the special education students and the non-special education students.

Using the observation checklist data, Bebell et al. argued that the structures between both classrooms were uniquely different in the way teachers instructed within the classroom learning communities. The students in the full-time 1:1 classroom mainly worked individually or in small groups while the students that shared laptops worked mainly in large-group settings. The researchers purported that the students in the 1:1

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laptop classroom learned better on an individual basis and the students in the part-time use group learned better in a larger group format. Bebell et al. also reported that the students using the 1:1 laptops on a full-time basis also used computers at home for listening to music, emailing, and chatting more frequently than the students who shared laptops even though the researchers controlled for socio-economic status.

The researchers concluded that those students in both classroom settings were highly engaged, that writing had increased in both groups, and the interaction between students to teachers and student to student had increased dramatically. They also pointed out that their findings supported more-frequent access to 1:1 computing opportunities as there were significant differences between the full-time access classrooms and the parttime access classrooms.

First-Year Investigation of 1:1 computing

Over a nine-month period, Bebell (2005) conducted a program evaluation of a 1:1 laptop program of six New Hampshire middle schools that had been using the program since 2003. He reported on many positive benefits which included increase in student and teacher use of technology across the curriculum, increased motivation, and increased engagement for both students and teachers.

Bebell's (2005) primary data collection encompassed pre- and post-measures on the use of laptop technology. In particular, teacher and student survey instruments were used to collect information across multiple subject areas. Student surveys also included access to technology, personal comfort levels with technology and technology use at home; teacher surveys consisted of in- and out-of-classroom technology use, personal comfort level of technology use, and attitudes towards the use of technology.

Bebell (2005) reported that the 1:1 laptop use had increased for many of the schools surveyed. There was a significant increase in the use of laptop technology in nearly all subject areas; however, the student survey data demonstrated that there was a lack of technology use in math and science. During the teacher pre- and post-surveys, teachers reported that they used computers to make handouts, create tests, quizzes, and student assignments. Additionally, the teachers indicated that the students were more engaged and more motivated to learn when they used 1:1 computing.

One-to-One Computing with Adults

Kitchenham (2006) investigated 10 teachers' educational technology development through the lens of transformative learning theory in 1:1 computing classrooms. In particular, his research question investigated to what degree teachers experienced perspective transformations due to their development in educational technology. Additionally, he explored whether transformative learning theory was a viable research theory, to describe teacher development in technology.

Before Kitchenham (2006) began the study, he ensured that the 10 teachers completed professional development technology action plans, which encompassed their technology goals, strategies, support systems, start and end dates, and their indicators of success. The data sources consisted of reflective journal entries, teacher questionnaires, interviews, and personal field notes. Teachers had recorded their comments and questions about their technology experiences in their journals. Mainly, teachers were asked to comment on activities that might have influenced their perspective transformations as learners, which identified a cognitive approach towards their learning by examining their own personal experiences through various learning styles and, the most important element, critical reflections. Questions were generated from the teachers' individual journal entries and questionnaire comments; these comments where then tailored to individual teacher's interviews administered by the researcher.

The research data were divided into two broad sets. First, Kitchenham addressed the systemic external factors which included transformation as the teachers learned to adopt and teach educational technology into the classrooms. Second, specific themes from the individual teachers were derived from key elements of perspective transformation, and were collected and pooled and placed in distinctive themes, again relating to perspective transformations.

Kitchenham's research study provided a more comprehensive study related to teachers and their personal experiences by exploring different learning styles and providing an understanding of critical reflection. His research provided classroom teachers with an understanding of specific reasons why teachers have adapted the way they teach, which led to an understanding of their personal transformations while teaching 1:1 computing in the classroom.

In a subsequent study, Kitchenham (2008) used the theoretical framework of transformative learning to describe teacher transformation with 1:1 computing in three school districts; one of which was the Nisga'a school district in which my present study was conducted. He explored the perspective transformations of the six teachers through critical reflection and critical self-reflection. In Kitchenham's transformational learning study, he demonstrated that teachers in his study were transformed to the extent that they changed their worldviews on using 1:1 computing in their respective classrooms.

Before Kitchenham (2008) began the study, he investigated three school districts

engaged in the 1:1 computing process. Kitchenham's research study explored specific schools, one at the beginning stages of the 1:1 computing process; another school district that had been involved in the 1:1 computing process for several years and, the third school district in the early stages of 1:1 computing for a few years. These school districts were Cowichan Valley School District, Nisga'a School District, and Prince George School District.

The data sources consisted of an online questionnaire, a semi-structured interview, and researcher field notes. Teachers were asked to complete the online survey, where teachers rated their responses on a 10-point Likert scale, a choice of 1 (Strongly Disagree) to 10 (Strongly Agree) demonstrating personal perspective transformations. Individual interviews were generated according to the individual teacher's questionnaire responses. In support of Kitchenham's research data, his field notes were recorded and his reflections of the teachers' perspective transformations were generated.

Kitchenham (2008) used a mixed-methods approach, combining qualitative and quantitative research methods. The qualitative data were coded and categorized from the 18 participants. The quantitative method the included frequency counts that described the degree of perspective transformation. The research data analysis, consisting of semistructured interviews, online questionnaires, and research field notes, were all entered into NVivo, a qualitative data analysis, to analyze complex data codes.

Kitchenham (2008) presented the results of his findings using key elements of perspective transformation: disorienting dilemma, critical reflection, critical selfreflection, and critical discourse. These key elements supported the adoption and infusion of teachers using laptops in the classrooms. He argued, without disorienting dilemma, perspective transformation would not occur.

Twenty-eight statements were recorded and all 20 participants provided comments identifying perspective transformation and critical reflection. Three hundred and two statements were recorded that reflected the critical thinking in the decision making process. Over 100 comments represented critical discourse which reflects an open mind, seeking a common ground that supports a common understanding or justifying an interpretation or belief.

Conclusion

This chapter reviewed the professional literature related to 1:1 computing in various educational settings. The review began by discussing studies on 1:1 computing with kindergarten to Grade 12 students. In particular, I presented the seminal research conducted by Jeroski (2003) in the Peace River School District and by Cavanaugh, Dawson, and Ritzhaupt (2010) in 47 schools across 11 Florida school districts which had relevance to my present study. Next, I reviewed Bebell, Higgins, and Russell's (2004) research with 209 students in nine classrooms in which they compared the students' and teachers' experiences of using shared laptops with those in 1:1 classrooms where the laptops were used full time and remained in the classrooms. Then, I presented Bebell's (2005) longitudinal study that evaluated six New Hampshire middle schools that had been using 1:1 computing since 2003. Lastly, I ended the literature review with an indepth discussion of Kitchenham's (2006, 2008) work with 1:1 computing and teachers which was partially conducted in the Nisga'a School District. The next chapter will present the research methods used in this study.

CHAPTER 3

RESEARCH METHODS

Chapter 1 outlined the purpose of the study and stated the research question. Chapter 2 provided a solid overview of the extant professional literature on 1:1 computing in the classroom. In this chapter, I will detail the research methods of data collection and data analysis. For the purpose of this research, there were two phases to the study to answer the central research question: *To what degree does 1:1 computing improve aboriginal students' writing achievement?*. I began with a quantitative data collection phase and then followed that phase with qualitative data collection. This concurrent-embedded strategy using student artifacts and the students' perspectives across the school district created a strong study (Cresswell, 2003).

Mixed-Methods Research

I utilized a mixed-method approach in this study (Creswell, 2003). The quantitative data included an examination of student writing samples. Specifically, I examined the 14 Grade 7 students' assessed writing samples (by their respective teachers) using the BC Ministry of Education Writing Performance Standards rubrics over the three-year period during which 1:1 computing was implemented in the school district. I calculated the mean, median, and standard deviation for the four-scale evaluation system to ascertain if there was an increase over the three-year period. The qualitative data were collected in the form of interviews with 12 students from Grade 4 (n = 5) and Grade 7 (n = 7). They were asked about their perceptions of the 1:1 computing program, in general, and of its use with writing, in particular. I compared their individual comments with their individual writing achievement results and with the overall writing achievement results.

My hypothesis was that the more positive the responses were about the 1:1 laptop computing program, the more improvement would be shown in writing achievement.

Participants

The interview participants in this research project consisted of five Grade 4 students who were using the laptops for the first time, and seven students with three years of experience, from Grade Seven classrooms. These 12 students volunteered to be interviewed with the encouragement of their teachers and the consent of their parents.

For the writing data, 38 students were recommended by their respective teachers; however, only 14 students' writing samples had been evaluated using the BC Writing Performance Standards from Grade Four to Grade 7. The 14 students who took part were willing participants whose parents signed informed consent forms.

In total, my study included 22 students. There were 12 interviewees and 14 students' whose writing samples were examined; however, four of the 12 interviewed children were part of the 14 students whose writing samples were evaluated.

Data Collection and Analysis

There were two types of data analysis supporting the findings to answer the central research question: student writing samples and interview comments. By using a mixed-methodology approach, and combining qualitative and quantitative research methods, I strengthened my research study since the interview comments reinforced the student writing sample results.

The first phase of data analysis involved scrutinizing the marked writing samples collected by the researcher and teachers. The BC Ministry of Education Performance

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Standards provided a provincial standard for writing at each of the four grades examined. The four levels of performance are:

- 1. Not Yet Meeting Expectations
- 2. Meeting Expectations at a Minimal Grade Level
- 3. Fully Meeting Expectations
- 4. Exceeding Expectations

The collected writing data allowed for the identification of individual growth from students through the use of 1:1 computing. For instance, in Year Four, a Grade 7 student's writing sample was rated as "Fully Meeting Expectations" while using the laptop for writing. That same student had been rated as "Fully Meeting Expectations" in Grade 6, "Minimally Meeting Expectation" in Grade 5, and "Fully Meeting Expectations" in Grade 4. I calculated manually the mean, median, mode, and standard deviation for each year, since the data set was so small (n = 14). In order to ascertain any statistically-significant differences between and among the grades, I performed a series of chi-square tests.

The second phase of data analysis was the close examination of the interview comments from the 12 students. They were asked about their perceptions of the 1:1 computing program. The 12 interviews were completed using students from two elementary schools in Grade 4 (n = 5) and Grade 7 (n = 7).

The specific interview questions for Grade 4 students included: *Tell me about a typical writing lesson when you use the laptops.*; *What are some of the challenges of using the laptops for writing?*; and *Does your teacher use any planning software like Kidspiration for pre-writing? If so, how does he or she use it?*" The Grade 7 students'

interview questions included: Tell me about a typical writing lesson when you use the laptop.; Do you think that your writing has changed since you started using your laptop three years ago;? What are some of the advantages of using the laptops for writing?; and, Does your teacher use any planning software like Kidspiration for pre-writing? If so, how does he or she use it?.

These interviews were conducted in the principal's office on both school sites. I used a digital recorder to support capture the essence of the student interviews. Before the interviews took place, students were asked to sign a "Student Consent Form" followed by an "Informed Consent Form" signed and dated by the student and parent. These interview responses generated codes and then into themes supporting the hypothesis that the more positive the responses were about the 1:1 laptop computing program, the more improvement would be shown in writing achievement.

Codes and Themes

The codes and themes were generated from qualitative response interview data analysis. The qualitative data were coded and categorized from the response of 12 participants. Common themes included, *creativity*, *discipline* and *a systematic approach*.

The narrative research data analysis generated from semi-structured interviews was generated from five main stages. Stage 1: Knowing your data. The interview responses were read and re-read and listening to video recorder several times, this supported the researcher's impressions through the data. Stage 2: Focusing on the analysis. The interview data analysis were studied, patterns of words or phrases began to generate codes. Stage 3: Categorizing. By categorizing the codes – codes began to form patterns and more re-reading of these codes generated into themes. Stage 4: Identifying patterns connecting between categories. Patterns of words or phrases were grouped into broader themes by assembling all specific data pertaining to a particular theme; this magnified the data analysis into more specific categories. Stage 5: Bringing it together. Below is a sample of how codes were identified leading to a specific theme, they are:

- 1. The underlined words indicate the codes
- 2. Theme for this specific response is Discovery Learning

Sample Quote:

Do you think that your writing has changed since you started using your laptop three years ago?

I believe that my <u>writing has improved</u> since first getting my laptop. Being <u>able to type</u> <u>quickly</u> and use a spell check has allowed me to <u>write quicker and more efficient</u>. I also believe that writing on a <u>laptop is less dull then pen and paper</u>, which has allowed me to be <u>more imaginative with my writing</u>.

Conclusion

This chapter has outlined the main research methods in this mixed-methods study. The quantitative data, the Writing Performance Standards rubric evaluations, ranged from 1 to 4. The 14 students' evaluated writing samples were examined for each of the three years in which they participated in the 1:1 computing program. The mean, median, and mode were calculated manually and were compared between each year and in clusters. Additionally, I performed a test of significance, the chi-square, to see if there were any statistically-significant differences between and among the years.

As well, I interviewed 12 students in Grades 4 and 7 to ascertain any differences between the perceptions of the Grade 4 students who had just begun using laptops and the Grade 7 students who had been participating in the 1:1 computing program for four years. The transcribed interviews were analyzed and divided into distinct themes. The combined results were examined to answer the original research question related to the degree to which 1:1 computing improved Aboriginal students' writing achievement and the supporting research questions examining their perceptions of the 1:1 computing program.

Chapter 4 will present the detailed results and provide a thorough discussion of those results.

CHAPTER 4

RESULTS AND DISCUSSION

Chapter 1 outlined the purpose of the study and stated the research question. Chapter 2 provided a solid overview of the extant professional literature on 1:1 computing in the classroom. Chapter 3 presented the research methods of data collection and data analysis. This chapter will contain the results of my findings and the discussion of what the results mean. In this chapter, I will present the results generated from the mixed-method approach of this study: The quantitative, "*To what degree does 1:1 computing improve aboriginal students' writing achievement*? The qualitative, "*What are the students' perceptions of their writing skills using 1:1 computing*?"; and, "*What strategies do beginning 1:1 students use*?" This chapter will contain the results of my findings and the interpretation of those results.

Results

The students were selected from an initial student population of 30 Grade 7 students which resulted in 14 students from four district schools. The 14 student data analysis was compiled over a four-year period beginning with Year 1 – Grade Four to Year 4 - Grade Seven (see Tables 1 to 4 and Figure 1).

Quantitative Data

For the purposes of explanation, the data will be discussed by year. That is, I will present, in tabular form and in discussion, the differences between Year 1 and Year 2 (see Table 2), Year 3 and Year 4 (see Table 3), Year 1 and Year 4 (see Table 4). Differences between Years 1 and 3, 2 and 3, and 2 and 4 will not be discussed as the results do not warrant further discussion due to the slight increases or decreases.

Student	Yr. 1 (Gr. 4)	<u>Yr. 2 (Gr. 5)</u>	Yr. 3 (Gr. 6)	Yr. 4 (Gr. 7)
1	2	2	2	2
2	3	3	3	2
3	4	2	4	4
4	4	3	4	3
5	3	2	3	2
6	4	4	4	4
7	1	1	1	2
8	2	1	3	3
9	3	2	2	3
10	2	2	3	3
11	3	2	3	3
12	2	3	3	3
13	3	3	3	2
14	2	3	2	2

BC Performance Standards Writing Data Summary of 1:1 Computing Students (n = 14) by Year and Grade

1 = Not yet meeting expectations; 2 = Minimally meeting expectations; 3 = Meeting expectations; 4 = Full meeting expectations



Figure 1.

Graphic Representation of the Four-Year Trend based on the BC Performance Writing Standards for the 1:1 Computing Program by Year and Number of Students

A Comparison of	Writing Performance	Data between	Year 1 and	2 (in raw	number	and
percentage)						

BC Writing Performance Standard	Yea	ur l	Yea	ar 2	
Not yet meeting expectations	<u>n</u> 1	<u>%</u> 7	<u>n</u> 2	<u>%</u> 14	<u>% Diff.</u> +7
Minimally meeting expectations	5	36	6	43	+7
Fully meeting expectations	5	36	5	36	0
Exceeding expectations	3	21	1	7	-14
Total FULLY OR EXCEEDING	8	57	6	43	-14

As Table 2 demonstrates, of the 14 students, six students (42.9%) were evaluated as "minimally meeting expectations" in Year 2, compared to five students (35.7%) in Year 1 which represented a seven percent increase. The data analysis also indicates 0% difference between Year 1 and Year 2 "Fully Meeting" writing expectation; approximately 36% of Year 1 and year 2 have maintained "Fully Meeting" writing expectations for both years. Also, between Year 1 and Year 2 there was a marked decrease from 21% to 7%; a 14% decrease in students who were "Exceeding" writing expectations. Between Year 1 and Year 2, eight students decreased to six students indicating a 14% decrease overall of students who were meeting or exceeding expectations.

In Table 3, Years 3 and 4 are compared. Of the 14 students, there was an increase of 22%, or three students, in the minimally meeting writing expectations category. Conversely, there was a seven percent decrease, or one student, from Year 3 to Year 4 in the fully meeting writing expectations category; that is, 21% of Year 3 and 14% of Year

A Comparison of	Writing Performance	Data between	Year 3 and 4	(in raw number	and
percentage)					

BC Writing Performance Standards	Yea	r 3	Ye	ar 4	
Not yet meeting expectations	<u>n</u> 1	<u>%</u> 7	<u>n</u> 0	<u>%</u> 0	<u>% Diff</u> -7
Minimally meeting expectations	3	21	6	43	+22
Fully meeting expectations	7	50	6	43	-7
Exceeding expectations	3	21	2	14	-7
Total FULLY OR EXCEEDING	10	71	8	57	-14

4. A similar decrease is noted between Year 3 and 4 for those students who were graded

as exceeding writing expectations. When combining the numbers for "fully" and

"exceeding" writing expectations, there is a clear decrease of 14% or two students.

Table 4

A Comparison of Writing Performance Data between Year 1 and 4 (in raw number and percentage)

	Yea	r 1	Year 4			
Not yet meeting expectations	<u>n</u> 1	<u>%</u> 7	<u>n</u> 0	<u>%</u> 0	<u>%₀ Diff</u> -7	
Minimally meeting expectations	5	36	6	43	7	
Fully meeting expectations	5	36	6	43	7	
Exceeding expectations	3	21	2	14	-7	
Total FULLY OR EXCEEDING	8	57	8	57	0	

In Table 4, Years 1 and 4 are compared. There was an increase of seven percent, or one student, in the minimally meeting writing expectations category. A similar

increase of seven percent was noted in the fully meeting writing expectations rating or from 36% in Year 1 to 43% in Year 4. Comparing Year 1 and Year 4 results in the combined fully and exceeding writing expectations categories, it is evident that there was no change in the number of students (n = 8) who were rated as fully meeting or exceeding the expectations for their grade level. Additionally, one student was recorded as not yet meeting expectations in Year 1 but no students were ranked so in Year 4.

I used descriptive statistics to ascertain whether the mean, mode, median, and standard deviations of the data revealed any patterns (see Table 5). Additionally, the median was used to check for any statistically-significant differences between and among years using chi-square (see Table 6).

Table 5

Descriptive Statistics for Grade 4 and Grade 7 Students by Year in the 1:1 Computing Program

	<u>Yr. 1 (Gr. 4)</u>	<u>Yr. 2 (Gr. 5)</u>	<u>Yr. 3 (Gr. 6)</u>	Yr. 4 (Gr. 7)
Mean	2.714	2.357	2.857	2.714
Mode	1/4	2	4	1/4
Median	3	2	3	3
St. Dev.	0.913874	0.841897	0.864438	0.726273
4 37				

1 = Not yet meeting expectations; 2 = Minimally meeting expectations; 3 = Meeting expectations; 4 = Full meeting expectations

Table 6

Chi-Square Results for Grade 4 and Grade 7 Students by Year in the 1:1 Computing Program (df = 3)

	Rating/Year	1	2	3	4
χ^2	Year 1	0.5	0.045	0.045	Û.1
	Year 4	0.5	0.045	0.045	0.1

As Table 6 demonstrates, I performed a chi-square test for Year 1 and Year 4 and found no statistically-significant difference (tab_v = 7.81; χ^2 = 1.38; p = .05). I also

Interview Data by Theme with Frequency Counts by Grade Level

Themes	Frequency	Grade 4	Grade 7
Discovery Learning	30	3	27
Nonlinguistic Representations of Learning	23	10	13
Technology Adoption	20	7	13
Student-centred Learning	14	0	14
Secondary Sources	13	6	7
Independent Learning	12	8	4
Scaffolding	10	6	4
Problem-based Learning	5	1	4
Visual Project	4	3	1
Direct Instruction	3	3	0
Self-Regulated Learning	2	0	2
TOTAL	136	47	89

performed a series of chi-square tests between the results for Year 1 and 2 and for Year 1 and 3. There were no differences for each data set.

Qualitative Data

Laptops were used in a wide variety of ways in the classroom as evidenced by the themed interview data (see Table 7). That is, after conducting the interviews with the 14 students, the interviews were transcribed and coded by hand (see Appendix A for sample statements). These codes were then merged to form themes and the total for each theme was calculated, by grade, to see if there were commonalities and differences across the grades. Table 7 presents these data in descending form from the theme that garnered the most responses to the one that received the fewest responses.

As can be seen from Table 7, the majority of the responses to the interview questions (73.6%) were related to the five themes of discovering facts and principles without assistance from the teacher or others (*discovery learning*), using mapping programs, such Inspiration, for pre-writing activities (*nonlinguistic representations of*

learning), students readily embracing the technology in the classroom (*technology adoption*), students working on tasks that require their own skills and creativity (*student-centred learning*), and utilizing the internet for information (*secondary sources*).

More specifically, the theme, *discovery learning*, received the most comments from the students with 22.1% of the overall number of responses. Sample responses included "the laptop helps me to find information for myself [rather than] the teacher just telling us" (Grade 7 student) and "I work out things on the laptop without asking no one [sic]" (Grade 4 student). This theme will be explained more fully in the next section.

The next most-common theme, *nonlinguistic representations of learning*, received 16.9% of the overall student responses. Typical responses in this category dealt with semantic mapping software or similar pre-writing activities: "teacher tells us to use Inspiration or whatever and then I write down my story stuff" (Grade 4 student) and "I've used maps and drawings to help [me] write better and make the sentences flow better since Grade 4 so [I'm] really good at it" (Grade 7 student).

The theme, *technology adoption*, was commented on 20 times during the student interviews and represented 14.7% of the overall responses. Typical student responses included accepting the laptops in the early stages of the 1:1 computing program (e.g., "at first, they were fun but then I used them lots and [realized] that they really helped me in all my work"), in the later stages (e.g., "each year, we use the laptops more and have to do more work with them [but] I see why they are important"), and in the use of other technologies (e.g., "teacher uses the SMARTBoard with us [and then] we get to use it and the laptops").

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The fourth most-common theme, *student –centred learning*, represented 10.3% of the overall responses and dealt with the students working independently from the teacher and their peers. Sample responses included "I find that I can work on [writing] on my own with the laptops and the internet [and] I don't need teacher as much because I know what I am doing" (Grade 7 response) and "after I used the laptop for a month or so, I didn't need the teach no more [sic] since I could work on my own and lots of other kids didn't help me" (Grade 4 response).

Secondary sources involved using the internet with the laptops for a variety of reasons and encompassed 9.65% of the overall comments. Students reported on using the Internet "to check facts", "to look up information for ideas", and "to see if I was right in my writing" (Grade 7 students).

There were also differences between the Grade 4 and Grade 7 responses in terms of the number of responses and the thematic response. Grade 7 student responses included 89 of the 136 coded comments or 65.4% of the overall comments whereas 34.6% of the responses were from the Grade 4 students. Additionally, the number of responses for the five most-common themes was twice as many from the Grade 7 students than the Grade 4 students. The only "outlier" was the number of responses from the Grade 4 students related to the theme of *problem-based learning* was four times that of the Grade 7 students (four versus one, respectively).

Discussion

In this section, the interpretation of the results will be presented. First, I will discuss the meaning of the quantitative data. Second, I will summarize and interpret the qualitative data. Lastly, I will summarize the combined data.

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Quantitative Data

Table 1 and Figure 1 are summaries of the four-year data analysis of the main measuring instrument, BC Performance Standards Writing that using a four-point ranking system: 1 ("Not Yet Meeting") to 4 ("Fully Exceeding"). The school district has used the BC Performance Standards for several years to measure school district-wide writing assessment. The 14 students' data analyses were tracked from Grade 4 to Grade 7. Students' assessed writing skills ranged over that four-year period. It is important to note that the BC Performance Standards Writing were marked by professional teachers over a four-year period but subjectivity could be a factor in the ranking of the four-point skill level scale since there appeared to be definite patterns across each year.

For instance, between Year 1 and Year 2 of the writing assessment, two students increased in their writing ability using the 1:1 computing, six students did not change in their ranking, and five students ranked one point lower and one student ranked two points lower than the previous year. That little change occurred between these two years could be anticipated since the students did not use the laptops frequently in Grade 4 and had just started using it daily in Grade 5; however, almost half of this group decreased which is a strong indication that the teacher has very high expectations for the students in Grade 5. Additionally, the drop in scores could be explained by the fact that the teachers had just started the 1:1 computing program on a daily basis.

Between Year 2 and Year 3, four students increased by one score and two students increased by two scores, five students had no increase, and one student decreased by one score. Given that the students used the iBooks on a daily basis and that the teachers formally taught the writing process in Grade 6, this finding reinforces the argument that daily use and specific instruction increases writing abilities as reported by others (Bebell, 2005; Jeroski, 2003; Kitchenham, 2006, 2008; Livingston, 2009; Russell, Bebell, & Higgins, 2004).

Between Year 3 and Year 4, there were two students who increased by one point, eight students who had no increase, and four students who were ranked one point lower. Given the high percentage of student who either had a one-point or no increase, it would appear that the 1:1 computing program shows the greatest gain in Year 3 and the student peak in that year. In other words, after four years in the 1:1 computing program, the students hit a plateau and do not appear to increase beyond meeting (n = 6) or exceeding writing expectations (n = 2).

As evidenced by the data presented in Table 5 and Table 6, the data analysis revealed very little change in the means, medians, modes, and standard deviations across the four years. It would appear, as mentioned earlier, that the largest gain occurs in Year 3 and plateaus in Year 4 while Years 1 and 2 are used for learning and adopting the technologies. As reported earlier, the chi-square analysis revealed no statisticallysignificant difference between and among the years; however, given the slight changes in the median, and, more importantly, the small sample size (n = 14), it is not surprising that there were no differences.

Qualitative Data

The specific interview questions for Grade 4 students included: Tell me about a typical writing lesson when you use the laptops; What are some of the challenges of using the laptops for writing?; and, Does your teacher use any planning software like Kidspiration for pre-writing? If so, how does he or she use it?. There were several

interesting comments from student interviews. All five students stated that while 1:1 computing with Inspiration, the use of the SMARTBoard added to the interest of writing. Most students stated they used Inspiration to help outline their stories while using the iBooks. Most students during the interview stated that they struggled with creating webs and charts; two students stated their search engine froze or a beach ball symbol would show up on their screen causing them to restart their computer. All students reported that they were able to solve many of these problems on their own.

The Grade 7 student interview questions included: *Tell me about a typical writing lesson when you use the laptop; Do you think that your writing has changed since you started using your laptop three years ago?; What are some of the advantages of using the laptops for writing?; Does your teacher use any planning software like Kidspiration for pre-writing? If so, how does he or she use it?.*

The Grade 7 interviews revealed several high response theme counts in all four interview questions. Two specific interview questions dealt with the use of Inspiration as a planning software. All students pointed out that since taking part in the 1:1 computing program, they were writing a great deal more and were being much more descriptive. They also reported that they were typing faster and were able to compose faster since using the laptops. Once again, every Grade 7 students reported that they tended to learn better on their own and were able to discover answers to problems without the assistance of the teacher or others.

As reported earlier in this chapter, the five most-common themes encompassed approximately three quarters of the overall responses. Of those five themes the most common, *discovery learning*, was the most significant and germane to my research

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compared to others (Bebell, 2005; Jeroski, 2003; Kitchenham, 2006, 2008; Livingston, 2009; Russell, Bebell, & Higgins, 2004). That is, I believe that it represents a typical Aboriginal style of learning that involves solving one's problems through thinking about them, reflecting on solutions, and presenting a defensible answer. In the writing process, the students typically would think about the writing topic, reflect on major points to be included, and then use their laptops to represent their answer in writing. The other dominant themes of *nonlinguistic representations of learning*, technology adoption, *student-centred learning*, and *secondary sources* reinforce the professional literature and add to the established argument that 1:1 computing may not increase student achievement (Bebell, 2005; Kitchenham, 2008) but it does change the way that students engage in prewriting (Jeroski, 2003), early adopt the technologies (Livingston, 2009), focus on their own learning (Russell, Bebell, & Higgins, 2004), and use outside sources seamlessly (Bebell, 2005).

Summary Data

When considering the quantitative and the qualitative data together, a stronger argument can be made for the success of the 1:1 computing program over the four-year period. At first glance, it does not appear that the program has had a positive impact on writing achievement; however, it is important to point out that all students in Grade 7 were minimally meeting writing expectations or above which is a significant finding given how poorly the school district performs on the Foundational Skills Assessment. As well, 42.9% of the students were at minimally meeting whereas 57.1% of the students were meeting or fully meeting writing expectations. When considered with the finding that these Aboriginal students report that discovery learning is a preferred learning style,

this research demonstrates that the teachers should consider allowing more opportunity for this type of learning in their writing classes. Additionally, it would appear that encouraging mind mapping for pre-writing, promoting early adoption and continued use, focusing on the students and using the internet for research are all effective strategies and could be used more in the classes.

Conclusion

The students in this student have shown that 1:1 computing works for them in terms of writing skills and strategies and that their writing achievement has increased over the four-year period. They are not rated as all meeting or exceeding writing standards; however, all 14 students have met the minimum level of writing competence.

The central tendency measures of mean, mode, median, and standard deviation revealed no real change the four-year period; however, these data did demonstrate that the students appear to peak in Year 3 and remain constant in Year 4. The chi-square analysis supported this finding.

Lastly, the qualitative interview data supported the notion that students do improve in their writing ability and maintain a satisfactory level of performance but their confidence in writing skills and strategies such as working out problems on their own and using semantic maps for pre-writing demonstrates that they are more confident writers. As well, the idea of using discovery learning in the writing classroom for these Aboriginal students appears to be supported by the interview responses.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Chapter 1 presented the purpose of and the rationale for this study and presented the research question. Chapter 2 outlined the extant professional literature on 1:1 computing in the classroom. Chapter 3 presented the research methods of data collection and data analysis using a mixed-methods approach. Chapter 4 presented the findings and outlined the significance of the findings. This chapter will outline the overall conclusions drawn from the study and will provide recommendations for further research.

In September 2001, School District 92 began a long-term literacy initiative that led to discussing the question: How can we improve success for students in the Nisga'a School District? This question has inspired this research to examine the use of 1:1 computing of students in Grades 4 and 7.

Since schools continue to address student achievement in writing, this study focused on how well students learn through 1:1 computing, and what strategies were demonstrated. From the perspective of working with Aboriginal students and the need to focus on an Aboriginal point of view, the answers to this research have revealed an understanding of how Nisga'a students learn from participating in the 1:1 computing program.

This study focused on a limited number of students, so it does not represent the entire school district student population; however, this research is unique in several ways. An Aboriginal administrator working with 100% of Aboriginal students initiated this study. As well, to the best of my knowledge, this study is one of the first attempts to directly explore the learning activities of students that provide 1:1 computing from an Aboriginal perspective.

Like the 1:1 computing literacy initiative in September 2001, this research examined Grades 4 and 7 students with the focus of the central research question: "To what degree does 1:1 computing improve Aboriginal students' writing achievement? What strategies do beginning 1:1 students use? Do these strategies improve over three years?; and, What are the students' perceptions of their writing skills using 1:1 computing?". The school District 92 laptop program have a strong connection to administrators and teachers seeking to promote achievement skill levels of the 21st century learner.

The 1:1 computing program has made several strides towards student writing achievement skill levels over the four-year period. However, the degree of 1:1 computing has sustained student writing achievement skill level over a four-year period, with no statistical significant change comparing Years 1 to Year 4; students have maintained mainly minimally meeting writing expectations from grade to grade.

From this research, two main strategies were drawn from the Grade 4 interviews. First, many early 1:1 computing students indicated that they used Inspiration for strategic planning when generating their writing outlines. It is unclear whether this strategy using Inspiration has improved over the four-year period. Second, students at the beginning years of 1:1 computing were more engaged towards independent learning as resulted from the theme count from Grade 4 students. The independent learning has definitely led students towards becoming student-centred learners by Grade 7. The students' perceptions of their writing skills using 1:1 computing have resulted in their believing that their writing has improved. Students have discovered fact and principles rather than having the teacher explain them when it comes to writing and editing as expressed through the interviews. During the interview, students indicated that they found it easier to edit their writing using the laptop compared to re-writing and hand editing any piece of handwritten work.

Although the findings presented here do focus on the effect of technology use on student learning leading to student engagement and achievement, the findings have important implications for further research that could examine 1:1 computing in the beginning years and the relationship between 1:1 computing and student achievement.

Recommendations

The BC Performance Standards Writing has become an important assessment measure for articulating the student writing skill levels for School District 92 (Nisga'a). It is important for our schools to promote 1:1 computing in writing. If the school district continues with the 1:1 laptop program, listed below are two specific recommendations for school district consideration and one recommendation for future research.

Recommendation One

Students in the beginning years of 1:1 computing are minimally meeting writing expectations and, are maintaining this writing skill level through to Grade 7. The school district should consider targeting the writing achievement levels so that students can be taught specific writing strategies using the iBooks and incorporating discovery learning so that all students will be minimally meeting writing expectations at the end of Grade 4 and exceeding writing expectations by Grade 7.

Recommendation Two

Most teachers and students were enthusiastic about new software they used; however, through my experience as an administrator and research, I know that there are teachers who feel unsure how to use specific software applications that are linked to their laptops. I, therefore, recommend that the district inventory all software applications from a teacher's laptop that would be using in the 1:1 computing program with students. Then the district should examine the usage of each software application. After analyzing the usage of specific software applications, the school district should allocate or use technology support teachers to present inservices on how to use these specific applications with the students. This kind of research could lead to knowing whether 1:1 computing would increase technical knowledge over a specific time period.

Recommendation Three

This sample of students was quite small as it involved 14 students' writing achievement and seven interviewed students. I recommend that other researchers consider increasing the sample to 50 students and 20 interviewed students in this school district so that a larger sampling across the school district could be obtained. In particular, the interviews could add more to the professional literature as the student responses introduced new information that does not appear to be in the literature and reinforced much of what has been reported on 1:1 computing.

Personal Reflections

As a result of this research, I have established some very important "next steps" in the 1:1 computing integration process. I have learned that our students are engaged in a more evolving way of learning while 1:1 computing; however, the paradigm shift from traditional teaching to a more student-centred approach may be difficult for some educators.

From this research, I believe that it is imperative for our school district to continue to move forward with intensive technology training, ensuring a transformation in both curriculum and pedagogy for our school district in order to ascertain the sustainability of 1:1 computing learning environment is maintained.

In addition, I have come to the conclusion from this research project that the school district should monitor all students in the school district as they learn to use 1:1 computing rather than concentrating on the scores for the students. There are many insights that could occur as our 1:1 computing journey continues.

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Appendix A

Themes	Themes Count	Grade Four	Grade Seven
Direct Instruction	3	3	0
Secondary Sources	13	6	7
Problem-based Learning	5	1	4
Independent Learning	12	8	4
Scaffolding	10	6	4
Visual Project	4	3	1
Nonlinguistic Representations	23	10	13
of Learning			
Discovery Learning	30	3	27
Self-Regulated Learning	2	0	2
Technology Adoption	20	7	13
Student Centred Learning	14	0	14

1) Students provided step-by-step format-Direct Instruction.

2) Rely on Internet for research-Secondary sources.

- 3) Teacher students to work in groups research and put together-Problem-based learning.
- Teacher has put students into situations to learn on their own-Scaffolding.
 Teacher introduces application on the Internet-Distance learning.
- 6) Student using a PowerPoint-Visual product.
- 7) Use of Inspiration-Using nonlinguistic representations of learning.
- 8) Students discover facts and principles rather than being explained to them- Discovery learning.
- 9) Students take their own steps in order to learn-Self regulated learning.
- 10) Students using laptops-Technology adoption.
- 11) Students working on projects independently-Student centred learning.