

Running Head: Engagement, Technology, and Inquiry

Motivation and Engagement in Inquiry Based Learning with One to One iPads

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Abstract

Inquiry based learning using iPad computers was investigated to determine if there was an increase in motivation and engagement using this educational intervention. A multi case study of four students was conducted using pretest/posttest design, classroom observation, and follow up interviews with students and teachers. Three students showed gains in five or six motivation and engagement categories and a loss in one or two or no categories as measured by the Motivation and Engagement Scale-Junior School. One student's already high scores were stable except for showing a decrease in one category. Whole-interval sampling during iPad use and class discussion of inquiry searches showed intense engagement. Student themes indicated inquiry based learning with iPads was a good way to learn, that teacher and parental support were important to them, that choice and responsibility was appreciated, as were the ability to redo tests and assignments. Teacher themes indicated that inquiry based learning with iPads increased motivation and engagement, that students developed critical/deeper thinking skills, and became more self-reliant learners. Further exploration of this teaching method is recommended.

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Chapter One: The Problem to be Investigated

Introduction

I am a special education integration support teacher who has worked in the field for 14 years and experienced the shift in educational support from the resource room to the classroom, and from working only with identified students, to working with all students who need extra help. I am responsible for meeting the needs of numerous students with diverse needs in seven classrooms in grades six through eight in a middle school. I am looking for ways to support all children, addressing the issue of declining motivation and engagement, using inquiry based learning and technology.

Justification of the Study

Lack of motivation and engagement are a problem in the middle school. Students' levels of motivation and engagement decline markedly during early adolescence in middle school (Eccles, Wigfield, Midgely, Reuman, MacIver, & Feldauer, 1993) and high school (Martin, 2009). Lower levels of student engagement are associated with lower school grades (Goodenow, 1993), and lower achievement scores on standardized tests (Roderick & Engle, 2001). Student engagement declines within secondary school from the start to the end of the year (Marks, 2000; Skinner, Furrer, Marchand, & Kindermann, 2008). In contrast, high school students who perceived their classrooms as encouraging autonomy increased their engagement throughout the course (Hafen, et al., 2012). Inquiry based learning environments are examples of a type of classroom that encourages student autonomy.

Pintrich (2003) called for research on inquiry based learning classrooms with computers to study the impact they might have on motivation. He wrote about the culture of these classrooms being different in that they were more student centered and that the relationship of the teacher to

the student had changed so the teacher was more of a facilitator and less of a task-master.

Inquiry based learning is a good pedagogical fit with computer technology and with the higher order thinking skills needed to problem solve rather than just memorize facts. In inquiry based learning environments students are introduced to the basic principles of a field and are then asked to develop their understanding by solving structured or open problems. When sharing their solutions with others in the class students learn a process of comparing information and learn that there are multiple solutions. This process of problem solving is a skill that is learned rather than a set of particular facts. Students can then be assessed on their understanding of a topic rather than on fact based learning (Jones, 2009).

One study found that computer supported inquiry based learning enhances student motivation. Students working in this environment have more freedom to choose their tasks and learning goals leading to high engagement (Veermans & J rvel, 2004). Fleischer (2012), in his review article of students given access to laptop computers in a one to one ratio, states that the researched articles all showed a positive effect for a wide variety of reasons that relate to motivation and engagement. He found that students had more autonomy to choose their learning, students with special needs could join in the learning, students did more homework and gained more control, students wrote and revised more, and students shared more with each other and with their teachers.

In this study of motivation and engagement in an inquiry based class with one to one iPads, observed counts were taken for interactions between students and others to see if these were indeed ongoing during classroom activities. Student and teacher interviews and the Motivation and Engagement Scale-Junior School (MES-JS) (Martin, 2012) were administered to

determine if the intervention of inquiry based learning with one to one iPads had an impact on motivation and engagement.

Research Question and Hypothesis

My study is an action based research project based in a middle school multi-grade six and seven classroom using one to one computers to implement an inquiry based curriculum. My research question is: What effect will an inquiry based classroom with one to one iPads have on motivation and engagement in a middle school? My hypothesis is that students placed in an inquiry based classroom with one to one iPads will show increases in motivation and engagement in spite of the low levels of these measures expected in middle school. My research goal is to gain a better understanding of using inquiry based learning and one to one iPads as a possibly effective way of increasing motivation and engagement in middle school students.

Definition of Terms

This study is an action based research project on the impact of inquiry based learning using technology on the levels of motivation and engagement in a middle school class. An action research project is defined as “A systematic inquiry conducted by teacher researchers, principals and/or other stakeholders in the teaching/learning environment to gather information about how their particular schools operate, how they teach and how well their students learn (Mills, 2011, p.5).

Students will conduct research using inquiry based learning and one to one computers, in this case iPads. One to one computers means that each student has access to one computer. Inquiry based learning consists of several steps so that it :1) Creates a context for learning, 2) Sets up questions or problems to guide inquiry, 3) Students use a working theory, 4) Students search and share new information, and 5) Students improve on their theory and ask new

questions (Veermans, & J rvel, 2004). Within the context of this study, the Teacher 1 has added a sixth step and that is student application of their learning.

Motivation and engagement will be measured using the Motivation and Engagement Scale-Junior School using eleven categories to measure positive and negative thoughts and behaviours (Martin, 2012). The word motivation is derived from *movere*, which means to move. Motivation is what gets individuals moving and toward what activities or tasks. (Pintrich, 2003). Engagement is defined as “student ...effort and persistence in academic tasks, as well as their ambient emotional states during learning activities...” (Skinner & Belmont, 1993). In this study, levels of engagement were also observed in the class by counting time on task, field notes, and teacher observations gleaned through teacher interviews.

Brief Overview of Study

This study of inquiry based learning with one to one iPads took place in a school district on Vancouver Island, BC, Canada. Students were recruited from a multi-grade six and grade seven classroom to participate. One grade seven student, who had been in the pilot program for grade six, and three grade six students, participated. Three of the students were girls and one was a boy. In addition, two teachers working with this class were also recruited. The study took place during the second year of this pilot program.

The students were given the Motivation and Engagement Scale-Junior School at the end of October and again seven weeks later in December. After completion of this instrument in December, students were interviewed about eleven of the categories in the scale; asking them to explain their thinking when they had given their answers on the survey. A twelfth question asked them to describe what they would like teachers to know about inquiry based learning with one to one iPads. The interviews were recorded, transcribed, and analyzed for themes.

Students were observed in three classes for one minute intervals for a total of five minutes in each class, and were monitored for time on task and for numbers of interactions with other students, teachers and their whole class. During each minute of observation, if the child was off task for even a moment, they would be scored as a zero for that minute. The purpose of counting time on task was to see if there was any correlation between the engagement that was self-reported in the Motivation and Engagement Scale-Junior School and actual observed and recorded results in the classroom. The purpose of counting the number of interactions between students and their peers, their teacher, and the whole class, was to gauge if the students felt a sense of belonging through the number of interactions with others and also to determine if they were utilizing each other and their teacher as a resource and as an audience.

Two teachers taught in this classroom, and they were also administered a semi-structured interview to assess their views of teaching inquiry based learning with one to one iPads and whether they felt this might be an effective way of increasing motivation and engagement of students. These interviews were recorded and transcribed verbatim and analyzed for themes that were in common or standalone themes between teachers. Finally themes were compared between students and teachers.

Chapter 2: Background and Review of Related Literature

This study examines the impact of inquiry based learning and one to one iPads on motivation and engagement in a middle school. This literature review examines academic motivation and engagement in the school setting, and the impact of technology and inquiry based learning on levels of motivation and engagement in early adolescence.

The decline in student motivation and engagement during adolescence has been well documented (Eccles, Wigfield, Midgley, Reuman, Mac Iver, & Feldlaufer, 1993; Marks, 2000; Martin, 2009). Student engagement declines in high school from the start to the end of the school year (Marks, 2000; Skinner et. al., 2008). There are several theories about motivation and engagement and which help explain why early adolescence is a particularly vulnerable time for students leading to a loss of desire to engage fully in their education. There are also promising approaches to increasing motivation and engagement in academic work, one of which is inquiry based learning (Veermans & J rvel, 2004), and another of which is the use of one to one computer technology (Fleischer, 2012). Other advantages to the use of inquiry based learning and one to one technology is that it enables a diverse student population to gain access to an education (Fleischer, 2012) that is individualized for their interests and abilities (Maninger & Holden, 2009) increases technological skills, writing skills (Penuel, 2006), multi-media skills (Dunleavy, Dexter, & Heinecke, 2007) as well as promoting higher thinking skills . With one to one technology students are able to direct their own learning processes and create a sense of community in their own classroom that extended to the home and community (Dunleavy et al., 2007). These issues and claims will be explored in more depth in the following literature review.

Decline in Student Motivation and Engagement

Definitions for motivation and engagement have been quite varied, and measures for these concepts also vary across research studies. However, for the purpose of this study, motivation has been broadly defined as the thoughts that get a person moving towards doing a particular action (Pintrich, 2003) and engagement is broadly defined as “student ...effort and persistence in academic tasks, as well as their ambient emotional states during learning activities...” (Skinner & Belmont, 1993). The Motivation and Engagement Scale-Junior School (Martin, 2012) was selected as a practical measurement tool which measures different aspects of motivation and engagement from a wide theoretical base. The focus in this study is on adolescent student motivation and engagement in the academic setting.

Some students start a downward spiral of motivation and engagement during their early adolescence (Eccles, Wigfield, Midgley, Reuman, Mac Iver, & Feldlaufer, 1993). Eccles et al. (1993) argue that there is a mismatch between characteristics of the classroom environment in middle schools and the needs of early adolescents during their development. Eccles et al. (1993) based their work on three theoretical foundations, expectancy-value theory (Eccles et al., 1983), self-efficacy theory (Bandura, 1977), and intrinsic motivation theory (Harter, 1981; Deci & Ryan, 1985). In a longitudinal study of how students’ ability beliefs and achievement values changed during the transition from elementary school to junior high schools, 1,450 students completed questionnaires twice each year during grade six and seven. Mean levels of children’s self-esteem were lowest immediately after the transition to junior high school but recovered during seventh grade (Eccles, et al., 1989). Similar results were found by Wigfield, Eccles, Mac Iver, Reuman, & Midgley, (1991). In this longitudinal study both Eccles et al. (1989) and Wigfield et al. (1991) found that students’ self-esteem, ability beliefs and liking of math,

English, and social activities, declined during the transition from elementary school into junior high school along with the value they gave to these studies and activities. Transition to middle school created difficulties for sixth grade students who had lower self-esteem than students who did not transition into another school during sixth grade (Thornburg & Jones, 1982). When they compared classroom environments in the elementary and middle schools they found that the middle schools researchers found that the middle schools had less personal and positive teacher/student relationships (Midgley, Feldlaufer, & Eccles, 1989). In addition, there was less opportunity for decision making, choice and self-management in traditional middle schools (Ward, et al., 1982).

The Canadian Education Association initiative conducted a study with approximately 32,000 students in 93 middle and high schools participating in the Canadian Education Association initiative, *What did you do in school today?* (Willms, Friesen, & Milton, 2009). Students were surveyed to determine if they were intellectually engaged in their learning environments. The percentage of students who were intellectually engaged went up overall over the years 2007-2009; however, the increase was from 37% to 41%. This indicates that approximately 59% of students in the schools surveyed were not intellectually engaged in school. This level of disengagement was corroborated by Marks (2000) who found that 40% to 60% disengagement rates at the high school level were the norm.

Further analysis of the Willms et al. (2009) data (Dunleavy, Milton, & Willms, 2012) showed classroom practices had a greater effect on engagement than did factors outside the school such as socio-economic status. Marks (2000) also found that while gender and socio-economic status has a variable effect across the grades, the most important factors occurred within the classroom. Willms et al. (2009) found that of the four measures of school and

classroom climate they focused on, high expectation for success and positive teacher/student relations had the strongest relationships to gains in levels of intellectual engagement. Classroom disciplinary climate had a significant but weaker relationship to gains in intellectual engagement and effective learning time had no significant relationship to annual gains in intellectual engagement. Average annual increases in the percentage of intellectually engaged students declined from grade six to grade ten and no increases were found for grades eleven and twelve. The authors attribute this to increasing subject specialization, fixed course timetables, and the challenges of generating school-wide change in larger schools (Dunleavy, et al., 2012).

In this study, the impact of inquiry based learning combined with the use of one to one iPads on motivation and engagement was measured at the beginning and end of a seven week period to see if the declines reported in the literature could be reduced or even reversed for grade six and seven students. The Motivation and Engagement Scale-Junior School (Martin, 2012) was selected to measure levels of motivation and engagement to determine the effectiveness of this educational intervention.

Instrument. Martin (2009) developed and used the Motivation and Engagement Scale (MES) to measure motivation and engagement in the elementary school, the high school and university/college students. He found good construct validity of his instrument across the different ages and genders. He also found that elementary school students were generally more motivated and engaged than university/college students who were more motivated and engaged than high school students.

Martin's MES was developed to be a practical measure of motivation and engagement based on a variety of motivation and engagement theories and includes both adaptive and impeding cognitions and behaviours reflecting cognitive and behavioural elements of goal

orientation and self regulation theory (Pintrich & Garcia, 1991; Zimmerman, 2008). In the MES there are 11 categories that reflect aspects of motivation and engagement such as self-efficacy (Bandura, 1997), attribution and control (Connell, 1985; Weiner, 1994), and valuing (Wigfield & Eccles, 2000). Starting with the specific items measured, students are asked about their (a) self-efficacy (Bandura, 1997), (b) learning which represents mastery orientation within intrinsic motivation in self-determination theory (Ryan & Deci, 2000) and mastery in achievement goal perspectives (Kaplan & Maehr, 2007), (c) valuing is based on expectancy-value theory (Wigfield & Eccles, 2000), (d) persistence, (e) planning, and (f) task management, central learning strategies in self-regulation (Pintrich & Garcia, 1991; Zimmerman, 2008), (g) anxiety, and (h) failure avoidance which represent maladaptive or impeding constructs in achievement need/motives and self-worth theories (Atkinson, 1957; Covington, 1992), (i) uncertain control, the perceived controllability of outcomes in attribution theory (Connell, 1985; Weiner, 1994), (j) self-handicapping, a behavioural strategy to protect one's self-worth (Covington, 1992), and finally (k) disengagement, a negative behavioural consequence of negative self-appraisals about ability and/or tasks in the academic context (Skinner, Kindermann, Connell, & Wellborn, 2009). An example of 11 sample questions addressing the 11 categories may be seen in Appendix A. Sample questions are shown because these have been published (Martin, 2007), while the actual instrument is sold for commercial purposes.

Autonomy and Engagement

Greater autonomy for adolescents in the classroom has been linked to greater motivation and engagement. In a study of 805 students in grades four through seven, (Skinner, et al., 2008), students were questioned at the beginning and the end of the school year about their self-perceptions. The authors used a self-system model of motivational development to determine if

the context of a supportive teacher in terms of warmth, structure, and support for student autonomy influences how individual students feel about themselves in the areas of relatedness, competence and autonomy. They found that if the students are feeling that they belong, are competent, and that autonomy is encouraged, they are more likely to become engaged rather than disaffected. Student perceptions of autonomy were particularly powerful in maintaining student engagement.

Autonomy has been found to be pivotal in engagement of students in the secondary school classroom (Hafen, et al., 2012). 578 high school students were given questionnaires at the start and end of a single course. Students who perceived their classrooms as encouraging autonomy in the first few weeks increased their engagement throughout the course, which is opposite to the engagement trend found in students in regular classrooms. The self-perceptions of students were validated by observations of student engagement, a comparative strength of the Hafen et al. (2012) study.

Hafen et al. (2012) used the theoretical framework of self-determination theory (Ryan & Deci, 2000) to explain that there are three needs that form the basis for an individual's self-motivation and well-being. These needs include competence, relatedness/connection, and autonomy. Of these three factors, autonomy was found to be the pivotal factor when introduced early in the school year as students maintained their engagement at high levels throughout the year. Inquiry based learning gives more choice and autonomy to students and thus was the context chosen for the current study.

Inquiry Based Learning

Inquiry based learning has been linked to increased motivation and engagement in students, largely because of increased autonomy in this method of instruction (Paris & Turner,

1994; Blumenfeld et al., 1991) but also because it has been shown to promote communication, collaboration, creativity and deep thinking (Barron & Darling-Hammond, 2010), factors that will also increase motivation (Blumenfeld et al., 1991). Inquiry based learning (IBL) incorporates different types of overlapping families of research some of which are called project-based learning, problem-based learning, and learning through design (Barron & Darling-Hammond, 2010).

Paris and Turner (1994) speak about problem-based learning as a way to create a situation that is likely to increase motivation and engagement. They write about four main characteristics of teaching environments that have been found to increase motivation for children to learn, and they are choice, challenge, control, and collaboration. Having an interesting question to pursue that allows students the choice to follow their own interests, seeking information from various sources, collaborating with others, organizing and integrating information for presentations, and integration across subject areas, allows for a teaching method that will promote engagement and motivation.

Barron and Darling-Hammond (2010) reviewed the literature and found that inquiry based learning results in students who think more deeply as a result of applying the knowledge they learn to real-world problems. The methods used in inquiry based learning promote communication, collaboration, creativity, and deep thinking, all of which increase motivation and engagement. The successful implementation of inquiry based learning is dependent on the quality of assessments of both the learning tasks and the content that has been learned. Teachers need the knowledge and skills to successfully scaffold students during their projects and provide ongoing assessments to direct students in their learning research (Barron & Darling-Hammond, 2010).

In their discussion of prior research Blumenfeld, et al. (1991) observed that project-based learning is motivating for students as it allows students to follow their own interests and explore areas of learning that they value. Project-based learning includes variety, challenge, choice, cooperation and closure when answering real life relevant questions. Project-based learning requires sustained student effort over time and requires delving into various subjects while solving the problem. No longer are math, science, language arts and social studies discrete and separate. Project-based learning also requires the development of metacognitive learning strategies so students can guide and control their own activities and deal with the inevitable errors and frustration encountered along the way.

Blumenfeld et al. (1991) note some difficulties in establishing problem-based learning classrooms, particularly in the areas of teacher beliefs, knowledge, and commitment to project-based learning. Teachers' roles in project based learning only start with providing access to information. Teachers also need to scaffold instruction, and guide students to make tasks manageable. Teaching students how to learn and become aware of their own thought processes are required for project-based learning as is assessing progress, diagnosing problems, giving feedback and evaluating overall results. Teachers need to encourage risk-taking, thoughtfulness and focus on learning, not performance. At the same time, students must be held accountable for active learning and understanding. According to Blumenfeld, et al. (1991) many teachers still focus on fact retention, assess publically, and give competitive reward systems; instructional practices that reduce motivation. Belief systems must be challenged and new and more complex work habits established if problem-based learning is to be adopted in schools (Blumenfeld et al., 1991).

The effectiveness of inquiry based learning. The fluidity of the term inquiry based learning and the different ways this type of instruction is utilized has created difficulties in defining what inquiry based learning is and also in performing a meta-analysis of the data of the effectiveness of inquiry based learning. However, a meta-analysis of inquiry based learning in science was done (Furtak, Seidel, Iverson, & Briggs, 2012) by using extensive criteria to focus on 37 experiments in 22 papers. The findings showed a mean effect size of .50 with even greater effect sizes shown for studies that focused on epistemic activities, or a combination of epistemic, procedural and social activities compared to more traditional teaching methods which largely focused on conceptual teaching. Conceptual domains focused on the facts, theories and principles of science. The epistemic domain focused on how scientific knowledge is generated by the students collecting, evaluating, and interpreting evidence to develop explanations for phenomena. The social domain focused on collaboration and communication processes to collectively construct and represent and present scientific knowledge. The procedural domain focused on methods that include questions, designing experiments, executing procedures and creating data representation. Furtak et al. (2012) concluded that there are positive effects of using inquiry based learning especially in the areas of epistemic, social and procedural domains with an emphasis on teacher led activities. They speak of a continuum of teacher guidance and support and allege some of the criticisms of inquiry based learning (Kirschner, Sweller, & Clark, 2006) are based upon minimal instruction and scaffolding for students which leads to ineffective results.

Inquiry based learning, computers, and motivation and engagement. In a case study investigating student engagement in computer-supported inquiry J vrel, Veermans, and Leinonen (2008) chose two 14 year old students with contrasting motivational approaches: task

oriented and non-task oriented. Three scales from the self-reporting Goal Orientation and Motivational Beliefs questionnaire were used (Niemivirta, 1998) to determine levels of avoidance, performance and learning orientations. Hanna, the female student, was characterized as withdrawn and showed avoidance behaviours and negative emotions to tasks. Matti, the male student, was characterized as an active student who masters tasks in order to learn. A literary inquiry project on science fiction using Knowledge Forum (Scardamalia & Bereiter, 1994), an on line site where information can be shared and worked on as a group. There were 20 internet connected computers in the class for the 18 students present. The steps in inquiry were creating a context, set up questions, creating a working theory, searching and sharing new information and improving on their theory by setting up subordinate questions. The teacher guided the students extensively at first by providing a context and helping students to set up questions and then was available to help on an ongoing basis. The students were expected to expand and share their inquiries each step of the way both in the classroom and using Knowledge Forum, where their ideas would be presented and commented upon. The study aimed to gain an understanding of engagement and its relationship to supported inquiry classroom practices.

Data was collected for on and off task behaviours, computer notes on Knowledge Forum were collected and analyzed, the Experience-sampling Method questionnaire was used to gather real-time data about student's experiences. Interviews were also conducted. Results were that both students progressively increased their task engagement. J vrel et al. (2008) speculate that collaborative inquiry activities provoked social goals which were more important to Hanna. Interview data indicated that writing in the Knowledge Forum helped Hanna to form metacognitive awareness. The fact that Hanna loved reading and that this inquiry required reading resulted in more time on task and incidentally more time planning her activities. J vrel et

al., (2008) point out that inquiry based learning allows students to focus more on their individual interests which is positively correlated with student attention, persistence, and positive emotions leading to better learning processes (Ainley, Hillman, & Hidi, 2002).

Matti, who was already task-oriented, became even more so as he was already curious about this new learning opportunity and was skillful in having strategies for learning in any new learning environment. Matti did not explicitly express any metacognitive activities which the authors' assume are because his learning processes are already automatic and of a high level of expertise.

Both pedagogical and technological approaches used in this study provided structure for students guiding their activities and reducing uncertainty. The Knowledge Forum provided space and time for students to connect and progress at their own pace and follow their own interests within a scaffolded environment. The multiple ongoing methods of data gathering as part of this study were crucial to these findings of increased engagement which could have been overlooked without this degree of focus and real-time feedback from the students.

The process of inquiry based learning enhances deeper thinking skills, communication and collaboration (Barron & Darling-Hammond, 2010). In addition procedural knowledge is gained (Furtak, et al., 2012) when learning strategies of how to ask questions, gather information, organize and analyze information, communicate results, and apply the information. Using inquiry based learning can result in increasing motivation and engagement for students who are already task-oriented but also for students who have shown task-avoidance (J vrel et al., 2008).

One to One Computers

Context. The idea of using computers in the school is not a new one. In the 1960s computer labs were being set up in schools to test out the idea of using computers for drill and

practice in math. Other simple programs were being tested out on students to see if the computer as teaching tool would be useful. Then, like now, computers were often put in separate classrooms, and teachers were encouraged to take their students to the lab to use them. Computers have changed since then and so have the reasons for using them. Now computer use is ubiquitous, in the home, at work, in the community, and in schools. Mobile phones have morphed into mobile mini computers and many people have them at all times and use them for a myriad of expanding functions personalized to each individual's needs. Computers give access to information on the web, and to communications, libraries, medical help, media, music, on line education, and to people around the world. Students with special needs, along with the rest of the population, can join in with the on line community. This "ubiquitous computing technology" was predicted by Mark Weiser who described how computer interfaces would move into everyday objects (Weiser, 1991). Weiser (1994) also predicted that good technology would become invisible. "A good tool is an invisible tool. By invisible, I mean that the tool does not intrude on your consciousness; you focus on the task, not the tool" (p. 7). Weiser (1991) explains that this is not a function of the computer but of the psychology of humans. "Whenever people learn something sufficiently well, they cease to be aware of it"(p 78).

Various school districts have introduced one to one computers for each student in the belief that ready access to technology is essential in preparing students for full engagement with an information based technology. In 1999 and 2000, the state of Maine, led by Governor Angus King, decided to use a surplus of money to give personal learning technology to all of its middle school and high school students and teachers. The Maine Learning Technology Initiative made a plan to provide long term support in the form of professional development, funding for computers, funding for upgrades, funding for technical support, and a structure by which the

initiative could be supported through time. Apple computers won the contract. By 2010, 100% of the middle schools had 1:1 computers, and 55% of the public high schools. The reasoning behind this initiative was fivefold: (a) equity, (b) integration with Maine's Learning Results, (c) sustainability/avoiding obsolescence, (d) teacher preparation/professional development, and (e) economic development (Maine Learning Technology Initiative – Maine Department of Education, 2012).

Other specific reasons for the one to one computer initiative in Maine was that two thirds of all jobs already utilize computers and Governor King wished Maine's students to be prepared. The justifications reported were to access electronic data bases and gain internet access to resource materials; to encourage multimedia projects that integrate information from many resources; to gain contact with practitioners in many fields via network use; to use computer tools, probes and simulations; to network and collaborate with others; and to have ready access to computers in an equitable manner for all students (Task Force on the Maine Learning Technology Endowment, 2001).

A Canadian example of one to one computer use is the Wireless Writing Project initiated in Peace River North in 2001. Each Grade 6 and Grade 7 student was given a laptop computer to use both in school and at home and instruction was given to enhance their writing skills. Students were assessed on their writing abilities over two years in the fall and spring of each year. Dr. Sharon Jeroski reported on the results of this initiative and stated that almost all the students were at least minimally meeting the writing expectations at the end of Grade 7. The author notes that most of the growth in writing skills occurs in Grade 6 and it is sustained and developed in Grade 7. Dr. Jeroski attributes these gains to "the initial novelty of having laptops, or to the age/developmental level of students" (p. 15). Dr. Jeroski also reported that there were

strong differences between schools in overall gains as well as the patterns of those gains over two years (Jeroski, 2009). Apple issued a press release as to the success of the project (Apple, 2004).

Review studies. Three key review studies were conducted on one to one computers in the schools by Apple Computers Inc., (2005); Penuel, (2006); and Fleischer (2012). These studies looked for gains in student achievement and came back with mixed results. All authors reported weaknesses in the studies of one to one computer use attributable to weak study designs such as lack of random samples, lack of pretest/posttest methods, and lack of control groups. Apple Computers Inc. (2005) noticed that there were not large changes in subject specific achievement, but there were increases in writing skills, technology skills and student engagement. Penuel (2006) noted that half the studies in his review reported positive effects of laptop programs on student motivation and engagement, but only three measured it. Fleischer (2012) reviewed 18 empirical studies published from 2005-2010. In his review of students given access to laptop computers in a one to one ratio Fleischer states that the researched articles all showed a positive effect for pupils' learning experiences for a wide variety of reasons that relate to motivation and engagement. Students had more autonomy to choose their learning; students with special needs could join in the learning; students did more homework and gained more control; students wrote and revised more; and students shared more with each other and with their teacher.

In the review conducted by Apple (Apple, 2005) there is the problem of having a computer giant like Apple sponsoring a research review as it raises the obvious question of bias. Nonetheless this paper is an important one as it described the findings from 30 separate studies of one to one initiatives. In particular, this study looked at the design features and factors that influenced teachers and implementation as well as the outcomes of one to one computer use. The

goals of the studies fell into four main groups: academic achievement, equity of access to digital resources, economic development by preparing students for the workplace, and enhancing teaching (Apple, 2005).

The results of how the computers were used by students varied depending on how new the program was to the teachers. Students initially used the computers for searching the net, word processing, communicating with peers and their teachers, and keeping organized. Few computers were used to develop basic skills. However, as teachers became more adept with the technology, they used more student-centered learning, such as project based learning. Then students were able to use design and multimedia tools, presentation software, photography and movies. The shift to more personalized learning for students is enabled by teachers widening their scope away from tightly controlled teacher made assignments (Apple, 2005) leading to more autonomy for students.

Penuel (2006) conducted a review of 46 studies on one to one computers, which was funded by Apple. These studies were selected because they used systematic methods for investigating implementation and outcomes. From his synthesis, Penuel (2006) noted that some initiatives are attempting to make instruction more student centered with the introduction of one to one computers; using more differentiated problem or project based learning and demanding higher order thinking skills (Penuel, 2006). He also noted that there are varying degrees of adoption of one to one technology so that teachers who are learning how to use the technology are having students use basic word processing, emails, and research on the internet. Teachers who use project based learning engage in more extensive computer use, and use presentation software, and software for making and editing digital images and movies. Many teachers were

surprised at the high skill levels of students using multimedia tools and they responded by assigning more complex and challenging work (Light, McDermott, & Honey, 2002).

Penuel (2006) also observed that there is a need for ongoing technical support so that teachers don't have to make two sets of assignments for when the computers aren't working or there is trouble accessing the web. Apparently students have been used extensively as the first line of technical support and were utilized formally as "iTeams" in the Maine initiative (Silvernail & Lane, 2004).

Of the outcome studies reviewed by Penuel (2006) only four were pretest/posttest designs and seven used comparison groups. Results showed positive effects in computer literacy and writing. While half of the 48 studies reported positive motivation or engagement, only three studies actually measured it (Lowther, Ross, & Morrison 2003; Russell, Bebell, & Higgins, 2004; Trimmel & Bachmann, 2004.)

Trimmel and Bachman (2004) reported that laptop use increased student achievement motivation with corresponding increases in school attendance and interest in learning. They also reported an increase in school related interaction among students who used laptops for project based learning.

A review of peer reviewed articles by Fleischer (2012), examined the literature on one to one computer projects in school settings covering the period of 2005-2010. Six hundred and five articles were screened, 36 were analyzed and 18 were closely looked at. Results showed that the research field has not developed since the earlier review articles in 2005 and 2006.

Fleischer (2012) states " ...research on one to one is scattered. On the positive side, this provides the opportunity for cross-disciplinary attempts to understand this field. On the negative side, although more than a decade has passed, it is quite hard to conclude if one to one projects

have the educational value that their advocates claim. There are many blind spots in the research. It is a field easily contaminated by biases, for example, the ones produced in the market” (p.120)

Fleischer (2012) believes that one of the difficulties of determining the success of one to one projects is that they depend upon conditions that are individual to each school. Another difficulty is trying to accurately measure knowledge formation. Finally, the projects that use the one to one computers have not been clearly described.

Fleisher (2012) split the studies he analyzed into Pupil Related Results and Teacher Related Results. Out of the 18 articles he selected the most frequent research foci which were instructional methods, learning strategies/styles, computer-aided communication/interaction/presentation, progress/tests and information search skills.

He pointed out that none of the studies focused on the qualities of knowledge formation. In addition, none focused on the effects of implementing the one to one projects such as the psychosocial environment, verbal communication in the classroom, bullying, or stress.

Pupil Related Results show that the amount of usage went up with one to one computers. Types of usage were (a) exploration (searches) and simulation, (b) expression (Word, Excel, PowerPoint), writing across genres (brochures, information letters), Imovie, Garageband, wikis and blogs, (c) communication such as email, discussion forums, messenger to increase collaborative learning and interactions, and (d) organization of student work (OneNote for note taking). Thus skills were developed in using software which enabled students to reach out to the larger community (Fleischer, 2012).

Conclusion

The problem of declining motivation and engagement in adolescent students may be addressed by using inquiry based learning that is enhanced with one to one computer

technology. Inquiry based learning is thought to increase motivation by allowing students to direct their learning to their areas of interest through increased areas of autonomy and choice, including social components through collaboration and support from teachers and peer, and through increasing competence in gaining procedural knowledge and strategies. These components of autonomy, a sense of belonging and competence are all described in self-regulation theory. One to one computer technology has been shown to increase motivation and engagement. Students gained more autonomy and control, students could communicate and collaborate using the technology, students with special needs could join in, and students could use the technology to show what they know. Combining inquiry based learning and one to one computers has also shown increases in motivation in individual students.

Chapter 3: Procedure and Methods

Description of the Research Design

The problem this study sought to address is that there is a noted decline in student motivation and engagement during the early adolescent years leading to declines in academic achievement (Eccles, et al, 1993; Martin, 2001; 2009; Wigfield & Tonks, 2002). A case study approach was used to examine levels of motivation and engagement in a multi-grade 6-7 classroom in response to inquiry based learning (IBL) with one to one iPad technology. The purpose of the study was to examine if the students' motivation and engagement increased due to their participation in IBL with one to one iPad technology and to determine what aspects of the program, if any, the students particularly enjoyed.

A mixed method multiple case study approach was chosen using a pre-test and post-test design, structured observation of students, and a short semi-structured interview of individual students and their teachers. This method was chosen upon the suggestion of Martin (2009) so that data from multiple sources could be triangulated to increase trustworthiness; it also allowed for exploration of student and teacher interpretations about their experiences with the educational intervention being used (Guba, 1981).

Quantitative data was gathered at the beginning of the school year with the Motivation and Engagement Scale-Junior School (MES-JS) (Martin, 2012). Observational data was collected using whole-interval sampling in which the students were scored positively only if the time on task behavior was observed for the full duration of the minute they were being observed (Chapman, 2003). Students were observed for five minutes a class using one minute intervals. Observational counts of time on task were done to measure engagement and numbers of communications with others were done to indicate a sense of belonging or relatedness during

three class blocks for each student. Communication with others was classified as communication with teachers, educational assistants, students, the researcher participant, or the whole class

Qualitative data was collected by taking field notes on each classroom to gather rich descriptive data (Guba, 1981). Students were interviewed using a semi-structured interview format to explain their thinking using questions reflecting the 11 categories on the MES-JS. Teachers were also interviewed in a semi-structured interview asking them if they thought IBL with one to one iPad computers increased motivation and engagement for their students and to reflect on other aspects of teaching this program. Information from all sources was triangulated to improve trustworthiness (Guba, 1981).

Description of Sample and Context

Students were selected from a pilot program in a Grade 6-8 middle school in the greater Victoria, British Columbia area; the program had started one year before this study took place. There are approximately 550 students attending this school supported by about 24 teachers, three counselors (two part-time), three support teachers, and 14 educational assistants. In the school, a pilot project was conducted for the first year in two Grade 7 classes sharing a class set of iPad computers so that each student had this tool for inquiry based learning in all their science, social studies, and language arts classes. This study took place during the second year of the program during which time the classes became multi-grade 6 and 7 classes with some of the grade 7 students remaining in the class from the previous year. One classroom was selected for this research as the teacher was enthusiastic about participating, and while all students in the class were invited to participate, four students accepted.

Of the four students participating in the study three were female and one was male. Three students were in Grade 6 and were 11 years old and one student was in Grade 7 and was 12 years

old at the time of the study. According to their teachers, they came from middle class families and did not experience lack of food, clothing or access to technology at home.

Teacher 1 and Teacher 2 were also participants in this study as they both work with the class and both were interviewed, however, only one teacher was observed teaching during the student observations. Both teachers are experienced and skilled in using inquiry based learning and are adept at using technology. Further identifying information has been withheld in order to protect anonymity.

My role in the school is as an integration support teacher with 14 years of experience. While I was available to assist students after my initial observation periods, all educational decisions for the students in this class were made by their teachers.

All students were introduced to the methods behind inquiry learning, where a main open ended question in a subject area is selected, and the students conducted research online to access the information they needed. Probing questions were asked by the teacher to insure that there was depth to the learning. Both teachers were available to coach the process, and students were encouraged to help each other as well.

Students had signed contracts in September regarding their use of iPads for inquiry stating that they would follow class rules when iPads are used: responsibly, purposefully, and carefully. Students who were weaker in technology use were supported by their peers and their teachers in previous classes. The class did not get integration support during my observations. The inquiry based learning methodology used in this classroom included the steps of (a) creating a context for learning, (b) setting up questions or problems to guide the inquiry, (c) students using a working theory, (d) students search and share new information, and (e) students improve on their theory and ask new questions (Veermans & J rvel, 2004), and the teachers added (f) students

apply what they have learned in their own context. This application of the findings is considered very important by the teachers as it provides meaning and relevance to the inquiry that has been done.

Intervention

In this study, the teacher makes sure that the students are setting up their own questions within a learning context determined by the teacher, and this takes some practice, as students are combining what they wish to know with guidance from the teacher as to what is a feasible and researchable question that promotes depth to the student's thinking and learning. It is important that the students ask their own questions because then the learning is based upon the student and their individual interests and abilities, not what the teacher wants to teach. The teacher uses guided, structured, and open inquiries, and is there to guide students continually.

One goal of the teacher is to teach how people learn so that students can become self-aware when they are thinking deeply and can articulate their thought processes. Another goal is that students understand what they need to learn and to do what is necessary to determine their own application of their learning. Additionally, the teacher is building self-belief in the students by showing students how to trust their thought processes, how to ask and answer their own worthwhile questions, and how to share, modify and improve their initial theories. Skill sets such as working with the iPads, finding out which sources are reliable on line, organizing, analyzing and presenting data, constructing knowledge as a group, upgrading working theories, and apply what they have learned are other areas that are being taught and developed. The teachers are directly teaching students what is needed to become self-reliant and self-regulated independent learners who are fully engaged in creating their own learning.

Students were observed during three classes of inquiry based learning and descriptions of the class contexts during those observations are given below.

Observations

Class one. In class one, the teacher created the context for learning in the class in a previous class session by setting up an initial inquiry in which students could pick something they would like to be in the future with a particular focus of what they are learning about themselves through their dreams and choices. Students were asked to determine a career, and then to research what they would need in terms of education and training in order to access that career. The observation took place after the initial research was done and the teacher was giving instructions on how to organize and expand on this inquiry. This particular inquiry was highly structured with instructions but had choice built in regarding which career was being researched and scope to widen the search about the career to interviewing people as well as searching the net. Even though it was only October, it was a given that students could present their information in different ways. Suggestions were given for organizing information for students who might be at a loss, with the assurance that if students wanted to organize their information differently they had the choice to do so.

Class two. In this class the students were beginning a year-long inquiry in creating their own society in a world where there were no other societies or human influences on the earth. This was an interdisciplinary inquiry focusing on support systems for citizens, such as health and safety, global interactions and order (government and laws). It was intended to integrate what students had been learning in social studies, science and language arts. The students' first task was to determine criteria for situating their 100 km country by connecting what they had learned in their adventure novels, the survival simulation, what they had learned about themselves in the

career inquiry, and how living things are able to survive in ecosystems. The next step was to determine a location on the world map and to justify it using the criteria the students had selected. The research to select a country was done with iPads during this class.

Class three. The third class was a follow-up class to the research done on iPads the day before. In this class the iPads were put away and students were given instructions about organizing the information on their countries in two ways. First to break into discussion groups to argue why their country had been well chosen according to the criteria they had selected. Second, the students were told to find all of the weaknesses of another student's selection of location. The students were avidly preparing and engaged in their discussions with an intensity that was palpable.

An instrument was needed to measure student motivation and engagement to determine if the motivation and engagement perceived by the researcher was corroborated by other measures of student motivation and engagement.

Instruments Used

The MES-JS was selected as an instrument to measure motivation and engagement because it was based upon multiple theories of motivation and engagement, had good reliability and validity in the high school version, and had been modified to use simplified language and a one to five point scale more suitable to younger students (Martin, 2009; Martin 2012). In addition, Martin (2009) has recommended the use of this instrument for program evaluation. See Appendix A for an example of the type of questions used on the MES-JS (Martin, 2009).

The original structure of the MES, both Junior School and High School versions consists of four higher order dimensions: adaptive cognition, adaptive behaviour, impeding/maladaptive cognition, and maladaptive behavior. Adaptive cognition consists of three second order

dimensions: self-efficacy, mastery orientation, and valuing. Adaptive behavior consists of three second order dimensions: persistence, planning and task management. Impeding/maladaptive cognition consists of three second order dimensions: anxiety, failure avoidance, and uncertain control. Maladaptive behavior consists of two second order dimensions: self-handicapping and disengagement. These components have been placed in a Motivation and Engagement Wheel (Appendix B) to facilitate communication with students, parents and teachers (Martin, 2009).

The theoretical basis for the components of this Motivation and Engagement Wheel has been explained by Martin (2009) as follows: (a) Self-efficacy is based on self-efficacy theory (Bandura, 1997), (b) mastery orientation is based on self determination in terms of intrinsic motivation (Ryan & Deci, 2000) and motivation orientation (Dweck, 1986, Martin & Debus, 1998), (c) valuing is based on the work of Eccles (1983) and Wigfield and Tonks (2002), (d) persistence, planning and task management come from self-regulation theory (Martin, Marsh, & Debus, 2003; Zimmerman, 2002), (e) uncertain control comes from attribution and control theory (Connell, 1985; Weiner, 1994), (f) anxiety, failure avoidance, and self-handicapping and disengagement, come from need achievement and self-worth theory (Atkinson, 1957; Covington, 1992; Martin, Marsh, & Debus, 2001a, 2001b; Martin & Marsh, 2003).

Administration of all instruments took place in a private classroom which is not visible to other students. The time selected was during times selected by the Teacher 1. The MES-JS was administered as a written survey with the researcher available to read questions out loud in case of reading comprehension difficulties. The administration of this instrument took about 15-20 minutes.

Individual students were interviewed with eleven questions that represented the eleven categories on the test (Martin, 2007) and asked what they were thinking when they answered

these questions. The twelfth question asked them what they thought about being taught in an inquiry based learning classroom with one to one iPads. To see a copy of the Student Interview Script see Appendix C.

The teachers were asked whether they thought IBL with one to one iPads increased motivation and engagement with their students. Additional questions regarding their thoughts about teaching the program were asked. See Appendix D for a copy of the Teacher Interview Script.

The Observation Count and Field Notes form (see Appendix E) was used to take counts of observed time on task and number of interactions with others for each student. Whole-interval sampling (Chapman, 2003) was used so that a student was scored as being on task only if they were on task for the entire minute they were being observed. Observations were taken across three classes in one minute intervals for each student with a total of five minutes for each class and 15 minutes for the study. Field notes were also taken to record what was being taught in the class that was being observed, and any other pertinent observations.

Procedures

A proposal for this study was submitted to the Vancouver Island University research ethics board, and approval was obtained by September, 2013. A thesis proposal was submitted to the superintendent of School District 63 and to the principal of the middle school where this study took place. Approval was obtained from both the superintendent and principal in October, 2013.

Parents of students who would be placed in the inquiry based learning classroom with iPads were sent letters of permission for parents and students along with a Parent Recruitment Poster and a self-addressed stamped envelope addressed to the researcher. In addition, a drop box was left in the main office. It was explained that the researcher was not engaged in any

educational decisions for these students and was not case managing them at the time of the study. There would be no repercussions for not participating in the study and participants could withdraw at any time. Parents were informed that it was likely that participation in this study would be noticed by classroom peers, and would be known by the researcher, so while students would not be anonymous, results for individual students would be kept confidential. Students' code names that were linked to their actual names were hand written and stored in a locked cabinet separately from electronic and coded student data.

Participating students were administered the MES-JS, in October and seven weeks later in December, in a private classroom, while the non-participating students were engaged in other activities for 15-20 minutes in their own classroom. The researcher introduced the instrument, explained the five point scale, read all the questions the first time, and was available to read and clarify other questions as needed in December. A few days later, students were interviewed in the same private classroom, and were asked individually what they were thinking when they looked at 11 questions that were similar to those on the MES-JS. The 12th question asked what they thought about inquiry based learning with one to one iPads.

Three classroom observations were done and counts of time on task and interactions with others took place in November and December. Observation times were selected that were convenient to the teacher and the researcher, but which also included a range of activities, including the use of iPads. Field notes were taken observing what was being done in class at the time.

Teachers were also interviewed in December using the Teacher Interview Script to elicit their thoughts on the impact of IBL using one to one iPads.

Validity

This study attempted to explore if inquiry based learning using one to one iPads had an effect on motivation and engagement of middle school students. The internal validity of the study is weakened when other factors could be the cause of change in measures of motivation and engagement. Many factors outlined below might weaken scores for motivation and engagement but the educational intervention of inquiry based learning with one to one iPads is the main variable that might increase scores for motivation and engagement. Another factor might be the increased attention given to students and their own increased interest because the program is relatively new.

Most variables would decrease motivation and engagement. Maturation is not likely to be a cause of increased motivation or engagement as studies have shown that Grade 7 is a time of decreasing motivation and engagement (Eccles et al., 1983). Other distracters such as puberty, friendship formation, and family and life events such as divorce, death in the family, and health issues would all tend to lower motivation and engagement scores but should be equally present before and after a seven week period based on chance.

Like most action research, the external validity of the study is poor as the generalizability of results to other groups is questionable based upon the results of four students in a context specific setting. However, according to Guba (1981) the trustworthiness of the study is enhanced through the use of multiple sources of data, through students' self-reports on the MES-JR and follow up questions, triangulated with multiple researcher observations and field notes, and teacher follow up questions. These multiple sources provide credibility to the study. Collecting detailed descriptive data adds to the transferability of the study so that readers can decide for themselves if there is a good fit with their own setting. In addition, by overlapping methods of

data collection, such as surveys and observation the dependability and confirmability of the data is improved. Reflecting on the data also adds to the confirmability of qualitative research (Guba, 1981).

The content validity of the MES-JS is strong (Martin, 2001, 2007, 2009; Martin, Malmberg, & Gregory, 2010). It has been used on 1,249 students in 63 classes in 15 schools with 53 % of students aged 11 years 7 months to 13 years old. The mean reliability (Cronbach's alpha) for the 11 subscales is .78. The MES-JS is based on the MES-HS which has been used with 21,579 students in 58 high schools. The MES-JS has been modified to use simpler language for younger students and the scale has been adjusted to a five point scale from the seven point scale used for high school students in the MES-HS (Martin, 2009; Martin, 2012). The main weakness of using this instrument is that it was developed and studied in Australia. Cultural differences could result in different outcomes in Canada.

Data Analysis

Data was analyzed on a group level and on a case by case basis. Test results from the MES-JS were scored using the procedures outlined in the MES-JS Test User Manual (Martin, 2012) and profiled as a group. Results obtained in October were compared to results obtained in December (see Table 4.1) and the direction of change in scores was noted (see Table 4.2). Individual results were examined in the case study descriptions and compared to answers obtained from the Student Interview Script (Appendix C).

Counts of time on task and number of interactions with others were intended to be measures of engagement and belonging or relatedness. These measures were compared to the field notes so that the context of the results were well understood.

Answers to the interview questions from students and their teacher were recorded, transcribed and searched for common themes and these were compared to MES-JS scores and to each other to see if there were any overlapping themes. Field notes were also used to provide a rich description of the context.

Chapter 4: Findings and Results

Summary of the Research

In this study the impact of inquiry based learning with one to one iPads on motivation and engagement was examined in a multiple case study of four students in a multi-grade six and seven class in a middle school. One student was in grade seven and the other three, were in grade six, three students were female and one was male. Brief descriptions were given about each student by their teachers during interviews with the teachers in December. Names have been changed to pseudonyms and grade and gender information has been withheld in order to protect anonymity.

The original question of this research was “What effect will an inquiry based classroom with one to one iPads have on motivation and engagement in a middle school?” It was hypothesized that there would be an increase in motivation and engagement in this setting; going against the trend of declines in measures of motivation and engagement in middle schools.

Findings and results have been divided into two sections, student and teacher. The student section includes a presentation of student results as a group followed by a case study description of each student with their individual results. Results from the Motivation and Engagement Scale-Junior School (Martin, 2012) in a pre-test/post-test design are reported in the group data as are observation notes on time on task and numbers of interactions with others. The themes that emerged from the students are also reported as a group and compared to each other.

Individual descriptions of the students were gathered from teacher interviews and reported in the case studies. Results from the Motivation and Engagement Scale-Junior School (Martin, 2012), are compared to results from student and teacher interviews. Possible explanations for individual results on the MES-JS are explored in the case studies.

The teacher section includes themes that emerged from the teacher interviews. These themes are compared to the themes that emerged from the students.

Comparing Data Across Students

Results from Motivation and Engagement Scale-Junior School.

Table 4.1

Student Scores on the Motivation and Engagement Scale-Junior School

Category	<u>Alex</u>		<u>Brook</u>		<u>Cory</u>		<u>Dale</u>	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Self-Belief	A	A	B	B	B	A	B	A
Valuing	B	B	B	A	A	B	B	B
Learning	A	A	A	A	B	B	B	A
Planning	A	A	B	A	B	A	C	B
Task Management	B	B	B	B	B	B	B	B
Persistence	A	B	B	A	*	B	B	A
Anxiety	B	B	D	C	D	C	A	A
Failure Avoidance	A	A	B	A	A	A	A	A
Uncertain Control	A	A	B	A	A	B	B	A
Self-Sabotage	A	A	A	A	B	A	A	A
Disengagement	B	B	A	C	B	A	A	A

*Cory did not complete sufficient question items for this category in the October test.

When examining Table 4.1 all the students had an “A” or a “B” except in the area of Anxiety in the pretest for Brook and Cory and Planning for Dale. The post-test scores for Anxiety had improved for both Brook and Cory and Planning had improved for Dale. The

amount of change between the October and December is minimal for Alex who decreased in the area of Persistence from an “A” to a “B”. Another way of looking at the same data examines the amount of change that occurred over the seven weeks for all the students which is displayed in Table 4.2.

Table 4.2

*Motivation and Engagement Scale – Junior School
Change from October to December*

Student	Grade	Increased	Same	Decreased
Alex	7	0	10	1
Brook	6	6	5	1
Cory	6	5	3	2
Dale	6	5	6	0

The scores for Alex were the most stable across the seven week time span; there was no increase in any scores, and in fact there was a decrease in the category of Persistence. There was an increase in five or six categories respectively for all the other students. Brook increased in the categories of Valuing, Planning, Persistence, Anxiety, Failure Avoidance, and Uncertain Control. Brook showed a decrease in grades for disengagement indicating that this student was becoming more disengaged. Cory increased in the categories of Self-Belief, Planning, Anxiety, Self-Sabotage and Disengagement indicating an improvement in all these areas. Cory showed a decrease in the categories of Valuing and Uncertain Control. Dale increased in the categories of Self-Belief, Learning, Planning, Persistence and Uncertain Control and showed no decrease in any category. Differences between students will be discussed within case study results.

Observation Results

Students were observed for a total of 15 minutes each during three different class sessions for one minute intervals. If the student was off task, even for a moment, during an observation the minute was not counted as being on task. Students' interactions with each other, the teacher, and the class were counted during these observations as an attempt to see if the students were engaged in their learning with others. The number of interactions was counted over the entire five minutes of observation.

The first class observed was an introduction to a new inquiry called Dare to Dream in which they were to research a future career for themselves. Students were given detailed instructions on what was going to be expected. While there was autonomy in career selection, the assignment was highly structured by the teacher regarding finding specific information. There was also autonomy in finding sources of information and ways to present the information. While students listened and appeared to absorb the information from the teacher, this class did not have the intense focus later observed in the following classes. This is reflected in the data in Table 4.3 where all the students except Cory were off task for at least part of the five minutes they were observed.

The second class observed was using iPads to research a hundred square kilometer place in the world that students would have to set up their own country. They could choose anywhere and they could choose their own criteria for selecting their location. There was more autonomy in this assignment than the previous one. The intensity of focus in this class was noted as students were highly engaged in finding information to inform their choice and about the location of their own country. None of the students were off task during any part of the five minute observation period (see Table 4.3).

The third class was a follow-up on the second. Students did not have the iPads for this class and had to use the notes they had taken or remember the information they had gleaned from the previous day. They were to have discussions on why their location was the best and the problems with locations selected by their peers. The discussions were focused and intense with points being made backed up by facts from their research. Only one student was off task during the five minutes observed during the discussion class (see Table 4.3).

Table 4.3

Time on Task (ToT) and Number of Interactions (Int.)

Type of Class		Alex	Brook	Cory	Dale
Class 1	ToT	3/5	4/5	5/5	3/5
Instructions	Int.	6	6	7	8
Class 2	ToT	5/5	5/5	5/5	5/5
iPads	Int.	1	2	1	5
Class 3	ToT	4/5	5/5	5/5	5/5
Discussion	Int.	9	5	6	12

Results from Time on Task are summarized in Table 4.3 and show that there were lapses in engagement during the teacher led instruction period. There were no lapses in engagement during the class using iPads. There was one lapse of engagement during the discussion period. There were more breaks in engagement during an introductory class with information being given by the teacher. It is apparent that time on task varied depending upon the activity the class was engaged in rather than individual variation among the students.

The number of interactions with others also varied depending upon the particular activity in the class so that the most interactions occurred during the discussion class, fewer interactions during the instructions class, and the fewest interactions during the research using iPads class although the actual counts varied somewhat from student to student (see Table 4.3).

Brief Descriptions of Students: Individual Results

Four students participated in the study. Three Grade 6 students and one Grade 7 student. In order to maintain anonymity the grades of the students are not reported in the student descriptions. Pseudonyms have been used in place of names.

Alex's description. Alex is a capable student in any class setting. She is hard working and has done well in the traditional classroom. She is also doing very well with inquiry based learning with iPads. At first, she needed some support in the form of being able to check in with the teacher as to whether her question and research were on the right track. Now, she is much more independent and her thinking skills have developed as well. She is able to think critically, analyze data, and make inferences. She also looks beyond her particular inquiry, placing it in context, and examining the issues around her inquiry to get at the big picture.

Alex's results. Alex had stable results on the MES-JS from November to December except in the category of Persistence where there was a decline from "A" to "B" (see Table 4.1). In Alex's interview the question that was a measure of persistence was "If I can't understand my school work at first, I keep going over it until I understand it". Alex responded, "Yes and no 'cause, I kind of repeat this from one of the earlier questions, but if it is so hard that I don't understand, I'll stop and I'll email the teacher or I'll put up my hand and ask her."

Themes raised by Alex during the Student Interview were Inquiry Based Learning with One to One iPads is a Good Way to Learn, Teacher as Helper/Guide, Parents as Helpers, Being

Allowed to Redo Things and Awareness of Different Strengths. Alex's positive view of inquiry based learning with iPads was supported by her motivation and engagement scores which were uniformly high when measured by the MES-JS (see Table 4.1).

Alex's description of inquiry based learning with iPads was generally positive as evidenced in these quotes:

Like the way we are learning is something that helps us to absorb what we are learning rather than it goes in one ear and out the other.

...this is a great idea and this is something that should be pursued in all the classes here.

Because it is different from how we used to learn. Like we used to have Math, we'd have Socials, we'd have Science, English. And they would be, that's it. Well, now they are mashed together and we are finding a way that we like to learn, which is something completely different from what we have done, but it helps, well at least it helps me, to understand and enjoy what we are learning.

Alex also appreciated being allowed to redo things: "And we always have the opportunity to redo something if we're unsatisfied with our grade."

Brook's description. Brook has made a good transition into inquiry based learning with iPads. She is accustomed to the traditional classroom and is a straight "A" student. She is starting to control her own learning process, and will independently decide on her own question, manage her research, decide how to present her findings, and applies her results. She is an independent thinker who is beginning to believe in herself. She doesn't entirely trust the system yet and will check with the teacher to see if she is learning the right things. This kind of inquiry based learning with iPads is a good fit for her.

Brook's results. Brook's results on the MES-JS showed increases in six scores and a decrease in one score (see Table 4.1). The categories of Valuing, Planning, Persistence, Anxiety, Failure Avoidance and Uncertain Control showed increases which indicate an improvement in all these areas. The category of Disengagement decreased from an "A" to a "C" and this is a negative result indicating a loss of engagement and motivation.

The statement that evaluated disengagement in the student survey was "I often feel like giving up at school". Brook's response was "No, I think if you give up you aren't going to do very well so I don't think like you should give up and I don't ever feel like I am going to give up because like you can never really give up at school. You have to keep going. And like in middle school and elementary school you get um, like you pass no matter what you get and in high school you actually have to pass. So, you should like keep persuading yourself." The score on the MES-JS is not congruent with this answer or with the teachers' descriptions who describe Brook as a highly engaged learner.

Themes that emerged from the interview data for Brook were Inquiry Based Learning with One to One iPads is a Good Way to Learn, Teacher as Helper/Guide, Parents as Helpers, Freedom of Choice and Responsibility, Being Allowed to Redo Things, Awareness of Different Strengths, Feeling Anxious, and Don't Want to Disappoint My Parents.

Brook's positive description of inquiry based learning using iPads was: "...I like learning in an inquiry based class because you can do things over again and you have an opportunity to ask questions. You do things differently."

Brook spoke about feeling anxious: "Yeah I get a lot of anxiety and like I can't sleep sometimes so um, I do worry, so I study hard, try my best and take deep breaths." She added,

“... so she [Mom] like just tells me to breathe, um and just relax. Everything is going to be OK and my teacher’s class is really good because you can take the test over again if you get it wrong.”

While Brook wanted to do well at school for her own sake, she also did not want to disappoint her parents: “Well, I work at school because I want to do well at school. And I don’t want to disappoint my parents. But mostly I don’t want to disappoint me because I’ll feel bad about myself if I do bad. So I want my parents to be proud of me and stuff, but I want me to be proud of me more.

Cory’s description. Cory is very new to inquiry based learning. She is very curious about many topics but needs to check with the teacher to see if it is appropriate to ask and research these topics. She is good at researching information to answer her own question and does some preliminary filtering, and then will check with the teachers, who need to prompt her to continue her own self-filtering as to what is valid and what is important. She still needs a fair amount of scaffolding in the application phase.

Cory’s results. Results for Cory on the MES-JS showed increases in five categories and decreases in two categories (see Table 4.1). In October, Cory did not answer two questions pertaining to the Persistence category resulting insufficient items to score this category so it is not possible to determine if the “B” score obtained in December is an improvement or a decline. Improvements in scores were in the categories of Self-Belief, Planning, Anxiety, Self-Sabotage and Disengagement. Decreased scores were found in Valuing and Uncertain control.

The question on the student interview that reflects Valuing learning is, “Learning at school is important to me”. Cory’s response was,

Yeah. Learning at school is very important. I always try to want to get better. I want to try to get “A”s and so far I have gotten about four “A”s and three “B”s but like by the end of the term I really want to get like straight “A”s. So. Yeah. Like learning is really important to me. I want to try to do better than I did like we’re allowed to redo stuff in class so I try to do better than I did before. And try to succeed. Like I don’t want to get a bad mark or anything. I like to try my hardest that I can.

Cory is showing indications of performance goals based upon grades rather than upon the actual learning (Dweck, 1986).

Uncertain Control means a student is unsure if their efforts to do better will pay off in actually doing better. The statement that reflects Uncertain Control is: I’m often unsure how I can avoid doing poorly at school. Cory’s response was “I don’t do poorly as school so I don’t really know how to answer that.” The statement was rephrased as “How can you make sure you do well at school? The response from Cory was “Well, the way I can make sure is to always study, and read harder books. It’s like to increase my vocabulary and just study, finish all my homework. Yes, that’s study and read, and do the best that I can. And do my homework.”

It could be that Cory misunderstood the question on the MES-JS. It could also be that Cory has not yet learned the skills to feel in control of the outcomes in class. Her teacher said: “Cory is a new... so she’s very new to inquiry.”“So, she needs a fair amount of scaffolding still ...”

Themes raised by Cory during the student interview were Inquiry Based Learning with One to One iPads is a Good Way to Learn, Teacher as Helper/Guide and Parents as Helpers, Freedom of Choice and Responsibility, Being Allowed to Redo Things, Feeling Anxious, Don’t Want to Disappoint My Parents, and School is Fun.

Cory's description of inquiry based learning using iPads was positive and indicated that school was fun: "I really like being in the inquiry based classroom. I think all the classes should be taught that way because I think it is really great. And I come to school every morning thinking "Oh yay! I have school!"

However, Cory would get anxious and found that being able to redo things helped:

"Yes, I tend to sometime worry about stuff because I'm worried. It's the kind of thing where I'm worried that I'm not going to do very well but I usually end up doing OK." Cory added,

I think 'cause I might think the worst that could happen but I usually say to myself, "Well, what is the worst that could happen?" Then I say if I don't get a very good mark I can always redo the test because our teacher says we are allowed to redo tests.

While Cory wanted to learn, she also did not want to disappoint her parents:

...I don't just work so that I don't disappoint my parents. Like of course I don't want to come home with an "F" on my paper but I don't want to get this right just so my parents see that I got a good mark.

Dale's description. Dale is independent minded, innovative and able to think outside the box. He is a very keen student who is already motivated and engaged. He is exploring inquiry based learning and is in the process of learning how to ask good questions and stay focused on his topic. He needed teacher support initially but is beginning to need it less and less as he sees the freedoms this method allows. Inquiry based learning with iPads is a good fit for this student.

Dale's results. Results for Dale on the MES-JS showed increased scores in five categories and no decreased scores (see Table 4.1). The lack of any decreases might be related to the fact

that Dale is already a highly engaged and motivated student. Increases were in the categories of Self-Belief, Learning, Planning, Persistence, and Uncertain Control.

Themes that emerged from the student interview data for Dale were Inquiry Based Learning with One to One iPads is a Good Way to Learn, Teacher as Helper/Guide, Parents as Helpers, Freedom of Choice and Responsibility and School is Fun.

Dale's description of inquiry based learning with iPads was: "Inquiry based learning and iPads help to prepare you for the future. It gives you lots of choices but you have lots of responsibility. You can explain well and it gives lots of choices." Dale seemed to enjoy school altogether: "School is fun and it is a learning experience and a social experience. Very fun!"

All measures for Dale, including the MES-JS, the student surveys, the teachers' comments, and observations in class, show a highly engaged and motivated student.

Evidence for Emerging Themes from Student Interviews

All four students mentioned that Inquiry Based Learning with One to One iPads is a Good Way to Learn. Students spoke about IBL as being a different way to learn that helps them absorb what they are learning. In addition, inquiry based learning uses information from across traditional subject areas. Students found that IBL makes learning more understandable and enjoyable. For example, Alex said, "We are finding a way that we like to learn, which is something completely different from what we have done, but it helps, well at least it helps me, to understand and enjoy what we are learning." Students also felt that IBL with technology prepared them for the future. As Dale said, "Inquiry based learning and iPads help to prepare you for the future".

All four students spoke about the importance of their Teacher as Helper/Guide. Because IBL is different from in the traditional classroom methods of teaching, the ready availability of

teacher support in person and via email was noticed by the students. In addition, the role of the teacher changed somewhat as noted by Brook who said, “Well, our teacher, like, treats us like we are not really her students but like we’re her friends and she’s, like, sharing her knowledge with us instead of like actually telling us what to do.” This shift in classroom culture from teacher as director to teacher as helper and guide allows students to become more self-directed learners.

All four students also noted Parent as Helper stating parents were available to help them with their school work. As Cory said, “...sometimes I ask my parents for help if it’s difficult”. Thus, all students in this study felt they could rely on their parents and their teachers for support with IBL.

Freedom of Choice and Responsibilities was noted by three students as being a positive factor. As Cory said, “Our teacher usually gives us a choice, freedom of choice about what we want to do for our project.” This allows students to follow their own interests but also to take responsibility for their own learning by using technology in a responsible way. Brook said, “...she gives us a lot of choice and opportunity to do what we want but she also gives us a lot of responsibilities like using the iPads.”

Being Allowed to Redo Things was considered a positive factor by three students, two of whom stated that it reduced their anxiety somewhat. Brook stated, “...you can take the test over again if you get it wrong. So if you are feeling nervous and you get the questions wrong because you are feeling nervous you can always take it again another time”. In addition, being allowed to redo work puts the matter of grades more in control of the students. Alex stated, “And we always have the opportunity to redo something if we’re unsatisfied with our grade.”

Themes with only two students speaking of them are still important as there is some overlap with teacher themes in some cases. Alex and Brook mentioned that they were aware of different strengths in the class, Brook and Cory spoke about Feeling Anxious, and Don't Want to Disappoint their Parents, and Cory and Dale expressed that school was fun. Themes that emerged from the teacher interviews mirrored some of the themes from the students.

Themes that Emerged from Teacher Interviews

The themes that emerged from teacher interviews are: (a) inquiry based learning with one to one iPads increases motivation and engagement, (b) students start out being motivated and engaged on their own, (c) technology is motivating and engaging because it is natural fast, and relevant, (d) inquiry based learning with one to one iPads requires higher level/deeper/critical thinking skills, (e) learning to do inquiry based learning with one to one iPads requires new skills and can be uncomfortable, (f) the teacher role has changed to a guide and questioner (g) inquiry based learning with one to one iPads increases students' self-belief, (h) students become more self-reliant learners, (i) inquiry based learning with one to one iPads works well for most students, (j) letting go of traditional classroom control is difficult for some teachers, and (k) inquiry based teaching with one to one iPads is worth trying. Two themes were mentioned by only one teacher. Teacher 1 stated that establishing bi-directional trust between the teacher and students is critical, and Teacher 2 spoke of technical glitches requiring adaptability.

Both teachers were strongly in favour of trying out even a small part of teaching inquiry based learning. Teacher 1 said, "I think the message of start small. I think that once, I truly believe this, that once you have experienced it in a real sense, a real sense of inquiry based learning, whether it is a unit, or a subject, or you know, even a let go of the one lesson, I think once you have experienced it you will realize how powerful it is for your students, and that

you’ll want to do more.” This teacher continued with, “And that doesn’t mean it can’t be of the curriculum, because it can, and it doesn’t mean that you are not “covering” what you are supposed to cover because it can, but it’s powerful, it’s enriching, it’s . . .you’ll go home and have the best day of your life!”

Teacher 2 said, “I think it would be worth [it], even if you weren’t going to do it in every aspect, to try it in something. Just try it in something because I think that it gives students amazing skills for all of their other areas of learning.”

Comparison of Student Themes to Teacher Themes

Table 4.4

Student and Teacher Themes

Student Themes	Teacher Themes
Inquiry Based Learning with One to One iPads is a Good Way to Learn	Inquiry Based Learning with One to One iPads Increases Motivation and Engagement
	Technology is Motivating and Engaging Because it is Natural, Fast, and Relevant
	IBL with One to One iPads Requires Higher/Deeper/Critical Thinking Skills
	Inquiry Based Learning with One To One iPads Increases Student Self-Belief
	Inquiry Based Teaching With One to One iPads is Worth Trying [students’ benefit]
	Technological Glitches Require Adaptability.
Teacher as Helper/Guide	The Teacher Role Has Changed to a Guide and Questioner
Parents as Helpers	
Freedom of Choice	Letting Go of Traditional Classroom Control is Difficult for Some Teachers

	Students Become More Self-Reliant Learners
Awareness of Different Strengths	IBL with iPads one to one iPads Requires Higher/Deeper/Critical Thinking Skills Some Student's Need More Support Than Others
Feeling Anxious	Inquiry Based Learning With One to One iPads Works Well for Most Students Trust Between Teacher and Students is Critically Important
Being Allowed to Redo Things	Transition to IBL with One to One iPads Requires New Skills and Can Be Uncomfortable for Students
Don't Want to Disappoint My Parents	Students Start Out Being Motivated and Engaged
School is Fun	Inquiry Based Teaching With One to One iPads is Worth Trying [teachers' benefit]

Students and teachers agreed that IBL with one to one iPads is a good way to learn, but for different reasons. There is some overlap between the role of the teacher changing and students being able to rely on the teacher for help. The importance of establishing trust between teacher and students was echoed in students feeling that the teacher prepared them for tests, allowed them to do redo tests and assignments, and was available to help them in an ongoing manner. The students appreciation of having choice and the accompanying responsibilities was echoed in the teachers themes of letting go, trust, and self-reliant/independent learners. Both students and teachers noticed that students have different strengths.

Technology was discussed intensively by the teachers but was hardly mentioned by the students except as a resource. The adaptability required from teachers when technology difficulties arise was also mentioned by one teacher. Discomfort in letting go and discomfort for

some students was noticed by the teachers but was not mentioned by the students. However, anxiety was discussed by two students and the ability to redo things was mentioned as being important by three students, two of whom said it relieved their anxiety somewhat.

Summary of Results

Motivation and engagement increased in five or six categories in the MES-JS and decreased in one or two or none of the categories for three students. The MES-JS scores remained stable for Alex except for a decrease in one category, Persistence.

Observed time on task indicated some time off task during the instructional class, but intense focus during the iPad research and the discussion held the following day. Interactions between students and others were fairly high during the instructional class (6-8 interactions in five minutes), relatively low during the iPad search class (1-5 interactions in five minutes), and relatively high during the discussion class (5-12 interactions in five minutes) for most of the students.

Student and Teacher themes were not exactly the same but there was some overlap in thinking that IBL with one to one iPads was a good way to learn/increased motivation and engagement in students, and that the teacher role had changed to more of a guide and helper. All the students mentioned that they could rely on parental support but this theme was not mentioned by teachers. Students appreciated the increased choice and responsibility they were given and teachers noted that letting go of classroom control can be difficult. Teachers noticed that doing this created more self-reliant and independent learners. Teachers were more aware of how IBL with one to one iPads made students deep and critical thinkers and how it developed their skill base in technology. Teachers also realized that there was a transition from the traditional classroom that was uncomfortable for some students who were developing their new

skill base and for some teachers when “letting go” somewhat in the classroom. Teacher 1 felt that establishing trust between the teachers and students was crucial and students appreciated the fact that the teacher prepared them well for tests, let them redo tests and assignments, and was available on an ongoing basis. Two students who were anxious appreciated the ability to redo tests. Teacher 2 mentioned that glitches in the technology meant that teachers had to be adaptable. Students hardly mentioned the technology except as a resource.

Chapter 5: Summary, Discussion, and Conclusions

Summary of the Research

Student motivation and engagement declines drastically in middle school and high school (Eccles et al., 1993; Marks, 2000; Martin, 2009). Inquiry based learning (Skinner et al., 2008) and one to one computers (Fleischer, 2012) have each been shown to increase motivation and engagement. Pintrich (2003) has called for more research on inquiry based learning classrooms, which he states can be conceptualized as different cultures from traditional classrooms, to determine the impact of these contexts on motivation. A case study using both inquiry based learning supported by one to one computers has shown an increase in motivation and engagement in both a task oriented student and in a non task oriented student (J vrel et al., 2008).

The research question in this study is: What effect will an inquiry based classroom with one to one iPads have on motivation and engagement in a middle school? The hypothesis was that students participating in an inquiry based classroom with one to one iPads would show increased levels of motivation and engagement rather than the decline in these measures expected in middle schools. The research goal was to gain a better understanding of inquiry based learning and one to one iPads as a possibly effective way of increasing motivation and engagement in middle school students.

Four students were recruited as well as their Teacher 1 and Teacher 2 to participate in a multiple case study using a pre-test/post-test design. Students were administered the Motivation and Engagement Scale-Junior School (Martin, 2012) at the end of October and then again seven weeks later in December. Students were observed during three different classes for one minute intervals for a total of 15 minutes each. During these observations time on task was measured as an indicator of student engagement. The number of interactions students had with others was

measured as an indicator of a sense of belonging. Notes were taken about what was being done in the class at the time of the observations. Interviews were conducted towards the end of the study asking students what they were thinking when they answered questions similar to the ones on the Motivation and Engagement Scale Survey-Junior School (Martin, 2012). An additional question asked what they thought about inquiry based learning with one to one iPads.

Both Teacher 1 and Teacher 2 were interviewed about whether they thought that inquiry based learning using one to one iPads increased student motivation and engagement. Additional questions were asked about their experiences and observations working with this teaching method.

Discussion

There are many theories of motivation that can be applied to analyze this data but self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000) integrates both needs and social-cognitive constructs. The three needs are competence, autonomy and relatedness. The effects of these needs on behavior are mediated by perceived competence, control beliefs and regulatory styles. This model has been expanded and used by Skinner et al. (2008) to describe the self-system model of motivational development in which the external context (teacher warmth, structure and autonomy support) and internal dynamics (engaged and disengaged emotions and behaviours). In their study Skinner et al. (2008) found that teacher support affects students' emotions and engagement behaviours that develop through the school year. Students who are engaged tend to continue to be engaged but students who become disengaged tend to have that disengagement amplified by their context. Eccles et al. (1993) have found a mismatch between adolescents growing need for autonomy and ongoing needs for personal and positive teacher/student relationships in traditional middle schools. There were few opportunities for

teacher/student relationships (Midgley, Feldlaufer, & Eccles, 1989), and few opportunities for decision making, choice, and self-management (Ward, Mergendoller, Tikunoff, Rounds, Dady, & Mitman, 1982) found in the traditional middle school setting.

In this study all four students started with fairly high motivation and engagement scores on the Motivation and Engagement Scale-Junior School (MES-JS) (Martin, 2013). This reflects the observation by both teachers that the students started enthusiastically and come with their own motivation. The only low scores were in the area of anxiety, which Brook and Cory spoke about openly. After the seven week gap between the pre-test and post-test using the MES-JS, both students reported a reduction in their anxiety reflected by a score increase in this area. This might have been due to the classroom culture created by the teacher using inquiry based learning with iPads, but it might also have been due to the fact that both students were transitioning into middle school from smaller elementary schools. Transitions are known to be disruptive. Students who moved to a new school at sixth grade were found to have lower self-esteem than sixth grade students who did not make a school transition (Thornburg & Jones, 1982). There might also be a history of generalized anxiety that has little to do with the current context.

When examining the answers to the interview statement number nine, “Often the main reason I work at school is because I don’t want to disappoint my parents”, which is meant to measure failure avoidance, both Brook and Cory stated that they want to do well at school but they are also concerned about pleasing their parents.

Brook stated “Well, I work at school because I want to do well at school. And I don’t want to disappoint my parents. But mostly I don’t want to disappoint me because I’ll feel bad about myself if I do bad. So I want my parents to be proud of me and stuff, but I want to be proud of me more.”

Cory stated:

...I don't just work so that I don't disappoint my parents. Like of course I don't want to come home with an "F" on my paper but I don't want to get this right just so my parents see that I got a good mark."

This concern about pleasing parents could indicate a performance goal rather than learning goal orientation, even though this wasn't indicated by the MES-JS scores measure of failure avoidance. This performance goal orientation could lead to being more anxious about assignments and tests in school. "Children displaying this pattern tend to evidence negative affect (such as anxiety)..." (Dweck, 1986). This is another possible explanation for the anxiety felt by these two students.

The most significant result of the study is that three of the students showed increases on the MES-JS in five or six categories which outweighed the number of decreases between the pretest and posttest. Alex was the exception, with a score decrease from an "A" to a "B" in the measure of persistence. Except for the decline in this one area, Alex showed stable scores between the pre-test and post-test. It could be that this student's already high scores are stable because they have found strategies that are effective within the classroom context and they see no need to change. In Alex's interview the question that was a measure of persistence was "If I can't understand my school work at first, I keep going over it until I understand it". Alex responded, "Yes and no 'cause, I kind of repeat this from one of the earlier questions, but if it is so hard that I don't understand, I'll stop and I'll email the teacher or I'll put up my hand and ask her." It could be that this highly capable student (according to both teachers) has found a more effective way of solving a problem than continuing to try hard over and over again.

Alternatively, one has to question whether this decline in one category is the beginning of the expected decline in engagement and motivation reported in the literature (Eccles et al., 1993).

Of the remaining three students, Brook showed a decrease in the area of disengagement from an “A” to a “C” indicating increased disengagement. Cory showed a decline in valuing and uncertain control from an “A” to a “B”. Both Brook and Cory showed increases in anxiety scores from a “D” to a “C” (meaning declines in anxiety experienced) between the pre-test and post-test. They both mentioned being able to redo things as one factor that reduced anxiety somewhat for them. Dale showed no declines in any area. It could be that the expected adolescent decline in engagement is starting to occur for Brook and Cory in spite of the context of inquiry based learning with one to one iPads. However, the student’s responses to interview questions did not indicate an increase in disengagement for Brook or a decline in valuing for Cory. Uncertain control may be a reflection of Cory’s skill level with inquiry based learning as she is very new to this approach.

Brook’s decline in disengagement scores on the MES-JS were not supported by her interview responses or by her teachers’ evaluation of her engagement. Brook might have had a discouraging day or made a mistake in filling out the form. Her teachers note that Brook is an exceptionally good student who is successfully engaged in inquiry based learning.

Cory showed declines in uncertain control, and valuing. Uncertain control means that the student is unsure if their efforts to do better will pay off in actually doing better. This may indeed be the case for Cory who did not fully understand the question and who is very new at inquiry based learning and is still developing skills in this area.

The question on the student survey that reflects valuing learning is, “Learning at school is important to me”. Cory’s response was,

Yeah. Learning at school is very important. I always try to want to get better. I want to try to get “A”s and so far I have gotten about four “A”s and three “B”s but like by the end of the term I really want to get like straight “A”s. So. Yeah. Like learning is really important to me. I want to try to do better than I did like we’re allowed to redo stuff in class so I try to do better than I did before. And try to succeed. Like I don’t want to get a bad mark or anything. I like to try my hardest that I can.

Cory is showing indications of performance goals based upon grades rather than upon the actual learning. This decline might be a reflection of a motivational stance which Dweck (1986) defines as maladaptive and which can lead to negative outcomes like anxiety.

Brook, who also indicated that she could become anxious, had no weakness in uncertain control, but did show a concern about not disappointing parents and also achieving good grades. When asked if learning at school was important to her, she said,

Yeah, because I would like to get good grades....when I get into school and do well at school so that I can like achieve what I want to do. And I feel proud of myself like when I get good grades.

It is possible that this performance goal about achieving good grades might be connected to feelings of anxiety for both Cory and Brook (Dweck, 1986). Alternatively, there are many reasons for anxiety that are completely unconnected to this study.

Engagement and belonging measures. The original intent was to measure engagement by measuring observed time on task as suggested by Chapman (2003) and measure belonging or relatedness (Ryan & Deci, 2000) by the number of interactions on the assumption that a socially isolated student would not be having many interactions. Instead, the results appear to be a reflection of the class content where students in the class where instructions were given showed

less time on task. In contrast the class with the iPad showed all the students were on task the entire time. During the discussion class, Alex was off task momentarily and otherwise all students were intensely involved in the discussion all the time. As an observer, the intensity of focused attention during both the iPad class and the discussion class were remarkable, and this was noted at the time. While the iPads certainly seemed to facilitate students' engagement, the discussion that took place the next day occurred without the iPads and the intensity was very similar. The iPad assignment was to locate your own country somewhere in the world and to find as much information as you thought would be relevant to know about it. The following discussion was to promote the positive aspects of your own country and then to find some negative aspects of other people's countries. The discussion promoted autonomy in that students selected the criteria to highlight when arguing in favour of their country but suggestions were given to scaffold students who needed extra support.

Overlap and interplay across themes. Both students and teachers thought that inquiry based learning with iPads was a good way to learn, but for different reasons, until you look at the themes more closely. Teachers spoke at length about what the technology had to offer in terms of immediacy, of teachable moments, as an amazing tool, as a resource, access to the internet, and ways of accessing, organizing and sharing information that break down barriers. One teacher also spoke about the difficulty caused when technology doesn't work and the adaptability required to deal with it. Students spoke about iPads in passing, as a resource, as preparation for the future, or as a way to access the teacher. This technology is already becoming invisible to them as it is taken for granted (Weiser, 1991). None-the-less, it was obvious to the teachers and to this researcher that when the iPads were in use there was intense focused attention for the

entire length of the class. Both teachers believe that the technology increases motivation and engagement and that it is natural to the children and of their world.

Both teachers spoke about inquiry based learning with iPads as increasing students' thinking skills so that they can think more deeply, and critically, using synthesis, evaluation and application. Furtak et al. (2012), in their meta-analysis of inquiry based science teaching noted that when evidence is collected by the students' own investigation and evaluated and used to develop and interpret explanations, they are in fact doing the work of scientists and learning to think like scientists in what she calls the epistemic domain. Furtak et al. (2012) also noted that the social domain of collaborative and communicative processes is how scientific knowledge is constructed and that students are to be encouraged to work together in groups and reason collectively to reach decisions together. Furtak et al. (2012) have also added the procedural domain or methods of discovery in asking questions, designing experiments, carrying out procedures and creating data representations. The power of inquiry based learning noted by Teacher 1, and the transferability of the skills learned noted by Teacher 2, becomes apparent in the areas that are being taught in the inquiry based classroom that are not being taught in the traditional classroom. While both traditional and inquiry based learning cover basic conceptual learning, inquiry based learning deals with the gathering, evaluating, and organizing of data, to come up with your own explanations, to share these explanations with others and modify them as needed by socially constructing knowledge, and then to use procedural knowledge to test and communicate data. This is indeed powerful learning. In Furtak et al.'s (2012) work the effect size of inquiry based learning that included all epistemic or procedural, epistemic and social domains the mean effect sizes were .75 and .72.

In regards to the student theme of teacher help/guidance being constantly available, Furtak et al. (2012) also emphasized the importance of teachers actively guiding student activities in the context of inquiry based learning. The students in this study all spoke of the guidance of the teacher being readily available at school and via the net. They noticed that the role of the teacher was different than in the regular classroom. Teacher 2 spoke about how the role of the teacher was different.

Well, it's far less, I want to say less teacher directed, but it is not. It is still teacher directed in terms of guiding students and helping students build the skills to create a good inquiry question, like a deep questioning versus a sort of more shallow questioning. I do think that, I think that the teacher becomes more of a guide than the disseminator of all knowledge. And a questioner. Like the teacher becomes a questioner as well. So, say a student comes up with something. They've got their question and they start to research it and find out about it and they are using the iPad and as a teacher you are circulating around the class and you can ask probing questions that are very specific to that individual versus like directing everyone. It becomes more like it is individualized, I guess.

Teacher 1 spoke about the importance of establishing trust with her students.

I think inquiry based learning does work best for most students. I think it is a learning curve. I think there has to be a trust that is established between the, shall I say teacher, but I don't really mean teacher, between the perceived authorities and the students. That as the students are developing their inquiry, that you trust them and are able to guide them where needed to develop that inquiry in an effective even accurate and thoughtful manner.

Teacher 1 added:

Well, the idea of trust, in inquiry based learning, even if you provide a topic, let's say chemistry, students have to believe in themselves that what they are learning is important learning and they also have to believe and trust in the teacher that the teacher will help guide them if needed and believes in them. So that the trust element has to go both ways, the student to the teacher, and the teacher to the student. They have to have that mutual trust and belief in each other. That no one is going to be left, that the student is not going to be left dangling and uncomfortable, or unreasonably uncomfortable, sometimes a little discomfort is good. Unreasonably uncomfortable. That the teacher will provide the scaffolding required, or the thinking, or the prompting or whatever is required, and the student has to believe and trust in themselves because inquiry based learning promotes self-belief.

So, while Teacher 1 is building trust in the students that she won't let them down in helping them with their inquiry based learning, they are learning to trust themselves. The students have all noticed the importance of the teacher's guidance. Three of the students also raised the theme of choice and responsibility, which I believe can be interpreted as autonomy. Skinner et al. (2008), Ryan and Deci, (2000) and Hafen et al. (2012) all discuss the central role of perceptions of autonomy in motivation and engagement. It seems that while teacher guidance is essential there must be aspects of autonomy so that there is a good fit between students' need for autonomy, competency, and relatedness (Deci & Ryan, 1985) within the inquiry based classroom. Of these three, autonomy is the greatest need (Skinner et al., 2008; Hafen et al., 2012). I would argue that part of the trust Teacher 1 has established is that while the teacher is guiding them there will be large areas of autonomy. As Teacher 1 said,

...they are taught from the very beginning of the year here, that it is their responsibility to do and have what they need as a learner in order to learn. So if that means moving something around or using a different process or recording in a different way or determining their own application of their learning then, so be it. That's fine. That's their job.

Researcher: So they become more independent?

Yes, very, very independent.

Teacher 2 also noticed that students are directing their own learning more.

I just think, I watch kids become more self-reliant learners. I think they become more questioning. I think they gain a wide variety of skills from it, maybe, even broader than if they were just learning...definitely broader. I think one of the things is that what they are learning is so much more relevant to them and their world. They are finding connections to themselves, in a way. Which is really what I like best about it too.

Both teachers and two students were aware of the diversity of strengths and weaknesses in the classroom. This diversity has several implications. First, the teachers are aware that students are in progress of developing necessary skills. Second, the technology can play a role in helping students to access and share information in non-traditional ways that do not single them out as needing special support. Third, the diversity in the classroom allows students to access each other as source of information and help as needed.

Teachers spoke about the students developing the necessary skills to ask good questions and gather information that is evaluated critically so that students know that the information they have gathered is valid. The growing skill set in all areas of inquiry based learning from gathering information to presentation, from social collaboration, to knowledge building increases

competence in the areas beyond conceptual knowledge taught in the classroom and expands to include procedural, epistemic, and social domains (Furtak, et al., 2012) This increased competency increases motivation and engagement (Ryan & Deci, 2000; Skinner et al., 2008). An example of how the skills needed for inquiry based learning using one to one iPads is given by Teacher 2:

...what you start to see, like right about now, in the last month or so [October, November] are students being able to refine their questions and being able to figure out ways to ask their questions to find the information they are looking for. And so if that helps them get more engaged or not, I'm not sure but I think that it has given them more skills and makes them feel like they are gathering good information. I also think, the other thing is, you see them operating the devices with a lot more capability because they are not just using them to find information, they are using it for writing, they are using it to capture image in video, they are learning how to export and import and embed information, how to send it electronically to their teacher, how to print for their...so they are getting good at all of that stuff. And so it gives them another way to produce work.

Some students have deficits in particular skill areas where the technology can be helpful. One example is students who are weaker in the area of writing and the technology enables them to show their work in different ways. Teacher 2 said, "I really like that students can show their learning in many different ways and feel successful and actually be successful. I think it is authentic. I think that students are gaining skills that are going to carry them through their further years...". The power of the iPads used this way is that students with skill deficits in written work can use strengths in making movies, for example, and share their knowledge in ways that are respected and useful to the whole class. Teacher 2 said:

I can think of a couple examples where written work is exceedingly difficult for a couple of students. Really bright students who struggle to do written work and where they are really able to show their knowledge and understanding of something by using a video of it of being able to give a verbal or oral presentation versus doing a written assignment. They still have done all of the steps of the assignment and have been able to present it in a different way. And I think, the iPads offer so many different options for how students present what they know in non-conventional ways than older styles.

Diversity in the classroom can be a useful tool for students if they need to access peer support. While Alex was aware her teacher was available to help her through any difficulties she added, “And like we have the students in our class. And since we have different strengths. Like there is a kid in the class somewhere that can help us out with a question or two that we are struggling with. So that’s kind of peer support too.” This social aspect of diversity is important to note because in the class being studied, students are encouraged to work together on some projects and to report on their results to each other. This can help students develop their social domain and help to construct knowledge within their learning community (J vrel, Veermans, & Leinonen, 2008) The power of accessing peer support transcends the learning of the moment as the relatedness or self-perception of belonging in school is linked to academic motivation, adjustment, and emotional engagement (Eccles & Midgley, 1989) as well as being an integral part of what builds good mental health in all human beings (Deci & Ryan, 1985).

Implications

The results found in this study are that inquiry based learning with iPads increased motivation and engagement for three out of the four students in the study. The implications of this result are that this method of instruction might be an effective way of reducing the academic

disengagement seen in about 60% of the students in Canadian middle and high schools (Dunleavy, Milton, & Willms, 2012). Key to this process is allowing middle and high school students increased autonomy in their own learning.

Increasing autonomy for adolescents is necessary for motivation and engagement to be maintained or increased. Choice (autonomy) accompanied by responsibility was important to three out of four of the students and this is an integral part of inquiry based learning (Skinner et al., 2008; Hafen, et al., 2012). In order for students to have more choice/autonomy, teachers need to be able to let go. The literature supports autonomy as being pivotal in keeping students motivated and engaged through the high school years (Hafen et al., 2011). Letting go so that students have some autonomy does not mean lack of teacher guidance and teacher led activities. On the contrary, teacher led guidance was found to be a crucial component in the success of inquiry based learning (Furtak, et. al., 2012). The Teacher 1 in this study spoke about building trust between the students and teacher as being vitally important to the success of inquiry based learning so that students are not left dangling without help when they need it and can begin to trust in their own thinking processes. The teacher builds in autonomy (choice), to all of the processes involved in researching and presenting their knowledge to the class but also teaches about the importance of responsibility. As a result, the students become very independent self-reliant learners.

Anxiety was reduced for two of the students who attributed the reduction to being able to redo their work, which was an important component of the program mentioned by three of the four students. Teachers did not mention anxiety directly but did talk about some students being uncomfortable until they acquired the necessary skills for inquiry based learning and for using

the technology. Gaining competence (Skinner et al., 2008) and working towards mastery instead of performance goals is known to increase motivation (Dweck, 1986).

Recommendations for Practice and Research

Inquiry based learning with one to one iPads is a teaching method that should be used in school to increase motivation and engagement by increasing student autonomy in their own learning. Teachers are often uncomfortable with letting go of traditional classroom control and would benefit from support in how to conduct inquiry based learning with increasing autonomy for students. Students can also feel uncomfortable in this type of learning until their skill base is sufficiently developed and will need confident teachers who can scaffold their learning initially, knowing they will need to remove supports gradually to enable growing student autonomy.

Teachers need to directly teach students what is expected from them as they shift from a traditional class to an inquiry based learning class. According to the Teacher 1, students must know “that it is their responsibility to do and have what they need as a learner in order to learn.” This is what makes students become more self-regulated learners, but it involves a learning process and takes some time. Teachers need to create projects that allow students increasing amounts of autonomy and are available to guide and question students along their learning journeys. Both need to trust that the students’ questions, which reflect their individual interests, will lead them to deeper learning and thinking skills set within a relevant context.

Both teachers noted that the iPad is a powerful tool that is natural, fast and relevant. While this technology has already become invisible to students who take it for granted, teachers are appreciative of the impact of using technology on the immediacy of information found. This immediacy is part of what keeps motivated students engaged. Too many technological glitches can slow down or even cripple inquiry based learning so technical support is crucial for this

initiative to work at optimal capacity. In addition, teachers need to have a back-up plan in case of technological difficulties.

What I have learned for my own practice is that providing structured lessons for inquiry while promoting autonomy for students seems to be one of the keys to maintaining high levels of motivation and engagement. Lessons at the beginning of the school year will have to be highly structured as students learn the inquiry process and become more familiar with the technology. As the year continues and the skill base increases, students will need less structured inquiries allowing them to pursue their own interests in greater depth.

Allowing students to be able to redo their tests and their work seems to promote mastery learning which increases motivation and reduces anxiety. Letting students have choice in developing their own question and how they find, organize, construct and present information, promotes self-directed learning and increases motivation and engagement. Structuring work so that information is shared and discussed as a group helps students to work and learn together socially and encourages support from fellow students. Being available to scaffold students as a guide and questioner rather than the traditional teaching role is important as students can be uncomfortable with the transition from traditional learning to inquiry based learning. Building bilateral trust between the teacher and students allows students to gain new skills with confidence that they won't be left unsupported while they are learning the inquiry based learning process. As they become more adept at the process they gain self-belief and confidence and become more self-directed learners.

In this study it was immediately apparent that specific classes fully engaged the students who were working in them. More research needs to be done on the specific components of

inquiry that engage students and whether this intense engagement continues across middle school and into high school.

There were no students with special needs in this study, however, the possibility of supporting students within the context of inquiry based learning using technology needs to be explored further. Technology allows each student to access support they need individually without making them look different from their classmates.

Finally, using inquiry based learning and being allowed to redo their work decreased anxiety for two of the students. This may be because redoing work allows for mastery learning which is associated with increased motivation and decreased anxiety (Dweck, 1986). Further research on inquiry based learning and mastery learning to reduce anxiety is another area that might prove fruitful for further research.

Limitations

The internal validity of this study is at risk because factors other than inquiry based learning with iPads can create changes in motivation and engagement. However, given the expected decline in motivation and engagement due both to transition into middle school (Eccles et al., 1993) and due to students being at the age where declines have occurred in other studies (Dunleavy et al., 2012), any increases in motivation and engagement measures would be bucking the downward trend. Other factors, such as the newness of the program and the extra attention that the students have been getting as being part of a pilot project and part of this study might have caused some increase in motivation and engagement. The observed counts of engagement and belonging using time on task and number of interactions were measures of student reactions to the classroom task at hand and did not adequately gauge student engagement and belonging. The fact that the pre-test was conducted at the end of October after the class had already been in

session for two months might have resulted in missing early changes in student engagement and motivation. The post-test was given only seven weeks later, not allowing much time for changes in engagement and motivation to occur. Factors such as sports and drama as well as social connections can cause motivation and engagement at school to increase. Other factors such as divorcing parents, health, and emotional issues can cause declines in motivation and engagement.

External validity of the study is threatened by poor generalizability due to the very small number of students being studied in a very specific context. The rich description is limited by the short amount of time spent in the classroom (three classes). In addition, the MES-JS was created in Australia and cultural differences could make it invalid in Canada. Trustworthiness of the study was increased by gleaning information from multiple sources allowing for triangulation between surveys, field notes, and follow up interviews with students and teachers, increasing credibility.

Conclusion

All the students and both teachers believed that inquiry based learning with one to one iPads was an effective way of learning. Three out of four of the students showed increases in measures of engagement and motivation within a seven week period on five or six categories of the Motivation and Engagement Scale-Junior School. The one student who did not show an increase in measures of engagement and motivation was already functioning at a high level in all measures. All the students observed showed intense engagement during the iPad research class and the following discussion class. During the instruction class and the discussion class all the observed students interacted with others at least one time per minute. These results are promising and indicate that inquiry based learning with one to one iPads should be studied

further to determine if the findings in this study can be replicated on a larger scale. Any teaching method that can stop or slow the decline in motivation and academic engagement typically found in adolescents in middle and high school is well worth trying.

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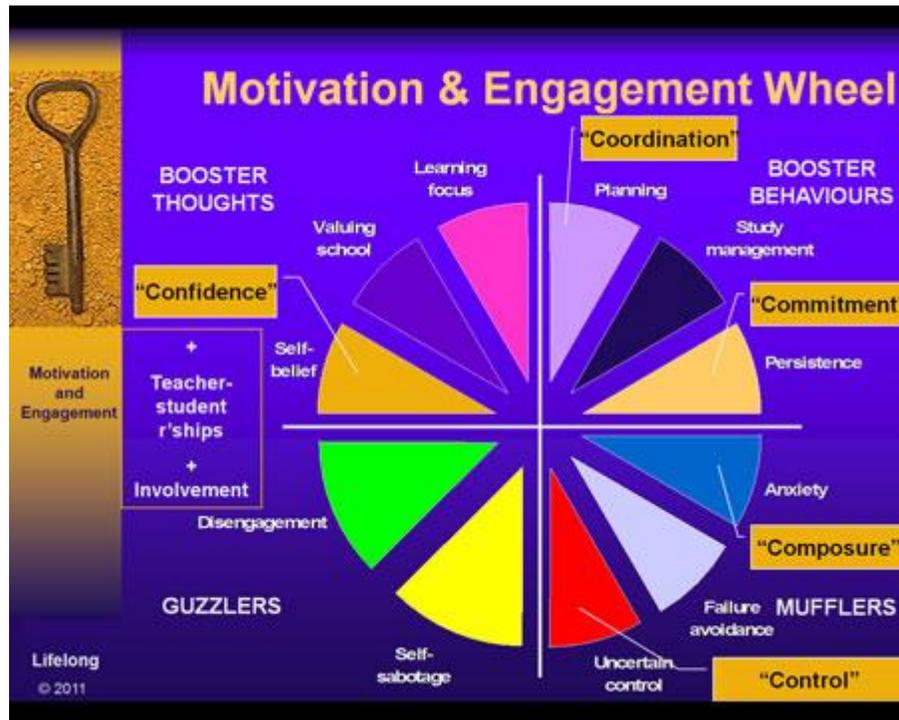
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Appendix A: MES-JS Sample Questions

1. If I try hard, I believe I can do my schoolwork well.
2. Learning at school is important to me.
3. I feel very pleased with myself when I really understand what I'm taught at school.
4. Before I start an assignment I plan out how I am going to do it.
5. When I study, I usually study in places where I can concentrate.
6. If I can't understand my schoolwork at first, I keep going over it until I understand it.
7. When exams and assignments are coming up, I worry a lot.
8. Often the main reason I work at school is because I don't want to disappoint my parents.
9. I'm often unsure how I can avoid doing poorly at school.
10. I sometimes don't study very hard before exams so I have an excuse if I don't do as well as I hoped.
11. I often feel like giving up at school.

Martin A.J. (2007). Examining a multidimensional model of student motivation and engagement using a construct validation approach. *British Journal of Educational Psychology*, 77, 413-440.

Appendix B: Motivation and Engagement Wheel



The Motivation and Engagement Wheel is reproduced with permission from Andrew J. Martin and Lifelong Achievement Group (www.lifelongachievement.com).

Appendix C: Student Interview Script

I am going to go over 11 questions you were asked on the survey and ask you to tell me more about what you think about each one. Question 12 will be your chance to tell me anything else you would like teachers to know about how you have been learning this year. If there are any questions you do not want to answer, just say pass. You can stop at any time you want to.

1. If I try hard, I believe I can do my schoolwork well.
2. Learning at school is important to me.
3. I feel very pleased with myself when I really understand what I'm taught at school.
4. Before I start an assignment I plan out how I am going to do it.
5. When I study, I usually study in places where I can concentrate.
6. If I can't understand my schoolwork at first, I keep going over it until I understand it.
7. When exams and assignments are coming up, I worry a lot.
8. Often the main reason I work at school is because I don't want to disappoint my parents.
9. I'm often unsure how I can avoid doing poorly at school.
10. I sometimes don't study very hard before exams so I have an excuse if I don't do as well as I hoped.
11. I often feel like giving up at school.
12. Is there anything else you would like teachers to know about how you have been learning in class this year?

Prompts like "Can you tell me more about this?" and "What was your thinking about this one?" will be used.

Martin A.J. (2007). Examining a multidimensional model of student motivation and engagement using a construct validation approach. *British Journal of Educational Psychology*, 77, 413-440.

Appendix D: Teacher Interview Script

- 1) Do you think inquiry based learning with one to one iPads impacts on students' motivation and engagement?
- 2) Why do you think so?
- 3) How has student motivation and engagement changed from the beginning of the school year?
- 4) How does inquiry based learning with one to one iPads differ from more traditional teaching methods?
- 5) Do you think this method works for most students?
- 6) Are there any observations you have made about this teaching method?
- 7) What do you like best about this teaching method?
- 8) What do you find most difficult about this teaching method.
- 9) Is there anything you would like other teachers to know about using this teaching method?
- 10) How has this teaching method worked for student X regarding their motivation and engagement?

Appendix E: Observation Count and Field Notes Form

Code is for student being observed; O.T. is on task for the entire minute, Int. is for interaction with Teacher, Student, or Educational Assistant. Field notes will describe the assignment being worked on with a description about how much autonomy students have in their learning.

Date: _____ Block: _____ Subject: _____

Code: _____

O.T. _____

Int: _____

Field Notes regarding autonomy: