How Does Guided Inquiry Learning Motivate and Engage Students?

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Abstract

This research study investigated whether or not the use of guided inquiry instruction would act to increase the motivation and engagement of science students more than the use of traditional instructional methods. The researcher conducted an action research study using two grade 8, linear math-science classes at a secondary school in Nanaimo, British Columbia. Two different science units were taught to both classes. One class was taught a science unit using guided inquiry while the other class was taught using traditional instructional methods. Then the classes were taught the second science unit using the other instructional method. Students were surveyed after the completion of each science unit, using a two part survey which consisted of semantic differential ranking questions and written response questions. Survey questions asked the students to evaluate their enjoyment, interest, motivation, effort, and to assess the difficulty of the science units. Data was analyzed using descriptive statistics: Average scores were calculated for each semantic differential question, for each survey, for each class. Written responses were shown as percentages of the total responses given. The study found that students preferred traditional instruction over guided inquiry instruction; however, many students enjoyed inquiry type activities, even though they found inquiry instruction to be more challenging. Although the study did not conclusively show that guided inquiry increased motivation and engagement, the results did show that all students had high levels of both motivation and engagement during both science units.
Table of Contents

Abstract ..............................................................................................................ii

Table of Contents ...................................................................................................iii

List of Figures .......................................................................................................vi

List of Tables .........................................................................................................viii

Acknowledgments .................................................................................................ix

Chapter One: Introduction ......................................................................................1

  Purpose of the Study ...........................................................................................1

  Justification of the Study ...................................................................................2

  Research Question and Hypothesis ..................................................................5

  Definition of Terms ............................................................................................6

  Brief Overview of the Study .............................................................................7

Chapter Two: Literature Review ............................................................................10

  Motivation and Student Engagement .............................................................10

  Inquiry Learning ...............................................................................................14

  Inquiry, Motivation and Engagement ...............................................................17

Chapter Three: Procedures and Methods ............................................................22

  Description of the Research Design .................................................................22

  Description of the Participant Sample ..............................................................22

  Description of the Research Instruments .........................................................23

  Procedure ..........................................................................................................26

    Recruitment of participants ............................................................................26

    Coding the participants ..................................................................................27
List of Figures

**Figure 4.1:** Average scores for semantic differential survey question responses for guided inquiry and traditional units for Class 1…………………………………………………35

**Figure 4.2:** Average scores for semantic differential survey question responses for guided inquiry and traditional units for Class 2…………………………………………………35

**Figure 4.3:** Comparison of average scores on the semantic differential questions for Class 1 and Class 2 after guided inquiry instruction…………………………………………………40

**Figure 4.4:** Comparison of average scores on the semantic differential questions for Class 1 and Class 2 after traditional instruction…………………………………………………40

**Figure 4.5:** Preferred instructional method for Class 1 students ………………………………41

**Figure 4.6:** Preferred instructional method for Class 2 students ………………………………41

**Figure 4.7:** Percentage of responses for the top seven preferred methods of learning science…………………………………………………………………………………………42

**Figure 4.8:** Number of responses which favored each instructional method for Class 1 ………48

**Figure 4.9:** Number of responses which favored each instructional method for Class 2………49

**Figure H1:** Percentage of written responses showing the preferred methods of learning science from Class 1 students after inquiry instruction………………………………………………97

**Figure H2:** Percentage of written responses showing the preferred methods of learning science from Class 1 students after traditional instruction ………………………………………98

**Figure H3:** Percentage of written responses showing the preferred methods of learning science from Class 2 students after traditional instruction ………………………………………98

**Figure H4:** Percentage of written responses showing the preferred methods of learning science from Class 2 students after inquiry instruction ………………………………………99
Figure I1: Percentage of Class 1 written responses showing a like or dislike of the inquiry unit………………………………………………………………………………………100

Figure I2: Percentage of Class 1 written responses showing a like or dislike of the traditional unit………………………………………………………………………………………100

Figure I3: Percentage of Class 2 written responses showing a like or dislike of the traditional unit. …………………………………………………………………………………………101

Figure I4: Percentage of Class 2 written responses showing a like or dislike of the inquiry unit………………………………………………………………………………………101

Figure J1: Percentage of Class 1 written responses indicating that the human body inquiry unit was easy, difficult or moderate in difficulty………………………………………102

Figure J2: Percentage of Class 1 written responses indicating that the traditional water unit was easy, difficult or moderate in difficulty…………………………………………………………102

Figure J3: Percentage of Class 2 written responses indicating that the traditional human body unit was easy, difficult or moderate in difficulty………………………………………103

Figure J4: Percentage of Class 2 written responses indicating that the water inquiry unit was easy, difficult or moderate in difficulty…………………………………………………………103

Figure K1: Percentage of written responses for Class 1 favoring either no preference, traditional instruction or guided inquiry instruction…………………………………………………………104

Figure K2: Percentage of written responses for Class 2 favoring either no preference, traditional instruction or guided inquiry instruction…………………………………………………………105
List of Tables

Table 4.1: Percentage of student responses indicating a like or dislike regarding unit instruction, or indicating a neutral view of the instructional method ........................................44

Table 4.2: Percentage of student responses that indicate students found the unit easy or difficult to understand .................................................................46

Table 4.3: Percentage of students who chose each instructional method compared to percentage of student responses which favored each instructional method .........................50
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Chapter 1: Introduction

Purpose of the Study

The purpose of this study was to examine the impact of guided inquiry instruction on the motivation and engagement of grade 8 science students. The goal of the study was to determine if using guided inquiry was actually more motivating to science students than using traditional instructional methods. The study did not measure whether guided inquiry increased academic achievement for the students, but rather whether or not it increased their overall interest and engagement in the topic being studied. The researcher’s assumption was that increased motivation and engagement would indirectly result in higher levels of student achievement, which was why the researcher felt that this topic was worthy of being studied.

The researcher has noticed in her many years of teaching that students vary in their interest toward learning. As a teacher of both science and mathematics, she has seen that motivation and engagement are often exhibited by some students, but that other students seldom seem to be engaged, no matter what the teacher does. The researcher has also noticed that a student who is engaged in her class might not be an engaged learner in another class, and of course the opposite was also seen to be true. Furthermore, students might be engaged in doing the worksheets and activities, but few students seemed to show the ability or willingness to understand the concepts at a deeper level. The researcher has attributed this observation to the notion that success at school has historically been associated with regurgitating back facts and concepts, rather than with critical thinking and deeper understanding.

The researcher has been using a form of guided inquiry instruction to teach a science unit to her grade 8 classes for three successive years. Guided inquiry instruction utilizes questioning, group work and the search for meaningful connections in the curriculum. The students have a fair amount of autonomy as they progress through the unit; however, the instructional unit is
carefully scaffolded and guided by the teacher. The researcher had noted that the use of guided inquiry seemed to enrich the learning experience of her students, but the extent to which this occurred was not clear. It was discovered over three successive years that students must be taught “how to do” inquiry, and that the effectiveness of the teacher in this type of instruction also seemed to play a role in the success of the unit. Although students seemed to experience more anxiety with the inquiry style of learning, the researcher perceived that students had experienced the curriculum more deeply and personally, and that students seemed to be more engaged during inquiry than during units taught with traditional instructional methods. The goal of this study was to collect data to explore whether or not, and in what way, guided inquiry instruction may motivate students to participate and increase student engagement.

**Justification of the Study**

The term student engagement is not uniformly defined in the literature. Exeter et al. (2010) define an engaged student as one who continually reflects on his or her own learning. According to Axelson and Flick (2011), “The phrase ‘student engagement’ has come to refer to how involved or interested students appear to be in their learning and how connected they are to their classes, their institutions, and each other” (p. 38). For this research study, *student engagement* was defined as the extent to which students are interested in the class, involved with their own learning, and motivated to try to do their best.

The question as to what affects the engagement of students at any age is of ongoing concern to educators. All teachers aspire to teach a class of engaged and motivated students who value learning. Engaged students tend to be motivated to learn, whereas disengaged students are more likely to be bored and disruptive (Reyes, Brackett, Rivers, White, & Salovey, 2012). Axelson and Flick (2011) noted in their research that the reasons for student engagement are not
always clear. Are students engaged because they intrinsically value learning, or are they engaged because they see learning as a means of achieving specific goals, such as employment? Furthermore, they observed that students may be engaged in one classroom while disengaged in another. These observations lead Axelson and Flick to question whether good teaching practices produce more engaged students, or whether engaged students learn more deeply in high quality teaching environments.

The Canadian Education Association study “What did you do in school today?” found that overall, Canadian students report low social, academic, and intellectual engagement. The study found that there was a steady decrease in school participation and academic engagement from Grade 6 to Grade 12, and intellectual engagement fell to about 30% by Grade 9, and stayed at this low level to the end of Grade 12. Furthermore, for intellectual engagement, boys consistently ranked lower than girls at all grade levels (Willms, Friesen, & Milton, 2009).

It would seem reasonable to assume that instructional methods which are relevant and meaningful, and which foster deeper learning, should lead to increased engagement. Mostrom and Blumberg (2012) discussed the importance of teaching methods which actively engage students through activities such as mind maps, debates and problem-solving. Virginia Lee (2011) considered the potential of inquiry-guided learning as a means for students to develop critical thinking, effective communication, organizational and management skills. Lee noted that these skills are necessary not only in education, but are valuable tools in the workplace as well. In a review of problem-based learning, peer-oriented guided inquiry learning and peer-led team learning, Eberlein et al. (2008) showed that despite the differences in these forms of instruction, all three of these student-directed pedagogies assist students in learning how to learn. They found that “studies of how people learn show that active-learning environments involving
problem-solving discussions with peers are more effective than traditional lectures” (Eberlein et al., 2008, p. 271).

A meta-analysis of inquiry-based science teaching by Furtak, Seidel, Iverson and Briggs (2012) concluded that inquiry does have a positive overall effect on teaching and learning, and they also showed that the role of the teacher to guide the inquiry learning is hugely important. This idea of the importance of the teacher during inquiry instruction was also demonstrated by Hmelo-Silver, Duncan, and Chinn (2007). Their research showed that the teacher played a key role in the success of both inquiry learning and project based learning classrooms.

In a study by Summerlee and Murray (2010), students in first year university who were exposed to an Enquiry Based Learning course showed continual average grade improvement each year for the next three years of their university degree. Summerlee and Murray attributed the success of these students to their exposure to a learning system that taught them how to learn, as opposed to one which simply taught them the necessary content facts.

Several studies have linked inquiry learning with student engagement and motivation. In a study of grade 8 students by Tuan, Chin, Tsai, and Cheng (2005), inquiry learning was found to increase the motivation of all students to some degree, even though different students utilized different learning styles. Toshalis and Nakkula (2012) noted that some students do not see the connection between effort and achievement, and so are not motivated to try to complete a task because they believe that they lack some innate ability to learn. However, if such students are given a voice, in other words, given the chance to choose, plan, design and collaborate, then these students will become more motivated to participate in the classroom and in their own learning.
One additional concept that has arisen during the research of inquiry, motivation and engagement is the concept of self-efficacy. According to Schunk and Mullen (2012), self-efficacy refers to a person’s confidence in his or her ability, which ultimately affects the person’s choice of tasks, the amount of persistence exhibited in completing those tasks, and the person’s overall degree of achievement. However, as Schunk and Mullen (2012) go on to point out, “high self-efficacy does not automatically translate into strong motivation and deep engagement. Students who feel efficacious about learning but disconnected from the school environment or mainstream society may be unmotivated and disengaged” (p. 229). In other words, a student with high self-efficacy might be disenchanted with school and fail to see the usefulness of school and the relevance of the school curriculum, which would result in disengagement at school. It appears that the concepts of motivation, engagement and self-efficacy are highly intertwined yet simultaneously independent of one another.

**Research Question and Hypothesis**

Given the tendency of middle and secondary school students to be disengaged from their learning, and considering the link between inquiry instruction and engagement, the researcher decided to investigate: “How does teaching a science unit using guided inquiry motivate and engage grade 8 students compared to teaching with traditional instructional methods?”

It was believed that the use of guided inquiry to teach the grade 8 science units would initially cause some anxiety and stress for many students, primarily because this form of learning would be new to most students in the class. But the researcher believed that as the students learned the inquiry process and became more comfortable with guided inquiry, they would become more motivated to learn the subject matter and more engaged in the learning process, as compared to a separate group of students who were taught the same unit without guided inquiry.
The researcher also compared traditional instruction to guided inquiry instruction within each class. It was the researcher’s belief that students in each class would self-report greater motivation and engagement after the inquiry instruction than after the traditional instruction.

**Definition of Terms**

The term *inquiry learning* (or inquiry instruction) has been used in many different ways. In a paper by Eberlein et al. (2008), a method called Process-Oriented Guided Inquiry Learning (POGIL) was examined. In POGIL, the instructor is the facilitator, group work replaces lectures, and the instructor monitors the groups for content knowledge as well as social dynamics. Eberlein et al. suggested that students who are exposed only to teacher-directed instruction are unable to master more complex course content, because the students never learn to process the information with higher-level thinking. Guided inquiry learning has been likened to inquiry that provides a certain amount of scaffolding in order “to provide a systematic way for students to organize and make connections with the information they gather” (Watt, Therrien, Kaldenberg, & Taylor, 2013, p. 41). Merrilyn Goos is a researcher who has examined inquiry learning within senior mathematics classrooms. Goos (2004) stated that inquiry learning involves scaffolding by the teacher as well as peer collaboration by the students. For the purposes of the current research study, *guided inquiry* was defined as learning through the use of individual and group work, based upon a framework that is provided by the teacher. The teacher acts to guide the learning process, but allows the students to take their inquiry in whatever direction is deemed necessary or appropriate to their inquiry question. The researcher in this study used a guiding inquiry question to help the students focus their thinking as they worked through the content material in small groups. Students were given autonomy in the way they chose to acquire knowledge and in their choice of a personal inquiry sub-topic.
Student motivation may determine whether or not a student will persist with a difficult task (Jansen, 2006). Toshalis and Nakkula (2012) stated that motivation determines effort and increased effort should result in higher levels of achievement. For this research study, motivation was defined as the extent to which a student will persist with a task and the amount of effort that a student will put toward achieving a goal.

The term engagement has been defined in several different ways in the research. Axelson and Flick (2011) discuss engagement as the extent to which a student is focused and involved in his or her own learning. Exeter et al. (2010) define the engaged student as one “who is a ‘deep’ learner, seeking to develop his/her knowledge, reflecting on the facts and details presented” (p.762). Schunk and Mullen (2012) define engagement as a “manifestation of students’ motivation” (p.220). For this research study, student engagement was defined as the extent to which students are interested in the class, involved with their own learning, and motivated to try to do their best.

The phrase traditional instructional methods also needed to be defined. For this research study, traditional instruction referred to the use of lectures, followed by worksheets or other activities (such as lab experiments) to support the concepts learned in the lecture. All the types of traditional instruction that were used during this research were led and directed by the teacher.

**Brief Overview of the Study**

This action research study used a mixed methods design to examine the motivation and engagement of grade 8 science students. Two classes from a high school on central Vancouver Island, British Columbia, were involved in the study. The researcher of this study was also the teacher of both classes. One class (Class 1) was taught the Human Body Unit using guided inquiry while the second class (Class 2) was taught the same unit using traditional instructional
methods. Then the classes switched roles. Class 1 was taught the Water Unit using guided inquiry while Class 2 was taught the Water Unit using traditional instructional methods. Therefore, each science class was taught one unit using guided inquiry and one unit using traditional instructional methods during the course of the research study. The research was conducted in the fall semester of the 2014-2015 school year and each science unit took about four weeks to complete.

Before the research study began, the teacher read the Recruitment Script (Appendix A) to each class and answered questions about the research study. Then each student was given a Parent/Guardian Information Letter (Appendix B), a Parent/Guardian Consent Form (Appendix C) and a Student Assent Form (Appendix D). Consent Forms and Assent Forms were dropped off at the school office and were later picked up by the research assistant. The research assistant kept all forms locked away, and also tracked which students were able to participate in the research study. At the end of each science unit, all students were given a survey to assess their interest and enjoyment of the unit, the level of challenge and difficulty they had experienced during the unit, their understanding of the content material and their perceived motivation and effort. The Human Body Survey (Appendix E) consisted of 15 close-ended, semantic differential ranking questions (Part 1), followed by three open-ended, written response questions (Part 2). The Water Unit Survey (Appendix F), which was administered after the second science unit, asked the same questions (but these were directed toward the water unit) but it also had a 16th ranking question and a fourth written response question. Prior to being administered, all student surveys were coded by the research assistant to assure anonymity of the participants. The surveys were administered to these students during class time while the researcher was out of the room in an effort to eliminate any feeling of coercion to participate. Surveys from those
students who did not have both consent and assent to participate in the research study were removed from the data set by the research assistant. The research assistant stored all the surveys under lock and key until the conclusion of the research, at which time the data was given to the researcher. The semantic differential part of each survey (Part 1) was given directly to the researcher, whereas the written response answers for each survey (Part 2) were typed into Word documents by the research assistant, and then given to the researcher electronically. This was done in order to assure that the researcher would be unable to identify the source of the written response answers.

Survey data was assessed and analyzed using descriptive statistics. The qualitative results were examined for emergent themes.
Chapter 2: Literature Review

The idea of inquiry learning has been present in education for many years, but it has taken many different forms. For this research study, the effect of inquiry learning on the motivation and engagement of grade 8 science students was studied, and the literature was grouped into three central themes: motivation, student engagement and inquiry learning. Although the researcher did find literature about the effect of inquiry learning on student achievement, this was not the direct focus of her research study. The researcher chose to focus on whether or not student participation in guided inquiry learning was more motivating and engaging than participation in teacher-led forms of instruction, with the hope that students who were more motivated and engaged would also show improved achievement.

Motivation and Student Engagement

Effective learning in schools requires students to be motivated to learn, but academic amotivation is a huge problem in schools today (Legault, Green-Demers, & Pelletier, 2006). Motivation determines effort. Both Jansen (2006), and Toshalis and Nakkula (2012), noted that students who associate effort with academic achievement will be more motivated to work hard and to persist with a difficult task, than those students who associate achievement with some ‘innate ability’ to learn. Furthermore, students who attribute failure at a task to a specific problem will be more motivated to try the task again. However, if students attribute failure at a task to an innate low ability, then they may develop a learned helplessness, and such students will lose all motivation to try to succeed at the task (Boekaerts, 2010).

Student motivation is determined by a number of factors: Ability beliefs (perception of one’s ability to complete an academic task), effort beliefs (belief that one can sustain the effort necessary to complete the task), task characteristics (perception of whether a task is interesting
or boring), and task value (perception of the importance and relevance of the task) (Legault et al., 2006). Similarly, Boekaerts (2010) found that motivation and emotion are integral to acquiring knowledge. Students have motivational beliefs which are cognitions about themselves in the context of a subject area. Boekaerts defines motivational beliefs as consisting of self-efficacy (belief that one can do the task), outcome expectations (belief about how the task will turn out), goals (purpose of the task), value judgments (perception of the task as fun or boring), and attributions (causes of success or failure). It can be understood then that the motivation of students in any classroom is highly complex and depends on a multitude of considerations.

This research study examined the effect of guided inquiry instruction on student motivation and student engagement. Engagement can be defined as the manifestation of a student’s motivation; or how the cognitions and behaviours of a student are sustained in order to complete a goal (Schunk & Mullen, 2012). Finn and Zimmer (2012) have determined that student engagement or disengagement in school is affected by both status risk factors and educational risk factors. Status risk factors include things like socioeconomic status, family structure, race and ethnicity. These are risk factors that are beyond the control of the educational system. Educational risk factors consider events at some time during schooling which may impact student success later on, such as being held back a grade level during elementary school, or having a poor experience with a classroom teacher. The researchers found that risk factors tend to cluster, such that multiple risk factors increase the chance for student disengagement with school, which in some cases may lead to students dropping out of school altogether.

Willms, Friesen, and Milton (2009) defined engagement as “the extent to which students identify with and value schooling outcomes, have a sense of belonging at school, participate in academic and non-academic activities, strive to meet the formal requirements of schooling, and
make a serious personal investment in learning” (p. 7). In other words, true engagement involves the social, academic, and intellectual realms. They go on to say that disengagement is currently a huge problem among Canadian adolescents and is also disproportionately higher among disadvantaged students, like those living in poverty, visible minorities, or those with disabilities. Willms, Friesen, and Milton also acknowledge that engagement is important not only for preparing adolescents for their adult lives, but also for enriching their current lives.

Finn and Zimmer (2012) classified student engagement according to four distinct themes: Academic engagement considers a student’s participation in learning activities, such as completing homework. Social engagement reflects the student’s willingness to interact with others and to follow established classroom behaviors. Cognitive engagement involves deeper learning, in which a student is motivated to question and to go beyond the minimum level of understanding. Affective engagement refers to the student’s perception of school as being useful, valuable and inclusive. For teachers, academic and social engagement are more easily observable, however, the presence or absence of affective engagement is probably the most important dimension for students. Students with high levels of affective engagement will likely demonstrate the other types of engagement as well, since they view their schooling as relevant to their lives.

Reyes, Brackett, Rivers, White, and Salovey (2012) stated that student engagement may be a response to the type of teacher instruction, but may also be affected by the social and emotional climate in the classroom. Teachers that fostered a high classroom emotional climate, characterized by warmth, respect, fairness, sensitivity, cooperation and security, were associated with higher levels of student engagement. These teachers acted to increase student engagement because they were sensitive to students’ emotional and academic needs. Teachers gave students
more autonomy in their learning, while at the same time helping them learn how to problem-
solve. Willms et al. (2009) noted that two factors, the classroom teacher and high expectations for student success, were shown to stimulate increased levels of social, academic and intellectual engagement among students.

One other aspect which was found to influence both motivation and engagement was the self-efficacy of the student. Self-efficacy was defined as the perceived capability for learning or performing actions at a designated level (Schunk & Mullen, 2012). Students who are self-efficacious are more confident, and this will influence their choice of tasks, their level of persistence to complete the task, and ultimately may direct the goals that the students will pursue. In turn, Schunk and Mullen argued that specific goals which are challenging yet attainable may enhance self-efficacy, whereas goals that are long-term and seemingly unattainable will actually decrease self-efficacy in students. This is similar to the idea of instructional challenge that was measured in the study by Willms et al. (2009). They found that students who exhibited high skills and were exposed to high challenge, showed the highest levels of engagement and had a sense of flow and balance. Students with high skills who were exposed to low challenge were bored. Students with low skills who were exposed to high challenge were anxious and frustrated, and students with low skills who experienced low challenge were uninterested because school lacked purpose. Consequently, the students with high skill and high challenge showed the greatest engagement in school. The challenge for all educators then would be to create learning environments which challenge but don’t overwhelm, and which help to facilitate skill development in every student. There is abundant evidence in the research which indicates that student-directed pedagogies, such as inquiry learning, may promote increased engagement among students.
Inquiry Learning

Watt, Therrien, Kaldenberg, and Taylor (2013) explained that students need a variety of ways to demonstrate their learning, since not all students are capable of producing the same written output. Today’s students require higher level skills just to enter the workplace, such as the ability to stay engaged, the ability to collaborate, and the ability to manage tasks and resources (Barron & Darling-Hammond, 2010), as well as the ability to communicate effectively (Lee, 2011). However, traditional teaching practices such as lectures do not promote these higher-order skills. “The term inquiry has figured prominently in science education, yet it refers to at least three distinct categories of activities - what scientists do,…how students learn,…and a pedagogical approach that teachers employ” (Minner, Levy, & Century, 2010, p. 476). Through the years there have been many types of student-led learning pedagogies designed to promote deeper learning and skill development, such as inquiry learning, project-based learning, problem-based learning, peer-led team learning, discovery learning, learning by design and experiential learning. These methods tend to differ according to the amount of teacher direction and instruction provided. However, all student-led learning pedagogies emphasize the idea of students directing their own learning through research, collaboration, experimentation and problem-solving.

Some researchers have debated the merits of direct instructional guidance versus minimally-guided, student-led learning strategies (inquiry, problem-based, discovery, experiential, etc.). An article by Kirschner, Sweller, and Clark (2006), explained that “learning…is defined as a change in long-term memory” (p. 75). They discussed the fact that minimally guided instruction places a large cognitive load on a student’s working memory, which would prevent the student from storing information in his or her long-term memory.
However, as pointed out by Hmelo-Silver et al. (2007), inquiry and problem-based learning both make use of extensive teacher scaffolding:

“Both PBL [problem-based learning] and IL [inquiry learning] are organized around relevant, authentic problems or questions. Both place heavy emphasis on collaborative learning and activity. In both, students are cognitively engaged in sensemaking, developing evidence-based explanations, and communicating their ideas. The teacher plays a key role in facilitating the learning process and may provide content knowledge on a just-in-time basis.” (p. 100).

According to a meta-analysis of 22 peer-reviewed papers on inquiry-based science teaching, inquiry can be defined in terms of two dimensions, cognitive and guidance. The cognitive dimension of inquiry consists of the conceptual domain (the knowledge to be gained), the epistemic domain (the understanding of how scientific knowledge is generated), the social domain (the collaboration to perform the science and report the results), and the procedural domain (the actual processes involved in doing science). The guidance dimension of inquiry considers the extent to which students are directed and led by the teacher. They found that teacher-led inquiry had a larger impact on learning than either student-led learning or traditional teacher-led instruction (Furtak et al., 2012).

The idea that the teacher has an important role to play during inquiry learning is echoed by several other studies. For example, Goos (2004) used scaffolding to build a community of practice in her senior mathematics classes. She initially provided direction for the discussion of content, ownership of tasks, and for self-monitoring, and then she slowly withdrew her assistance
and allowed the students to accomplish more tasks unaided. Mostrom and Blumberg (2012) described a pedagogy called learning-centered instruction, where the teacher is a facilitator who uses ongoing formative assessment which allows the students to learn concepts more deeply and critically. But Mostrom and Blumberg noted that the teacher needed to model these higher-order learning skills in order for learning-centered instruction to be effective. Conklin and Hart (2009) noted that “while expectations of what is created are not dictated by the professor, there is no denying her presence in the system and her potential impact on the resulting aspirations of students” (p. 90). In other words, students will become better at the collaboration, questioning and critical thinking involved in inquiry when they have a teacher who models those activities and gradually turns more of the learning over to the students, as they become more adept at inquiry processes.

Barron and Darling-Hammond (2010) stated that success with inquiry learning depends largely on the knowledge of the teacher and on the extensive planning and scaffolding of the inquiry lessons, as well as the teacher’s ability to assess the learning and redirect the students as needed. The necessity of scaffolding content acquisition, inquiry skills and self-assessment strategies was also demonstrated in a study by Eslinger, White, Frederiksen, and Brobst (2008). According to Virginia Lee (2011),

“inquiry-guided learning is a powerful way of learning that requires at once a sophisticated understanding of the discipline, a solid grounding in contemporary approaches to teaching and learning, and a broad repertoire of teaching strategies, a combination that few instructors possess” (p. 158).
A study of an Amsterdam university teacher education program looked at the responses of students as they changed from teacher-centered learning in year 1 to open inquiry learning in year 2. The researchers found that inquiry instruction generated more excitement, motivation and a greater sense of accomplishment in the university students. However, inquiry learning also induced strong negative emotions like frustration, anxiety and stress, but it was not associated with negative feelings like boredom (Litmanen, Lonka, Inkinen, Lipponen, & Hakkarainen, 2012). Students did, however, report negative emotions like boredom and disinterest during the period of lecture instruction. In light of the negative responses associated with inquiry instruction, Litmanen, Lonka, Inkinen, Lipponen, and Hakkarainen (2012) determined that “a gradual scaffolding of the learning process by the teacher is essential to ensure that the friction caused by the challenges does not become too great for the students” (p. 1098).

In light of reading the extensive literature on inquiry learning, the guided inquiry unit in this research study was carefully scaffolded, because previous experience had shown the researcher that if the students were not given adequate guidance during their first foray into inquiry learning, that they would become anxious and frustrated and overwhelmed, making any meaningful learning unlikely.

Inquiry, Motivation, and Engagement

Several empirical studies have looked at the impact of minimally guided learning strategies on student motivation. Tuan et al. (2005) found that “inquiry instruction can promote all students in their motivation toward science learning” (p. 563), even when students displayed a variety of different learning styles. Furtak and Kunter (2012) associated active hands-on learning with greater interest and motivation in students. They also associated the greater procedural and cognitive autonomy that comes along with active hands-on learning with helping
to foster increased motivation and deeper learning. Another study looked at the effect of collaborative reasoning discussion on student motivation and engagement. In this study, collaborative reasoning involved the students reading a passage about a somewhat controversial subject and then engaging in group discussion about the topic. Students were not required to “solve” the issue, but rather to participate in a thoughtful discussion about the topic. The study concluded that “children who participated in collaborative reasoning discussions reported significantly higher interest, attention and effort, and value in discussion than their counterparts who participated in regular classroom discussions” (Wu, Anderson, Nguyen-Jahiel, & Miller, 2013, p. 628).

Exeter et al. (2010) examined student engagement in large (>1000) university classes, where professors were making efforts to change their lecture format to include tasks that required students’ active participation. They defined the engaged student as one who “is a ‘deep’ learner, seeking to develop his/her knowledge, reflecting on the facts and details presented in the lecture related to their own experiences and ‘the big picture’” (p. 762). The researchers found that when the university students were actively engaged during the lecture, that they were better able to learn and understand the material.

Eberlein et al. (2008) stated that “active-learning environments involving problem-solving discussions with peers are more effective than traditional lectures” (p. 271). Although the concept of active learning is not necessarily indicative of inquiry learning, during inquiry learning students are actively engaged in the direction that their learning will take. Furthermore, most inquiry activities involve collaboration among group members. Eberlein et al. examined the method of process-oriented guided inquiry learning. They defined this type of learning as one which uses the teacher as a facilitator who monitors the group work for understanding and
who will assist if needed. This pedagogy uses textbooks as reference materials, but also allows students to use many additional resources to enhance and direct their learning. This pedagogy also recognizes that the direction that the learning may take will evolve as the student progresses through the topic.

In a study by Hu, Kuh, and Li (2008), college students in the middle and higher-performing achievement range were more likely to engage in inquiry type activities, and this participation in inquiry activities was positively correlated to self-reported gains in college. However, the effect of inquiry on lower-performing students was not as strong. As Mostrom and Blumberg (2012) noted, teaching methods which utilize mind maps, debates, critical-thinking or problem-solving activities all work to actively engage students more than teacher-led activities. If true, then these activities should enhance engagement in students of any age.

A review of 2006 assessment data for the Program for International Student Assessment (PISA) was conducted by McConney, Oliver, Woods-McConney, Schibeci, and Maor (2014) to assess the effect of inquiry-based activities on science literacy (achievement) and engagement for 15 year old students from Canada, Australia and New Zealand. As noted by the authors, there is a widespread assumption that the inclusion of inquiry activities is associated with both greater student engagement and higher achievement. The PISA study examined the frequency of inquiry-based activities and looked at six variables to measure student engagement in science. In all three countries, the students who reported the highest levels of inquiry activities showed lower than average levels of science literacy, but higher than average levels of interest and engagement in science. For students who reported low levels of inquiry activities in science class, the reverse was seen: These students had higher than average achievement in science but lower than average interest in science. Although the study supports greater engagement with
inquiry, it does not support the widely held assumption that inquiry will also lead to higher achievement. However, the authors noted that

“inquiry typically emphasizes depth of understanding and development of ideas that mimic scientists’ deep understanding of specific questions or topics. If students are assessed with instruments that measure the breadth of their science knowledge, they may not fare well if they have experienced teaching strategies oriented toward more in depth understanding of a limited number of topics” (McConney, Oliver, Woods-McConney, Schibeci, & Maor, 2014, p. 977).

Consequently, inquiry may still be a very valuable tool, both in science and other subject areas, due to the fact that it promotes engagement and deeper learning.

The importance for students to be inherently motivated, the necessity for students to be engaged in their learning, and the value of student-led pedagogies such as inquiry learning, have all influenced this current research study. The research seems to be clear that with greater motivation and engagement, students exhibit greater effort and persistence in completing tasks. If inquiry learning really does increase the interest and motivation and engagement of students, then its implementation in secondary school curricula would become valuable to any educator. Based on the literature presented, the researcher in this study believed that student motivation and engagement would be higher during the unit of guided inquiry instruction than during the unit of teacher-led instruction, with the hope that if the students were more engaged in their learning, then greater achievement would ultimately be the end result. The main goal of the research study was to assess whether guided inquiry instruction increased students’ motivation to
participate, in part because students were allowed to assist in determining the focus and direction of their learning. The researcher hoped that with the right amount of challenge provided, the guided inquiry instruction would act to increase the relevance, importance and interest of the learning for her grade 8 students.
Chapter 3: Procedures and Methods

Description of the Research Design

In this research study, grade 8 science students were taught two different science units, one on the human body and one on water systems. One class (Class 1) was taught the Human Body Unit using guided inquiry (student-directed instruction), while the other class (Class 2) was taught this same unit using traditional instructional methods (teacher-directed instruction). Then the two classes were taught the Water Unit at the same time, but each class was taught using the other instructional method. The students were surveyed at the end of each science unit using a two-part survey consisting of semantic differential ranking questions in the first section, and written response questions in the second section. The survey asked the students to assess their level of enjoyment, interest, motivation, effort and the difficulty of understanding the science unit which had just been taught. The surveys were analyzed to see if there was any difference between the control group (traditional instruction) and the experimental group (guided inquiry instruction) with regards to motivation and overall student engagement.

Description of the Participant Sample

The potential participants included 53 students (30 male and 23 female) from the researcher’s two linear math-science classes in a secondary school in Nanaimo, British Columbia (School District 68). Fifty of the 53 students consented to participate in this research study. This secondary school services a low to middle income area of the city, but as there are numerous sports academies at this school, there are also a large number of students at the school who come from outside the regular catchment area. The students in the two classes were mostly Caucasian, and about 8% of the students were of Aboriginal or other ancestry. The students ranged in age
from 12-14 over the course of the school year, with most students being 13 years old during the time of the research study.

Two classes (Class 1 and Class 2) were chosen to be included in this study so that the researcher could compare the two different instructional methods. The classes were of “regular” composition, meaning neither class was an “honours” or an “essentials” grouping of students. The researcher chose to conduct the study with grade 8 students for several reasons: Firstly, the researcher had already taught a science unit using guided inquiry to her grade 8 classes in previous years, so she wanted the research to examine what she had already begun to investigate informally in her classroom teaching. Secondly, the researcher felt that grade 8 students were a good choice for her study because the students were in their first year of secondary school, so they would not already have set ideas about what high school classes should be like. Furthermore, the researcher was aware that research has shown that intellectual engagement, regular attendance and participation in school sports and clubs fall drastically during the middle school years (Willms et al., 2009). Consequently, any instructional strategies that might improve interest, motivation and engagement at the grade 8 level would be invaluable in preventing this drop in intellectual engagement, attendance and participation. Lastly, due to time constraints for completing the research within the first four months of the school year, using grade 8 linear classes allowed the researcher some flexibility in knowing that she had the entire year in which to teach the math and science curricula to her students.

**Description of the Research Instruments**

Two surveys were used in this research study. Both surveys were administered to participants at the end of each science unit, in order to get a sense of what the students thought about that particular form of instruction. Both surveys consisted of two parts; Part 1 included
semantic differential ranking questions and Part 2 included open-ended written response questions.

Part 1 of Student Survey #1 - Human Body Unit (Appendix E) was composed of 15 semantic differential ranking questions. These questions asked the students to assess their level of enjoyment, interest, motivation, effort and difficulty of understanding of the science unit that they had just completed. Some of the questions referenced the Human Body Unit specifically, whereas other questions discussed science or school in general. Part 2 of the survey consisted of three written response questions which asked the students to explain what teaching methods they liked best for learning science, whether or not they liked the way the unit was taught to them, and how well they understood the content of the unit. All students in both grade 8 classes were given the same survey on the same day.

Part 1 of Student Survey #2 – Water Unit (Appendix F) was composed of the same 15 semantic differential questions as in Survey #1, with some of the questions re-written to ask specifically about the Water Unit. Part 1 of Survey #2 also had a 16th question which asked students to choose which teaching style they preferred; guided inquiry, traditional or prefer both equally. Part 2 of Survey #2 had the same three written response questions as in Survey #1, but there was a fourth question which asked the students to explain the reasons why they chose either guided inquiry, traditional, or prefer both equally as their answer to question #16 in Part 1. Again, all students were given the Water Unit survey on the same day at the conclusion of the unit.

Semantic differential questions were chosen for the survey so that the researcher could assess the students’ attitudes toward the two methods of teaching science with a quantitative rating. Geoffrey Mills (2014) states that; “by totaling the scores for all items on the semantic
differential, the teacher researcher can determine whether a child’s attitude is positive or negative” (p.103). Fabrigar and Norris (2007) state that semantic differential questions may be used to reflect the good-bad continuum, the strong-weak continuum, or the active-passive dimensions, but that mostly they are used by researchers to assess attitudes. The researcher in this study also decided to use open-ended written response questions so that she would have a more complete idea as to why her students had either positive or negative attitudes with regard to each teaching method.

The content of the survey questions fell within five categories; enjoyment and interest, motivation to participate, perceived effort, like or dislike, and ease or difficulty of understanding. The survey questions were derived from the researcher having read numerous research studies concerned with motivation, engagement and inquiry. Amotivation was outlined as a huge problem in today’s schools by Legault et al. (2006). Several other studies linked the motivation of a student to the effort that the student would expend in his or her classroom situation (Jansen, 2006, Toshalis & Nakkula, 2012). Boekaerts (2010) stressed the link between motivation and positive emotions in order for students to learn. In consideration of the apparent necessity for students to be motivated in order to learn successfully, several of the survey questions tried to assess the level of interest, motivation and effort of the students during this research study. The semantic differential survey questions on these topics were asked three different ways: To assess student interest/motivation/effort 1) during the science unit, 2) during science class in general, and 3) in all school subjects.

A study by Reyes et al. (2012) connected the importance of a warm, respectful and inclusive classroom to greater student engagement and academic performance. Schunk and Mullen (2012) stated that challenging yet attainable goals help to increase the self-efficacy of
learners. Barron and Darling-Hammond (2010) illustrated the importance of well-designed inquiry instruction (along with well-designed formative assessment) as a way to engage students and deepen their learning experience. Studies such as these helped the researcher formulate the questions which compared guided inquiry to traditional instruction. One semantic differential question asked the extent to which the students liked or disliked the way in which the science unit was taught, while a similar question asked the students how much they would like to learn another science unit by the same method. Two other questions in the semantic differential section and one written response question asked the students to evaluate how well they understood the unit which they had just completed, as well as what made the unit easy or difficult. The researcher was interested in evaluating the amount of difficulty that the students experienced in the guided inquiry unit because several studies have indicated that guided inquiry instruction is often found to be more challenging for students than traditional, teacher-directed instruction. (Barron & Darling-Hammond, 2010; Kirschner, Sweller, & Clark, 2006; Litmanen et al., 2012).

Procedure

Recruitment of participants. During the second week of the school year the researcher spent time in each grade 8 class explaining that she was doing a Masters in Educational Leadership at Vancouver Island University and that she would be conducting a research study using her two classes from October to December, 2014. She explained the research study to her classes using a Recruitment Script (Appendix A). Then the researcher passed out three documents to each student; the Parent/Guardian Information Letter (Appendix B), the Parent/Guardian Consent Form (Appendix C), and the Student Assent Form (Appendix D). The researcher read the entire Student Assent Form with her students. The form clearly stated that
participation in the research study was voluntary, and it also described how students would not be penalized if they chose not to participate, nor would they be penalized by what they wrote in their surveys, since the surveys were going to be anonymized. The researcher then answered any questions that her students had regarding the research study. The students were sent home with all three documents and with instructions to discuss the forms with their parents, and to bring back the signed documents to the school office, not to the researcher. The three documents were also sent to the parents via email two weeks later, accompanied by the Recruitment Email Message (Appendix G), in an effort to notify any parent whose child had not previously taken the information home.

Coding the participants. The signed Parent/Guardian Consent Forms and Student Assent Forms were collected in a bin in the office by the school secretary. These were picked up daily by the research assistant, who was also the educational assistant working in the researcher’s classroom.

The research assistant developed a master list for each class which showed which students had both parent consent and student assent. The Parent/Guardian Consent Forms and Student Assent Forms, along with the master class lists, were stored in a locked office in the school for the duration of the study.

The research assistant developed a numerical code for each student, regardless of whether or not the student had consented to participate in the research study. This code was known only by her and was written on the master class lists. The research assistant used this numerical code to code all surveys, thereby anonymizing the data.

Teaching the science units. The researcher taught two different science units to both classes, and each unit lasted approximately four weeks. The first science unit covered the human
body, and Class 1 was taught using guided inquiry while the Class 2 was taught using traditional instruction. The second science unit covered water systems, and this time Class 1 was taught with traditional instructional methods and Class 2 was taught using guided inquiry.

For the purposes of the research study, *traditional instructional methods* referred to the use of lectures, note-taking, worksheets and labs, and all class activities were teacher-directed. *Guided inquiry* referred to student-directed learning through individual and group work, which was based on a framework provided by the teacher. The students followed the teacher's framework but were allowed to extend their learning in an individualized direction according to an inquiry question which was related to the overarching inquiry question for the whole unit. The guided inquiry project for both the Human Body and Water units culminated with a mind map. Three parts of the mind map were based on group learning of the curricular content, whereas the fourth section consisted of the personal inquiry topic which was related to the unit content. Several research studies have indicated the necessity of careful teacher guidance and scaffolding during inquiry instruction, as well as the use of carefully planned, regular formative assessment (Barron & Darling-Hammond, 2010; Goos, 2004; Hmelo-Silver, Duncan, & Chinn, 2007; Lee, 2011; Litmanen et al., 2012; Reyes et al., 2012; Watt et al., 2013). The researcher designed her inquiry units in tune with this belief that students must be taught “inquiry skills” in order to do inquiry effectively. As this was likely the first exposure to inquiry learning for most of the students, the inquiry unit was carefully planned and guided, group work was constantly monitored by the teacher (who intervened when necessary), clear criteria were established for the mind map, and ongoing formative assessment and reflection (both oral and written) occurred throughout the unit.
At the conclusion of each science unit, the students in both classes were surveyed during the first 30 minutes of class. Of note is that for each inquiry unit, all students were also required to complete journal reflection assignments during the unit. These reflections were part of the learning outcomes for the inquiry unit and were not included as part of this research study, however these journal reflections were used by the teacher to inform her teaching practice.

**Data collection.** Prior to the completion of the Human Body Unit, the research assistant prepared and coded the surveys. On the day of the survey, the researcher left the classroom during the first 30 minutes of the class in order to allow the research assistant to administer the surveys. Before handing out the surveys, the research assistant reminded the students that participation in the research survey was completely voluntary. The research assistant also reminded the students that the research surveys were coded to prevent students from being identified, and she reminded the students not to write their name anywhere on the survey. The research assistant passed out the surveys and read over the survey instructions with the class before the students were allowed to begin writing. The research assistant asked the students to work quietly and independently for the remainder of the allotted time, and the students were encouraged to answer all questions to the best of their ability. Surveys were collected by the research assistant, and the teacher researcher was called back into the classroom when the surveys were completed.

The research assistant separated the two parts of the surveys (semantic differential and written response), and both parts were stored in the same locked office as the Consent Forms and Assent Forms. Surveys from each class were placed in separate file folders that were marked with the date, time, class, science unit, survey section (Part 1 or Part 2) and teaching method (inquiry or traditional). Any surveys from students who did not have consent to participate were
stored in a separate folder and were not included in the data, but were used after the study by the teacher to inform her practice.

At a later date, the research assistant typed up the written responses from the Part 2 sections of the surveys. These responses were transcribed to Word documents (one document for each survey question for each class). This was done so that the researcher would not be able to recognize her students' handwriting. The transcribed answers did show the student codes. This allowed the researcher to compare the inquiry/non-inquiry survey answers for individual students, as well as examining whole class results. These Word files were saved to a memory stick and to the researcher’s home computer. Once the entire research study was concluded, the research assistant shredded the paper copies of the written response sections of the surveys so that only the transcribed documents remained.

The researcher did not examine any of the survey data until the research study was concluded and both science units were taught and evaluated.

Validity of the Study

The research design increased internal validity in a number of ways. Internal validity was fairly high since the design of this research study allowed the use of a comparison group. The researcher used two comparable eighth grade science classes, and both classes were taught the science units on the same topic by the same classroom teacher. As well, each of the science classes acted as both the experimental group (taught with guided inquiry) and the control group (taught with traditional instructional methods). This made the results more meaningful than if the inquiry had only been taught to one of the classes, since it allowed the researcher to see if differences in the data were due to the teaching method alone, or whether other factors might have come into play. Furthermore, internal validity was also increased because the teacher
structured the inquiry instruction for the Human Body Unit and Water Unit to be as similar in design as possible. The teacher also used similar teaching methods and activities during both traditionally taught units. The researcher hoped that by keeping her teaching as consistent as possible, her surveys would actually measure the motivation and engagement experienced by her students during each different type of instruction.

External validity of this particular research study was low since the research participants were from a very specific population (the researcher’s two science classes) and were not randomly chosen in any way. As such, results were not generalizable to any other population or environment. However, results from this study could provide information to other middle school or secondary school teachers about how grade 8 students might view their learning by traditional instructional methods as compared to guided inquiry methods. Such teachers might be able to utilize these results to apply strategies within their own classrooms to improve student motivation and engagement.

**Limitations of the Study**

There were numerous limitations to this research study. Firstly, the researcher created her own surveys so reliability of the data collection instruments might be questionable. The researcher had no training in creating data collection tools, so her surveys might not have measured responses as consistently as she had hoped. However, the questions in the surveys were all derived from intensive examination of the literature on the topics of inquiry, engagement and motivation, so it was the researcher’s hope that her questions would accurately measure the extent to which her students were engaged and motivated during the two different types of instruction.
Another limitation could have been the types of questions used in the surveys. The researcher drafted the surveys so that students would find the semantic differential questions easy to understand and hopefully fairly easy to answer. However, according to Fabrigar and Norris (2007), one limitation to the use of the semantic differential question is the meaning of the midpoint answers (in this case, a score of zero). The midpoint answer might have meant that the respondent was neutral on the topic question, or that the respondent had no opinion about the question, or it might indicate that the respondent was highly ambivalent, in other words, had both strong positive and negative feelings about the question.

The use of open-ended written response questions might have been a limitation because the written response questions were longer and consisted of several parts. It was probable that some participants answered only some parts of each question, which would therefore limit the usefulness of the data.

Data Analysis

All data analysis was performed by the researcher. The researcher used Excel to calculate descriptive statistics from the semantic differential results. The researcher compared the ‘control’ class to the ‘inquiry’ class for each science unit. She also compared the two control classes to one another and the two inquiry classes to one another, to see if there were similarities and differences in the trends between the two groups. This allowed the researcher to determine if there were any other differences between the groups which could not be attributed to the teaching method used. The researcher examined the written responses in Part 2 of the surveys for emergent themes which might have supported or contradicted the other survey data. These themes were illustrated graphically using Excel.
Chapter 4: Results and Data Analysis

The purpose of this research study was to investigate whether teaching a science unit using guided inquiry would motivate and engage grade 8 students more than teaching the same science unit through traditional instructional methods. The researcher’s goal was to use the results of this research study to improve the motivation and engagement of her science students.

The research study was conducted from September to December 2014 in a secondary school in School District 68. The possible participants were from a convenience sample of the researcher’s two grade 8 science classes, which included 30 male students and 23 female students. Fifty students consented to participate in this research study including 28 male students and 22 female students. However, two female students were withdrawn from the classes during the course of the study, so there were only 20 female participants in the sample when the second survey was administered. All students participated in the classroom activities involved in this research study, including completion of the survey instruments, however, only the surveys from consenting students were included in the data analysis. Students completed two surveys, one after the completion of each science unit. The surveys were composed of two parts: Part 1 consisted of semantic differential ranking questions and Part 2 consisted of written response questions.

Semantic Differential Survey Questions

The semantic differential survey questions assessed five main areas; enjoyment and interest, motivation to participate, like or dislike of the instructional method (and like or dislike of group work), ease or difficulty of understanding the instruction, and perceived effort. The questions on interest, motivation and effort included questions about the specific science unit being studied, science class in general, as well as all school subjects in general. The researcher
hoped that by asking similar questions about science and school in general that she would be able
to determine if students showed any different responses with regards to the specific science units.
The semantic differential scale used in the survey questions was scored from -3 to +3, where the
negative values indicated a disinterest, lack of enjoyment, dislike, lack of motivation, lack of
effort and difficulty in understanding (depending on the question). The positive values indicated
interest, enjoyment, a liking, higher motivation, greater effort, and better understanding. An
average score for the semantic differential scale was calculated for each question, for each class,
for each survey (see Figure 4.1 and Figure 4.2). Possible average scores on the semantic
differential scale ranged from -3 to +3. The calculated average scores for all questions from both
surveys ranged from a lowest value of -0.16 to a highest value of 2.16. For the purpose of this
research study, a weak positive response to a question was considered to be an average score
between 0 and 0.75 and a weak negative response was between 0 and -0.75. An average score
between 0.75 and 1.5 was considered to be a moderate positive response and an average score
between -0.75 and -1.5 was a moderate negative response. Lastly, any positive average score
greater than 1.5 and any negative average score less than -1.5 were considered to be strong
responses to a question. The researcher decided to group average scores into weak, moderate
and strong responses after observing that the majority of the average scores in the survey data
fell within this moderate range of 0.75 and 1.5.
Figure 4.1. Average scores for semantic differential survey question responses for guided inquiry and traditional units for Class 1. (n = 25 for Human Body Survey, n = 23 for Water Survey)

Question 1 of the survey asked how much the students enjoyed the science unit. Both classes expressed positive levels of enjoyment for both units, however, both classes indicated...
higher levels of enjoyment for the traditionally taught unit. Both classes had a weak response to enjoyment after the guided inquiry unit and a moderate response to enjoyment after the traditional unit. In this case the difference seemed reflective of the type of unit, not when the unit was taught or the subject matter.

Questions 2 and 3 of the survey asked the students how interesting they found the science unit (Q. 2) and science class in general (Q. 3). Again, both classes expressed positive levels of interest toward the science units and toward science class, but interest was ranked higher after the traditionally taught unit. For interest in the science unit, there was a measureable difference when students were asked after inquiry instruction versus after traditional instruction: Both classes had higher average scores for interest after the traditional unit than after the inquiry unit. Class 1 had an average score of 1.52 for the traditional unit and 0.88 for the inquiry unit, and Class 2 showed a similar difference of 1.24 for the traditional unit and 0.5 for the inquiry unit. However, when students were asked about their interest in science class in general, the average scores were only marginally higher after the traditional instruction compared to after inquiry instruction (1.13 compared to 1.04 in Class 1, and 1.14 compared to 1.09 in Class 2), and all average scores were within the moderate range.

Questions 4, 5 and 6 asked the students how motivated they were to participate in the daily activities in the science unit (Q. 4), in science class (Q. 5) and in all school subjects (Q. 6). Class 1 students expressed positive levels of motivation for all three questions, but the rankings were higher when surveyed after the traditional unit. Class 2 students also expressed positive levels of motivation for all three questions, but for the questions about science class and school in general, the average scores were higher after the inquiry unit. Following the completion of the inquiry unit, Class 2 students had slightly higher average scores on all three motivation questions.
(average scores ranged from 1.04 to 1.83, all within the moderate range), than did Class 1 students (average scores ranged from 0.72 to 1.78). Conversely, following the traditional unit, Class 1 students had slightly higher average scores on all three motivation questions (average scores ranged from 1.39 to 1.78) than did Class 2 students (average scores ranged from 1.29 to 1.50). It was noted that in each case, the class with the higher average scores on the motivation questions scored higher after the second science unit. This suggests that it was likely the timing of the unit that made the difference, rather than the instructional method or the science topic, since both the instructional method and topic were different for each class during the second unit.

Questions 13, 14 and 15 asked students about the amount of effort they put into the science unit (Q. 13), science class in general (Q. 14) and all school subjects (Q. 15). Both classes had average scores ranging between 1.59 and 2.16 for all three effort questions, which indicated that students exerted a strong amount of effort in each science unit, in science class in general, and in all school subjects. Furthermore, there did not appear to be any apparent distinction between responses after inquiry compared to responses after traditional instruction. However, it can be noted that the perceived effort of students in both classes was slightly higher when surveyed after the first science unit, irrespective of whether the unit used inquiry or traditional instruction. This is in contrast to the responses given to the motivation questions, in which both classes indicated greater levels of motivation after their second unit, irrespective of the type of instruction given.

Question 7 asked the students to rank how much they liked the way that the unit was taught, while Question 12 asked how much the students would like to learn another unit in the same way as the unit just completed. These two questions were used to gauge whether or not the students liked doing guided inquiry. Class 1 students indicated that they strongly liked the
traditional unit (average score was 1.65) but only weakly liked the inquiry unit (average score was 0.16). Class 2 expressed a moderate liking for the traditional unit (average score was 1.40), but indicated a weak dislike for the inquiry unit (average score was -0.04). So it appears that for both classes, guided inquiry instruction was liked less than the traditional instruction. As to whether or not the students would like to be taught another unit the same way, Class 1 had a weak negative response (-0.16) after the inquiry unit and a moderate positive response (0.91) after the traditional unit. Class 2 had a neutral response (0.0) after the inquiry unit and a moderate positive response (1.48) after the traditional unit. Both classes had a higher ranked response for wanting to learn a second science unit by traditional instructional methods.

Questions 9 and 10 asked the students to rank how much they liked doing group work (Q. 9) and whether or not they thought that group discussion helped their understanding of the unit content (Q. 10). Class 1 showed a weak dislike of group work after the inquiry unit (average score was -0.08), but a weak to moderate liking of group work after the traditional unit (average score was 0.74). Class 2 showed a moderate liking of group work after the inquiry unit (average score was 0.96) but indicated a strong liking for group work after the traditional unit (2.06). Overall, Class 2 had a more positive average response to the use of group work in science class. Both classes had positive average responses to Question 10 on both surveys, indicating that group discussion helped the students to better understand the content material. For Class 2, the average response to Question 10 was similar after both types of instruction (1.30 after inquiry and 1.56 after traditional). However, Class 1 had a greater disparity in the average responses to Question 10 (0.24 after inquiry and 1.09 after traditional). Class 1 responded much more positively after the traditional instruction, when less group work was actually done.
Questions 8 and 11 evaluated how *easy or difficult* the students found the unit (Q. 8), and also the *depth of understanding* that the students had of the content material by the conclusion of each unit (Q. 11). The average scores from both classes to Question 8 indicated that students perceived the inquiry unit to be more difficult than the traditional unit. That said, in Class 1, the average score for how easy or difficult the students found the work fell into the moderate range after both the inquiry and traditional units. In Class 2, there was a weak positive response to Question 8 after inquiry and a moderate positive response after traditional instruction. Students from both classes also indicated that they had a good understanding of the content material after each instructional unit. The average response to the depth of understanding was moderate for both classes after the inquiry unit and strong in both classes after the traditional unit. Neither class gave a weak positive response or a negative response with regards to their difficulty and understanding of the science units.

Figure 4.3 and Figure 4.4 show the average responses to the semantic differential questions as a comparison between Class 1 and Class 2. Figure 4.3 compares the responses after inquiry instruction and Figure 4.4 compares responses after traditional instruction.
Figure 4.3. Comparison of average scores on the semantic differential questions for Class 1 and Class 2 after guided inquiry instruction. (n = 25 for Class 1, n = 23 for Class 2)

Figure 4.4. Comparison of average scores on the semantic differential questions for Class 1 and Class 2 after traditional instruction. (n = 23 for Class 1, n = 25 for Class 2)
Through a visual inspection it can be seen that both Class 1 and Class 2 had higher average positive responses to most questions after traditional instruction than after inquiry instruction. Furthermore it was apparent that after inquiry instruction, the average scores for Class 1 were quite different that the average scores for Class 2 (for most questions). However, after traditional instruction, the average scores for Class 1 and Class 2 were quite close (again for most questions). As well, it can be seen that the answers to the three questions regarding perceived effort (Questions 13, 14 & 15) had the highest average scores of all the 15 questions after both inquiry instruction and traditional instruction.

Not shown in Figures 4.1 through 4.4 is the 16th semantic differential question which was asked in the survey administered following the conclusion of the second science unit (Water Systems). Question 16 asked the students to choose the instructional method which they preferred, or alternatively the students could say that they preferred both instructional methods equally.
As can be seen in Figures 4.5 and 4.6, guided inquiry was the least preferred instructional method for both classes. Class 1 showed a preference for the traditional method of instruction as 52% of respondents chose this option. In Class 2, 44% of the students chose “prefer both methods equally”, with traditional instruction (28%) ranked only slightly higher than guided inquiry (20%). In each class, there were two students who did not circle any of the three options, so these were listed as “no response”.

**Written Response Survey Questions**

**Question One: Favorite ways to learn science.** The first written response survey question asked students to describe their favorite ways to learn science and to explain what they liked about their chosen methods.

*Figure 4.7. Percentage of responses for the top seven preferred methods of learning science. Class 1 Inquiry (n = 45), Class 2 Inquiry (n = 50), Class 1 Traditional (n = 58), Class 2 Traditional (n = 51).*  
*Note.* n is the number of responses for each class.
After the traditional unit, both classes ranked lab experiments as the most popular activity, and it was also ranked highly after the inquiry unit. Class 2 showed a greater percentage of respondents favoring lab experiments than did Class 1. Working in groups was ranked highly for both classes after both units, where Class 2 showed a greater percentage of respondents (after both units) than Class 1. Both classes also ranked note-taking quite highly, but this time Class 1 students had a greater number of respondents than Class 2 after both units. Doing worksheets was ranked higher by both classes following the traditional unit, and class discussion was ranked higher by both classes following the inquiry unit. Other learning methods that were mentioned by students but were not ranked in the top seven included having fun, watching the teacher, watching videos, using pictures, making mind maps, and working independently (see Figures H1 to H4 in Appendix H for detailed responses from each class).

**Question Two: Like or dislike of the way the unit was taught.** In this question, students were asked to think about the *way* in which they had learned the science unit and to describe the activities which they liked and/or disliked (see Figures I1 to I4 in Appendix I for detailed responses). The responses given were grouped into three themes: students liked the instructional method, students disliked the instructional method, or the student responses were neutral about the instructional method and/or unrelated to the question. Table 4.1 summarizes the responses of the students in each class, after each unit.
Table 4.1.

Percentage of student responses indicating a like or dislike regarding unit instruction, or indicating a neutral view of the instructional method.

<table>
<thead>
<tr>
<th></th>
<th>Class 1</th>
<th>Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inquiry n = 59</td>
<td>Traditional n = 36</td>
</tr>
<tr>
<td>Liked the unit (%)</td>
<td>49</td>
<td>83</td>
</tr>
<tr>
<td>Neutral/Unrelated (%)</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Disliked the unit (%)</td>
<td>44</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Inquiry n = 39</td>
<td>Traditional n = 42</td>
</tr>
<tr>
<td>Liked the unit (%)</td>
<td>54</td>
<td>81</td>
</tr>
<tr>
<td>Neutral/Unrelated (%)</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Disliked the unit (%)</td>
<td>34</td>
<td>9</td>
</tr>
</tbody>
</table>

Note. n values represent the total number of responses to the question for each class, for each survey.

Following the inquiry unit, the percentage of positive versus negative responses was similar in both classes. In Class 1, 49% of respondents liked the inquiry unit compared to 54% of respondents in Class 2. The percentage of respondents who disliked the inquiry unit was 44% in Class 1 and 34% in Class 2. However, after the traditional unit, the majority of student responses (83% in Class 1 and 81% in Class 2) consisted of positive comments about the parts of the unit which they had enjoyed. There were relatively few negative comments about the traditional unit. All of the surveys showed a low percentage of neutral responses (7% to 12%), indicating that most students either liked or disliked the instructional method, and very few students were ambivalent. Some of the student responses that indicated a liking of the science unit included: Students liked learning in groups, teaching in groups, watching videos, class discussions, taking notes, doing labs, doing worksheets and doing library research projects. Some of the student responses that indicated a dislike of the science unit included: Students
disliked working in groups, they were frustrated when their group members were off task or unprepared, and they disliked homework, note-taking and doing worksheets.

**Question Three: Ease or difficulty in understanding the science unit.** Question three in the written response section of the surveys asked students to evaluate how well they understood the concepts that were presented during the science unit. Students were asked to discuss whether they found the unit to be easy or difficult to understand, and also to state what kinds of activities made the unit simpler or more difficult (see Figures J1 to J4 In Appendix J for detailed responses). The student responses for each survey were grouped into three themes: the unit was easy to understand, the unit was difficult to understand, or the unit was moderately difficult to understand. Student responses in the moderate category indicated that there were parts of the unit that were more challenging, whereas other parts of the unit were quite manageable. Table 4.2 summarizes the student responses after each unit.
Table 4.2.

_Percentage of student responses that indicate students found the unit easy or difficult to understand._

<table>
<thead>
<tr>
<th></th>
<th>Class 1</th>
<th></th>
<th>Class 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inquiry</td>
<td>Traditional</td>
<td>Inquiry</td>
<td>Traditional</td>
</tr>
<tr>
<td></td>
<td>n = 38</td>
<td>n = 34</td>
<td>n = 40</td>
<td>n = 31</td>
</tr>
<tr>
<td>Unit was easy to understand (%)</td>
<td>41</td>
<td>62</td>
<td>37</td>
<td>29</td>
</tr>
<tr>
<td>Unit was moderately difficult to understand (%)</td>
<td>16</td>
<td>20</td>
<td>17</td>
<td>36</td>
</tr>
<tr>
<td>Unit was difficult to understand (%)</td>
<td>35</td>
<td>15</td>
<td>43</td>
<td>29</td>
</tr>
</tbody>
</table>

*Note.* n values represent the total number of responses to the question for each class, for each survey.

For both classes following the inquiry unit, few student responses fell into the category of moderate understanding. Most student responses indicated either a good understanding because the unit was easy, or a poor understanding because the unit was difficult. In both classes, the percentages of ‘easy’ versus ‘difficult’ responses were quite similar (41% easy compared to 35% difficult for Class 1 and 37% easy compared to 43% difficult for Class 2). The results for the two classes following the traditionally taught unit were quite different. For Class 1, 62% of responses indicated that the unit was easy to understand, whereas only 15% of the responses indicated difficulty with the unit. However, for Class 2, only 29% of the student responses
indicated that the unit was easy and an equal percentage of responses (29%) indicated that the unit was difficult to understand. In this group of students, the largest percentage of responses (36%) indicated a moderate understanding of the unit. Some of the responses which the students wrote to indicate that the unit was easy included: The unit was easy to understand, the unit was easy to understand because the teacher taught the class, the unit was easy because they had studied the topic before, using pictures and diagrams made understanding the unit easier, and the unit was easy because the group worked well. Some of the responses which indicated difficulty with the unit included: The unit was difficult to understand, there was too much material to learn in the given time, the groups didn’t work effectively, the teacher didn’t teach well enough, and the homework was difficult. Comments that indicated a moderate understanding included: okay understanding and the unit was slightly difficult.

**Question Four: Reasons for preferring one type of instruction over another.** The final written response question only appeared in the survey that was administered after the second unit (Water Systems), and it was meant to supplement Question 16 of the semantic differential section of the second survey. Semantic differential Question 16 asked the students to choose their preferred method of instruction. They could choose “guided inquiry”, “traditional”, or “prefer both equally” (see Figures 4.5 and 4.6). Written response Question 4 asked students to provide reasons why they made the choice they did for Question 16. The student responses to Question 4 were grouped into three categories, those reasons that supported traditional instruction, those reasons that supported guided inquiry, and those reasons that indicated both units were equally favored. Class 1 students had the highest number of responses favoring traditional instruction (12 out of 23) and the lowest number of responses favoring guided inquiry (5 out of 23). Class 2 students had the highest number of responses favoring no preference (12
out of 30), but they had an equal number of responses favoring traditional and guided inquiry instruction (9 out of 30). Furthermore, Class 2 students wrote more responses (30) than did Class 1 students (23). This suggests that several students must have included positive comments about guided inquiry in the written response Question 4, even if they didn’t choose guided inquiry as their preferred instructional method in semantic differential Question 16. Figure 4.8 and Figure 4.9 show the number of responses that favored traditional instruction, guided inquiry instruction, or both instructional methods equally, for each class.

![Bar Chart](image)

*Figure 4.8.* Number of responses which favored each instructional method for Class 1. (n = 23)
The responses explaining why students chose “prefer both methods equally” included: Both methods were fun, both methods were easy, they learned equally well with both methods, and they liked both methods equally. The responses given to support the traditional method of instruction included: It was easier to learn and understand, there was less to write, they didn’t like working in groups and the group work was more confusing. The responses which supported guided inquiry as a preference included: Guided inquiry was more challenging, it was easier to understand, they liked working in groups, and guided inquiry was fun/not boring. (See Figures K1 and K2 in Appendix K for detailed responses to Question 4.)

A direct comparison between the results to semantic differential Question 16 and written response Question 4 can be seen in Table 4.3. The table compares the percentage of students who preferred guided inquiry instruction or traditional instruction or preferred both instructional
methods equally in Question 16 to the percentage of student responses in Question 4 that supported one of the instructional methods or showed an equal preference for both methods.

Table 4.3

*Percentage of students who chose each instructional method compared to percentage of student responses which favored each instructional method.*

<table>
<thead>
<tr>
<th></th>
<th>Class 1</th>
<th></th>
<th>Class 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Question 16</td>
<td>Question 4</td>
<td>Question 16</td>
<td>Question 4</td>
</tr>
<tr>
<td>Guided Inquiry Instruction (%)</td>
<td>16</td>
<td>22</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Traditional Instruction (%)</td>
<td>52</td>
<td>52</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Prefer both Instructional methods equally (%)</td>
<td>24</td>
<td>26</td>
<td>44</td>
<td>40</td>
</tr>
</tbody>
</table>

*Note.* n values for Question 16 represent the total number of students surveyed. n values for Question 4 represent the total number of responses to the question.

When the responses to the two questions are directly compared in Table 4.3, it can be seen that students in each class answered with similar frequency for favoring traditional instruction and for preferring both methods equally. In Class 1, 52% of students preferred traditional instruction and 52% of responses in Question 4 favored traditional instruction. In Class 2, 28% of students favored traditional instruction compared to 30% of the Question 4 responses. Similarly, the percentage of students who preferred both methods equally was 24% in
Class 1 compared to 26% of the Question 4 responses, and in Class 2, 44% of students and 40% of Question 4 responses also supported both instructional methods. However, with regards to guided inquiry, in both classes the percentage of responses favorable to guided inquiry was higher in Question 4 than the percentage of students who chose guided inquiry as their preferred instructional method in Question 16. In Class 1, 16% of students but 22% of written responses favored guided inquiry. In Class 2, 20% of students but 30% of written responses favored guided inquiry.

Lastly, direct comparison of the two survey questions indicates that the greatest percentage of students favored traditional instruction in Class 1, whereas the greatest percentage of students favored both instructional methods equally in Class 2.

**Summary**

The findings from the surveys indicate that overall, more students preferred traditional methods of instruction. The students reported that traditional activities such as note-taking, completing worksheets, watching videos and reading the textbook were ways that they liked doing science. Proponents of traditional instruction also frequently offered the comment that they liked having the teacher “teach” the material to them, instead of learning it independently. All students chose lab experiments as either their first or second choice of preferred science activity. It is interesting to note that lab experiments are neither a distinctly traditional or guided inquiry type of activity. Furthermore, note-taking, reading the textbook and watching videos may also be part of a guided inquiry unit, as they were in this research study. The main difference between the traditional unit and the guided inquiry unit in this research study was the presence or absence of the teacher actively teaching the course content to the students.
Regardless of their instructional preference, many students were still able to articulate reasons why guided inquiry was an enjoyable instructional method. Many student responses indicated that the students had enjoyed working in groups with their peers, even while many students found it frustrating and unproductive at times. And a significant number of student responses indicated no preference for either method by the time the research study was completed.

Students in both classes reported a strong liking of the science unit when it was taught by the traditional method. However, after the science unit learned with guided inquiry, students from both classes were divided almost equally into those who liked the unit and those who disliked the unit, with very few students feeling neutral.

With regards to student understanding of the science units, student responses were again fairly evenly split between those who found the unit easy to understand and those who found the unit difficult to understand. This was true in both classes except for Class 1 after the traditionally taught water unit, where over 60% of the student responses indicated that the unit was easy and only 15% of student responses indicated difficulty with understanding.

With regards to effort and motivation, students ranked themselves as exerting a moderate to strong amount of effort after both instructional units, indicating that students were trying hard with either instructional method. Students ranked their overall motivation slightly lower than their overall effort, and the results of the motivation questions were less clear, as one class ranked motivation higher after the inquiry unit and the other class ranked motivation higher after the traditional unit.
Chapter 5: Summary, Discussion, and Conclusions

Summary

This research study investigated whether there was a difference in the motivation and engagement of grade 8 science students when taught with guided inquiry or traditional instructional methods. Fifty students in two eighth grade science classes in a secondary school in School District 68 were used as the participant sample in this study. Two science units, one on the Human Body and one on Water Systems, were taught to both classes. During the first science unit, Class 1 learned the content through guided inquiry, whereas Class 2 learned this topic through traditional instructional methods. When the second science unit on Water Systems was taught, it was taught to Class 1 by traditional instruction and to Class 2 by guided inquiry. Therefore, each class acted as both a control class (traditional instruction) and an experimental class (guided inquiry instruction).

Guided inquiry instruction for this research study involved the learning of content through group work done under a guiding inquiry question. There was also an individual component to the learning whereby students investigated a personal inquiry topic. The entire inquiry unit culminated in the creation of a mind map in order to link all ideas and understandings together. During the guided inquiry instruction there was ongoing formative assessment and reflection, which allowed the students to become better at both the group work and individual work. Traditional instruction in this research study referred to a teacher-directed type of instruction, in which the teacher first “taught” a lesson using notes, videos, or the textbook, which was then followed by worksheets, diagrams and/or lab activities.

Students were surveyed after the completion of each science unit using a two-part survey which consisted of semantic differential type questions in Part 1 and written response questions
in Part 2. The survey questions asked the students to answer questions around five main themes; enjoyment and interest, motivation to participate, like or dislike of the instructional method, ease or difficulty of understanding the instruction, and perceived effort. The two surveys asked the students the same questions, except the survey following the unit on Water Systems also asked the students to indicate which instructional method they preferred (or if they preferred both methods equally), and to provide reasons for their choice.

Semantic differential data was graphed to display the average response for each survey question in each class. Written response questions were evaluated for emergent themes and these were shown in graphs as a percentage of the total number of responses, again for each class. The most preferred instructional method was also graphed for each class, as well as the reasons supporting these choices. Themes were grouped into categories and displayed in tables to illustrate the differences between inquiry and traditional instruction and between the two classes.

Discussion of the Findings

Enjoyment. It appeared that both classes enjoyed the science units, as positive average scores were seen for the semantic differential question in both surveys. This finding is important, as according to Boekaerts (2010), motivation and emotion are both integral to the process of acquiring knowledge. Litmanen et al. (2012) specifically notes that enjoyment has been shown to be a factor in successful learning. Consequently, students who do not find enjoyment in the class work will have more difficulty learning the material. In this study, although both classes indicated enjoyment of both science units, Class 1 indicated a much higher level of enjoyment of the traditional unit (average score was 1.39) than of the inquiry unit (average score was 0.36). Class 2 showed similar levels of enjoyment for both units (0.84 after
the traditional unit and 0.70 after the inquiry unit). Since each class was taught a different unit by inquiry, the researcher assumed that the greater enjoyment level after the traditional unit was likely due to the type of instruction rather than due to the unit content. However, the researcher wondered whether the fact that Class 1 was taught the inquiry unit first may have contributed to the students’ lower level of enjoyment, since the inquiry instruction likely placed greater demands on the students than did the teacher-directed traditional instruction in the other class. As Litmanen et al. (2012) noted in their research, students show higher levels of being challenged during inquiry instruction than during teacher-directed instruction. Furthermore, it is essential that students be taught inquiry skills alongside course content (Eslinger, White, Frederiksen, & Brobst, 2008). The researcher assumed that her grade 8 students had no prior inquiry skills. It was possible then that the adjustment to a new class and school (as this research study was done early in the school year) and to the learning of new inquiry skills might have contributed to the lower level of reported enjoyment in Class 1 after their inquiry unit. Although Class 2 did not have any inquiry skills either, the researcher suggests that the students were more settled in their school and classroom routines by the time they experienced the inquiry instruction, and therefore their level of enjoyment was less negatively affected by the greater challenge of the inquiry unit.

**Interest.** The students were asked to rate their level of interest after each science unit. Both classes clearly rated a higher level of interest in the traditionally taught unit, although neither class showed a disinterest (negative average response) toward the inquiry unit. Class 1 showed a slightly higher level of interest in each science unit than did Class 2. Legault, Green-Demers, and Pelletier (2006) noted that the characteristics of a task will influence a student’s motivation to complete the task. A task which is viewed as interesting and exciting will
encourage learning more than a task that is boring and tedious. Therefore the fact that students showed a weak to moderate interest in the science units is an important finding. As a comparison, the students were also asked about their level of interest in science class in general. Both classes had a moderate average response for their level of interest in science and they rated their interest in science similarly after each unit. In this case, neither the type of instruction nor the content of the material being studied appeared to impact the students’ interest in the study of science. The overall result for the survey questions on interest indicate that students are generally interested in science class, which would suggest that the students would then be motivated to participate in science activities.

**Motivation to participate.** Students were asked to express their level of motivation to participate in the science unit, the science class, and in all school subjects in general. The researcher thought that these three parallel questions would allow the researcher to determine if student motivation was affected by the type of science instruction. In both classes after both units, the average scores indicated a positive motivation to participate in the science units, in science class, and in all school subjects. Mostly the average scores fell within the moderate response range (0.75 – 1.5), and no average scores indicated a lack of motivation to participate (< 0). In Class 1, motivation to participate was scored higher for all three questions after the unit of traditional instruction. It is possible that the students were more motivated to work in science during the teacher-directed instruction, perhaps because this method of learning was more familiar to them. It is also possible that the Class 1 students became more motivated to participate as the semester progressed, because the average response for motivation to participate in the unit, in science and in all school subjects, all increased when the students were surveyed after the second unit of instruction in Class 1. When Class 2 was examined, motivation was only
higher after traditional instruction for the question which asked about the science unit, but for motivation to participate in science and in school subjects, the average response was higher after the guided inquiry unit (which was also the second unit taught). This apparent contradiction between greater motivation after the traditional unit in one class and greater motivation after the inquiry unit in the other class led the researcher to postulate that motivation increased for all students as the semester progressed. Since motivation scores were higher in each class after the second instructional unit, perhaps the students had become more comfortable and confident with both science and their new high school by the time the second science unit was taught. This may have led to the increase in self-reported motivation scores after the second unit. There did not seem to be a clear link between the type of instruction and the students’ motivation to participate.

Furthermore, for both classes, the average score for motivation was lower when referring to the individual science unit and higher when referring to all school subjects, regardless of the method of instruction. Motivation to participate in all school subjects was probably ranked higher because this accounts for all the different subject areas, rather than only science, which students may or may not enjoy. As Jansen (2006) noted in her study, students have a variety of reasons which may motivate them to participate in class. Students may be motivated to participate in order to demonstrate competence, to help classmates, to behave appropriately or to help them complete a task. It may be possible that as the semester progressed, many of the students developed reasons to increase their motivation to participate.

Amount of effort. The highest average scores of all the questions in the semantic differential survey involved the three questions about effort. The questions asked the students to assess their level of effort in the science unit, in science class and in all school subjects. Both classes had strong average responses (between 1.59 and 2.16) for all three questions, after both
INQUIRY, MOTIVATION, AND ENGAGEMENT

instructional units. It appears that the grade 8 students perceived that they had exerted a high level of effort in the science units, in science class and in school generally. There was little distinction in effort scores between the inquiry and traditional units. However, in Class 1, the average score for each effort question was slightly higher after the inquiry unit. One possibility for this result might be that inquiry was a new method for the students and so required a greater level of effort in order to learn the content material in this way, yet this same trend was not observed in Class 2. An additional observation was that with one exception, both classes scored their effort higher after the first instructional unit than after the second. Perhaps students were more willing to put in a greater effort earlier in the semester, as they were well rested after the summer holiday and were eager to participate in their new school. It might even be possible that the students’ effort decreased slightly as time passed because they developed more social relationships with their new classmates. Regardless, the data shows that the grade 8 students indicated a positive level of effort in the science units, in science class, and in all school subjects.

It is interesting to note that the effort level was higher after the first science unit, whereas the motivation to participate was higher after the second science unit. According to Toshalis and Nakkula (2012), motivation determines the intensity of effort. However, if this is true then both motivation and effort should have increased after the second unit of instruction. Although this result was not clearly seen, average scores for both motivation and effort were positive, indicating that students viewed themselves as motivated to participate and trying hard in class. As Toshalis and Nakkula (2012) clearly stated, if students believe that the amount of effort expended will determine success in school, then they will be more motivated to work hard. If motivation and effort are in fact inextricably linked to one another, then perhaps the survey questions did not accurately assess these factors. For all three motivation questions, the positive
+3 score read “very motivated – I want to participate in everything”. For all three effort questions, the positive +3 score read “I always work my hardest to do my best”. The researcher may have skewed the results by the very nature of these answer statements. A student who always does his or her best on school assignments still might not be motivated to want to participate, and may not consider participation to be analogous to effort. This might explain the slightly higher scores for effort than for motivation.

**Ease or difficulty of understanding.** The results from the semantic differential questions about the difficulty of the unit and how well the students understood the content showed that in both classes, students found the inquiry instruction to be more difficult and harder to understand. The actual content material did not seem to make a difference (since the inquiry unit for each class was a different topic) but the method of instruction did. As well, since the inquiry units were taught to the two classes at different times, the order that the units were taught did not play a part in the students’ assessment of inquiry as being more difficult. Although the semantic differential question results showed inquiry instruction to be more challenging, the average scores for understanding still fell into the moderate range for Class 1 and the weak and moderate range for Class 2, indicating that the students felt that they understood the material with either instructional method, since no negative average scores were seen.

In written response Question 3, the students were also given an opportunity to clarify what kinds of activities made the units simpler or more difficult to understand. These written responses were grouped into one of three themes; the unit was easy, the unit was difficult or the unit was moderately difficult. The results for this question were less clear cut. Following the inquiry unit, more students tended to classify the unit as either easy or difficult to understand, with few student responses indicating a moderate level of difficulty and understanding. This
trend was seen in both classes. This seemed to indicate that students either felt that they understood well with the inquiry style of instruction, or they felt that they really didn’t “get it” at all. Following the traditionally taught unit, the student responses were quite different between the two classes. In Class 1, 62% of student responses indicated that the traditionally taught unit was easy, 20% indicated moderate difficulty and only 15% indicated that the unit was difficult to understand. By contrast, Class 2 had an equal percentage of responses (29%) for easy and difficult, and a greater percentage of responses (36%) indicated a moderate difficulty and understanding. For whatever reason, Class 2 did not perceive the traditional instruction to be that much easier than the inquiry instruction, as did Class 1. And despite the prevailing result that inquiry instruction was seen to more challenging; both classes had positive average scores with regards to their perceived understanding. This told the researcher that although the inquiry instruction might be harder for the students, it was not so difficult that negative average scores were seen. In fact, as one student wrote “I chose guided inquiry [as the preferred instructional method] because we have more independence and you are challenged to pay attention in class”. Such a response indicated that some students actually enjoyed the level of challenge offered by the guided inquiry instruction.

According to Lee (2011), there is a need to balance the amount of challenge given to students doing inquiry with the amount of support that is needed to help the students complete the tasks. If the tasks are too challenging, then students may become frustrated and give up, whereas if the tasks are too easy and/or there is too much teacher support, then students may give up because they are bored. Barron and Darling-Hammond (2010) describe a successful inquiry program as one which incorporates well-planned and structured activities, enough teacher scaffolding so that students are not left to flounder, clearly defined criteria, and well-designed
formative assessment and reflection. The researcher in this study believed that her students were appropriately challenged during their inquiry units because there were no negative average scores for understanding in the semantic differential survey questions, and in both classes fewer than 50% of the written responses indicated a difficulty in understanding with the inquiry instruction.

**Like or dislike of the type of instruction.** There were not large differences in the average scores for interest, motivation, effort and understanding between the inquiry and traditional units for either class. However, upon examination of the students’ responses to the questions about their like or dislike of the instructional method, some definite differences were seen between the two surveys. Semantic differential Question 7 asked the students to assess how much they liked or disliked the unit that they had just been taught. After the inquiry unit, Class 1 had a weak positive average score (0.16) and Class 2 had a weak negative score (-0.04), indicating that Class 1 was close to being neutral about liking inquiry, whereas Class 2 had a weak dislike of inquiry instruction. And when the students were asked to indicate how much they would like to learn another science unit in the same way as the unit just completed (Q. 12), Class 1 had a negative average response of -0.16 and Class 2 had a neutral score of 0.0 after the inquiry unit. The negative scores indicated a dislike of inquiry instruction, since the students indicated that they did not want to learn another science topic using the same instructional method. The neutral score may have indicated a split in the responses (some being positive and some being negative), or it may have indicated that this class was actually neutral about wanting to learn another unit by guided inquiry. In fact, when individual student surveys were analyzed, there were students who chose the extremes. For example, a student might have circled +3 for liking traditional instruction and -3 for liking inquiry instruction. Yet most students had
responses that changed much less drastically. For example, a student might have circled +2 for liking traditional instruction and +1 for liking inquiry instruction. Generally, a stronger positive response was expressed toward liking traditional instruction, but it was often only slightly stronger than the response given for liking inquiry instruction. Consequently, the calculation of average scores did not always reflect the types of individual responses that were seen.

Question 9 in Part 1 of the surveys examined the students’ like or dislike of group work. Following the inquiry unit, Class 1 had a negative average score of -0.08 which indicated a dislike of group work, but they indicated a weak positive response to group work after the traditional unit (0.74). Class 2 showed a moderate positive response toward group work after inquiry (0.96), but a very strong positive response toward group work after the traditional unit (2.06). This result was interesting, since little group work was done during the traditional unit, other than some lab work done as pairs. The researcher observed that in comparing her two classes informally, Class 2 seemed to work better in groups than Class 1, which might explain why Class 2 had a moderate liking of group work after the inquiry unit while Class 1 showed a weak dislike.

In written response Question 2, students were also asked to provide examples of the activities that they liked or disliked during the instructional unit. Responses were grouped into three themes: students liked the method of instruction, disliked the method of instruction, or were neutral about the instructional unit. An interesting pattern emerged in both classes: In the survey following the inquiry unit, student responses were split almost equally between “like” and “dislike”, indicating that students either liked inquiry or disliked inquiry, but few were neutral about this instructional method. Conversely, following the traditional unit, over 80% of the responses in both classes indicated a liking of the traditional method of instruction. It stands to
reason that students would be more comfortable with the traditional, teacher-directed type of instruction, since few (if any) students had been previously exposed to guided inquiry. The comment by one student, “It was easier when Mrs. Tyce was teaching”, shows that traditional instruction is considered to be the easier method, and so it was not surprising that many students indicated that they liked traditional instruction better.

**Preferred method of instruction.** The main goal of this research study was to ascertain whether or not students found guided inquiry instruction to be more motivating and engaging than traditional instructional methods. At the completion of the second science unit, Question 16 of the semantic differential survey asked students to choose either “guided inquiry”, “traditional” or “prefer both equally” as their preferred instructional method. Guided inquiry was the least preferred method in both classes (16% preferred inquiry in Class 1, 20% preferred inquiry in Class 2). Class 1 had the highest percentage of students choose traditional instruction (52%), whereas Class 2 had the highest percentage of students choose “prefer both equally” (44%). Using this assessment alone, it seems clear that students did not prefer the guided inquiry method of instruction. However, written response Question 4 of the second survey provided some additional information about students’ thoughts about inquiry: In Class 1, the largest percentage of responses (52%) supported reasons why students favored traditional instruction, and student responses were split almost equally into reasons which favored guided inquiry (22%) or preferred both methods equally (26%). In Class 2, the greatest percentage of responses (40%) supported reasons for “prefer both equally”, with the remainder of the responses split evenly between guided inquiry (30%) and traditional (30%). In both classes, the percentage of written responses favoring guided inquiry instruction was higher than the percentage of students who chose guided inquiry as their preferred instructional method. This result was possible because
although some students may have circled “traditional” as their preferred instructional method for
Question 16, their written response in Question 4 often included statements that supported both
guided inquiry and traditional instruction. This indicated to the researcher that students valued
inquiry activities, even though they were less comfortable with the inquiry process and might
have chosen traditional as their preferred instructional method. This finding reinforces the
research which states that inquiry skills must be taught to students and that inquiry activities
must be carefully scaffolded by the teacher in order to be successful (Barron & Darling-
Hammond, 2010; Eslinger et al., 2008; Furtak, Seidel, Iverson, & Briggs, 2012; Hmelo-Silver et
al., 2007; Lee, 2011; Litmanen et al., 2012; Mostrom & Blumberg, 2012).

The fact that the written responses showed a higher percentage of support for guided
inquiry was also supported somewhat by the written responses to Question 1, which asked
students to describe their favorite ways to learn science. As shown in Figure 4.5, the top seven
preferred activities in science were; lab experiments, working in groups, taking notes, doing
worksheets, having class discussions, doing research projects and reading the textbook. What is
interesting to note is that any and all of these activities could be experienced in either a guided
inquiry or traditionally taught unit. In the guided inquiry units taught in this research study, the
only activity listed above which was not included was the lab experiment. All the other activities
were done in both the guided inquiry and traditional units. Perhaps one reason why students may
have preferred traditional instruction over inquiry instruction might have been because they were
able to do a lab experiment during the traditional unit. The researcher is well aware of the
popularity of lab activities with most science students, so being able to do a lab experiment may
have caused some students to favor the traditional instructional method, especially if they
answered this question immediately following the traditional unit.
Another factor that may have influenced the students’ choice of preferred instructional method might have been the timing of when this question was asked. The two questions (semantic differential and written response) which asked students to choose their preferred method and give the reasons for their choice, were only asked at the completion of the second unit of study. It is possible that the type of instruction that the students had just completed may have influenced their choice because the first instructional unit had happened earlier in the semester, and was less well remembered.

Furthermore, the researcher wondered if the students might have had trouble answering some questions because of their general lack of science experience. The researcher is aware that many elementary schools offer limited science experiences, so it might not have been realistic to ask students to describe their preferred ways of doing science. The researcher acknowledged that asking the students to evaluate their preferred method of doing science might have been better accomplished by doing this research study later in the school year, because by then the students would have experienced a wider range of science activities and science concepts.

**Students and Inquiry: What does it all mean?**

The data in this research study supported the general idea that grade 8 science students liked traditional methods of instruction more than guided inquiry instruction. Although this seemed to be the case, the researcher questioned why such results may have occurred. The researcher believed that the timing of her research study probably influenced the results quite substantially. The research study was conducted in the fall term of the grade 8 students’ first year in high school. As with any new experience, the students took some time to settle into their new school and to adhere to the routines of the teacher-researcher. As the guided inquiry units involved a substantial amount of cooperative learning in groups, Class 1, which learned its first
science unit through guided inquiry, was probably at a significant disadvantage compared to Class 2, who did guided inquiry as its second science unit. Students in Class 1 were expected to conduct extensive group work and collaborative activities before there was an established element of trust within the classroom environment. As documented in the study by Reyes et al. (2012), student engagement may be a product of the social and emotional climate in the classroom. Teachers who create a classroom with a high Classroom Emotional Climate (CEC) have a class which is characterized by warmth, caring, empathy and respect. Boekaerts (2010) also states that students are more motivated to engage in learning and more able to use self-regulation strategies when they perceive the classroom environment to be favorable for learning.

In consideration of this link between the classroom emotional climate, student engagement and motivation, the researcher wondered whether or not Class 1 students would have had a more favorable view of guided inquiry if they had experienced this unit later in the school year, once the classroom emotional climate was well established. Although Class 2 also experienced inquiry relatively early in the school year, these students still experienced this unit a full month after Class 1, which might account for Class 2 having more students choose either “guided inquiry” or “prefer both equally” as their preferred instructional method.

In conclusion, the results of this project indicate that more students liked traditional methods of instruction than instruction by guided inquiry. However, students were able to learn equally well under both instructional systems, even though indications were that inquiry was found to be more challenging. Overall, the grade 8 students were motivated to participate and ranked themselves as exerting a high amount of effort in science class, in school and in the specific science units being studied. Students tended to indicate either a like or dislike of the instructional method, and few students tended to be neutral (or ambivalent) about what they
thought about the instructional method. Students expressed positive average responses toward enjoyment and interest, which tended to be slightly higher after the traditional units. Students did, however, indicate an enjoyment of “inquiry type activities”, such as working in groups, discussing with peers, and investigating personal research topics.

Limitations of the Study

There were numerous factors which the researcher thinks may have influenced the results of this study. Firstly, the school year started three weeks late due to the teachers’ strike. The loss of those three weeks reduced the time available to conduct this research study. There were no extra days available for completing the research projects, and this time crunch may have added to the perceived difficulty of the unit.

Another unforeseen element was that in Class 2, several students left for vacations during the time period of the cooperative group work. This caused some stress among those remaining group members as they had to complete some of the work that was supposed to have been done by the vacationing students. Additionally, it was observed that when someone was missing from the group, the dynamics of that group often changed. This change was especially pronounced when the missing group member was someone who had taken on a leadership role within the group, as was the case with one of the vacationing students. The researcher wondered whether the complications due to absent group members may have contributed to a lower percentage of students choosing guided inquiry as their preferred instructional method.

One of the practical (and frustrating) limitations to this research project involved poor access to technology due to limited Wi-Fi connection in the classroom. While the students were working in groups to learn the content material, they had the use of laptops in order to access other resources on the internet, such as You Tube videos, encyclopedias, university sites and
images. However, the Wi-Fi access was very poor on some days, and students wasted time trying to login to the network. Although students were encouraged to continue this search for information at home (and were provided with some useful links to effective videos), it was the researcher’s feeling that many students did not watch (or re-watch) these videos at home, and so probably had a lesser understanding of the content material as a result. It is possible that students’ view of the inquiry instruction might have been somewhat less favorable because the learning did not run as smoothly as was intended.

The single biggest factor that may have affected the outcome of this research was likely the timing of the research study during the school year. The researcher has taught an inquiry unit to prior grade 8 classes, but the inquiry unit was always taught during the second half of the school year. The researcher felt that because the units were conducted early during the school year, the classroom environment was not as well established as it had been in previous years when the inquiry unit was taught in the second semester. The probable lack of trust, uncertainty with routines, and even unfamiliarity with fellow students, may have acted to increase students’ anxiety during the inquiry units, since the inquiry instruction required the students to work in groups and to direct their own learning. And notwithstanding the need for trusting relationships for effective group work, was the need for students to trust that their teacher would guide them effectively through the complicated process of inquiry learning.

One final limitation to consider for this research study was the fact that the participant sample was derived from the researcher’s own science classes. Although the surveys were anonymized and the students were assured that their science grade would not be affected by their participation in the study, one could still assume that some students might have told the
researcher what they “thought” she would want to hear, in an “unconscious” effort to please their teacher.

**Implications for the Future**

Although the research data did not show that grade 8 students preferred guided inquiry instruction over traditional instructional methods, it did indicate that the students enjoyed many aspects of guided inquiry, and that they showed enjoyment, interest, motivation and effort toward both types of instruction. This indicated to the researcher that with more frequent exposure to inquiry, (and with attention to the timing of the inquiry instruction and the creation of well-planned and well-supported units), students should become more confident in their inquiry skills and more successful in the inquiry process. And with an increased confidence in the inquiry process, the researcher would expect to see an increase in the motivation scores of the students, illustrating increased engagement with the learning process. Even considering that the results of this study showed a dislike of inquiry, students’ scores for motivation and effort were still high, leading the researcher to believe that the students experienced high engagement during guided inquiry, albeit without a strong liking of the process.

One implication that may be derived from this research study is the need for teacher-leaders and administrators to offer inquiry instruction and mentorship to their school staff. The researcher in this study (along with several colleagues) received inquiry instruction from a knowledgeable teacher-leader in her school district, and this allowed the researcher to plan an inquiry unit that was appropriate in the degree of scaffolding and the level of difficulty. Schools need to work collaboratively to develop and establish new teaching methods. Just as research into inquiry learning has shown the importance of student-centered education in the development of higher order skills like critical thinking and problem solving, school staffs must utilize similar
methods to conduct their own inquiries about how best to improve the educational environment in their school.

**Recommendations for Future Research**

The data from this research study has not shown conclusively that guided inquiry directly leads to greater motivation and student engagement. Further research could help to establish a connection between inquiry, motivation and engagement. Repetition of this research study would be beneficial in establishing this link; however, certain changes to the study would be necessary to improve its reliability. Firstly, if this study was able to utilize a larger sample size, and preferably students that were not from the researcher’s own classes, then the results would probably better reflect the impact of inquiry on motivation and engagement. However, this would make the research study more difficult to do, as the researcher would need to access several teachers who would be willing to teach identical inquiry units and identical traditional units in similar ways at the same time. Internal validity would decrease compared to the current study, since the same teacher would not be leading all the traditional and inquiry units. Another alteration to the current study would be to conduct the study later during the school year, so that the cooperative group work involved in the inquiry unit would be less stressful for students once classroom relationships and routines were well established. A further amendment might be to re-examine the survey questions in order to make certain that both the number of questions and the wording of the questions was not adversely affecting student responses. And lastly, since all students indicated that laboratory experiments were a favorite activity, it would be beneficial to include at least one lab activity during both the inquiry unit and the traditional unit, so that the presence or absence of a lab activity would not skew the study results. With these changes to the
research study, it should be easier to see the effect of guided inquiry instruction on student motivation and engagement.

Further research might also explore how repeated exposure to guided inquiry instruction might make students more amenable to the inquiry process and ultimately more motivated and engaged as a result. A study with this focus might use the same teacher-researcher, doing a similar research study over the course of several school years. This would allow the researcher to determine if students reported greater motivation and engagement as a result of increasing familiarity and comfort with the inquiry process. Of course the logistics of such a study would be difficult, especially in secondary schools, because one teacher will not keep the same students for successive years, and most secondary classes in School District 68 are semester courses rather than linear. Practically speaking, to conduct a research study over several years would involve the commitment of numerous teachers, working together to offer similar units of traditional and inquiry instruction, in order to ensure that students were receiving repeated exposure to inquiry instruction.
References


Dear Student,

I will be your math-science teacher this year. Right now I am also “in school” at Vancouver Island University. I am doing my Master’s Degree in Educational Leadership. To get a Master’s Degree, you have to do research and then write a paper called a Thesis. So this fall I will be doing my research, and I will be asking for participants from my two grade eight classes.

Today I will be giving you several papers to take home to your parents. One is an information letter which describes my research study. There is also a Parent/Guardian Consent Form. This is the form that your parent or guardian will sign if they allow your survey information to be used in my research study. There is also a Student Assent Form that you will sign if you want your survey data to be included in my study. We will read the Student Assent Form together and then there will be time for me to answer any of your questions.

My research is to compare how students feel about learning science in two different ways. I will teach a science unit on the Human Body to both classes at the same time, but one class will be taught with a method called guided inquiry, and the other class will be taught with more traditional instructional methods. Then I will teach both classes a science unit on Water, and each class will be taught using the other method.

Each time we finish a unit everyone in the class will complete a survey that I will use to inform my teaching practice. The survey has two parts, ranking style questions in part one and open-ended questions in part two. You do not put your name on the survey, so I will not know which survey is yours. I will only use the survey results in my thesis from those students who have given assent and whose parents have granted consent.

Participation in this research study is completely voluntary. Whether or not you participate you will still be taught the science units the same way as everyone else in the class. Your science grade will not be affected by whether or not you choose to allow me to use your survey information in my thesis.
Appendix B - Parent/Guardian Information Letter

September 10, 2014

Dear Parent,

My name is Clarice Tyce and I am your son/daughter’s Math-Science teacher for this school year. I am currently enrolled in my second year of the Masters in Educational Leadership Program at Vancouver Island University. This fall I will be conducting research for my Master’s Thesis in your child’s classroom. In addition to this letter, a Parent/Guardian Consent Form has been sent home. If you are willing to allow your son/daughter to participate in my research study, please read the Consent Form carefully, sign and date the form, and return it to the Woodlands School office. A Student Assent Form for your child has also been sent home. This is your child’s personal consent form to participate in my research study. If your child chooses to sign the Assent Form, please have him/her return this signed and dated form to the school office.

My research question is: “How does teaching a unit of science using guided inquiry motivate and engage grade eight students, compared to teaching the same science unit through traditional instructional methods?”

For this study I will be using my two math-science classes. I will teach a science unit on the Human Body to both classes at the same time, but one of the classes will be taught the unit using guided inquiry, and the other class will be taught using traditional instructional methods. The students in each class will be taught the same way and will participate in all academic activities, regardless of whether or not they are participating in the study. With your consent, and student assent, I would like to also use student survey responses as data for the study. I have defined guided inquiry as a student-directed form of instruction, in which students are given a framework for the unit from their teacher, and are then allowed to explore the unit as individuals and groups. Students are given some opportunity to choose what direction to explore, but are guided by their overall inquiry question. I have defined traditional instructional methods as teacher-directed instruction that involves lectures and note-taking, lab activities and worksheets.

At the conclusion of the unit (which should take approximately four weeks), all the students will be given a survey to complete. The survey will consist of 15 ranking style questions and three open-ended questions. The questions ask the students to assess the level of enjoyment, interest, motivation, difficulty and understanding they had during the science unit.

After learning a unit of math, both classes will be taught a second science unit, this one on Water. This time each class will be taught using the opposite teaching method. The Water unit will also take approximately four weeks, and at the conclusion of the unit all the students
will again be given the survey. The second survey will be identical to the first, except that there will be two additional questions that ask the students to choose which teaching method they preferred, and to provide reasons for their choice.

During this research study, all students can be assured of having anonymity. I will have a research assistant who will codify all surveys so I will never know which student completed which survey. Furthermore, on the days that the students are to be surveyed, my research assistant will come into the classroom and I will leave. My research assistant will collect all the surveys and then will only pass on to me surveys from students who have parental consent and student assent. The surveys will be kept in a locked file cabinet in the Vice Principal’s office for the duration of the research study. My research assistant will transcribe the open-ended responses of the surveys into Word documents so that when I do examine the data, I will not be able to recognize student handwriting. I will not examine any of the surveys, nor the transcribed data, until the entire research study is concluded, so you can be assured that your child’s participation in my study will have no effect whatsoever on his or her science grade. After the study is concluded and the marking for the units has been concluded I will examine all the surveys for student feedback on units and how they were taught which will help to inform my teaching practice.

Thank you for reading this letter. Please feel free to contact me by phone or by email if you have any questions regarding this research study.

Sincerely,

Clarice Tyce
Woodlands Secondary School
cyce@sd68.bc.ca
Appendix C – Parent/Guardian Consent Form

“This research study will investigate the difference between guided inquiry instruction and traditional instructional methods on the motivation and engagement of grade eight science students. This research study will involve two linear math-science classes and will be conducted between September and December 2014. This research study is being conducted in partial fulfilment of the requirements of a Master’s in Educational Leadership Degree.

Students in my classes will be taught two separate, four week science units; one on the Human Body and one on Water. Each class will be taught one of the units using guided inquiry and the other unit using traditional instructional methods.

All students in the class will complete a two-part survey at the end of each science unit. Surveys will be administered and collected by my research assistant while I am out of the room. All surveys will be coded with numerical codes (in advance) by my research assistant, so that I will not know which survey belongs to which student. Furthermore, all open-ended responses will be typed into Word documents by my research assistant so that I will not be able to identify participants’ answers. These actions will assure anonymity of the participants. At no time will any participant be identified by name.

Your child’s participation in this research study is completely voluntary. All students will be expected to complete the survey as part of the teaching unit, however, only students who have provided consent will have their survey data used in my research thesis. Furthermore, any student who decides to withdraw from the study will have his/her data removed by my research assistant.

As the researcher, I will not examine any of the data until the entire research study is concluded and grades have been awarded for each science unit.
There are no known risks to your child. There will be no penalty if your child chooses not to participate in my research study. There is also no direct benefit to your child for choosing to participate in my research study; however, students may find that answering the survey questions helps them to think more deeply about how they best learn at school.

If you have any questions or concerns about your child’s treatment as a participant in this research study, please contact the Vancouver Island University Ethics Officer at 250-753-3245 ext. 2665, or by email at reb@viu.ca.

If you have any questions about this research project, please feel free to contact me at the phone number or email below:

Clarice Tyce
Woodlands Secondary School
cTyce@sd68.bc.ca

Name of student (please print)

I have read the above Consent Form. I understand the nature of this research study and the nature of my child’s participation in this research study. I understand that my child’s participation in this research study is completely voluntary. I understand that my child may choose to withdraw from this research study at any time, even though I have granted consent. I consent to allow my child to participate in this research study.

Signature of legal guardian         Date

OR

I have read the above consent form and I do NOT consent to allow my child to participate in this research study. I understand that my child will complete the same work as those children who do participate in the study, but that my child’s data will NOT be used by the researcher.

Signature of legal guardian         Date
Appendix D – Student Assent Form

“HOW DOES GUIDED INQUIRY MOTIVATE AND ENGAGE STUDENTS?”
September 2014

Clarice Tyce
Graduate Student
Masters of Educational Leadership
Vancouver Island University
ctyce@sd68.bc.ca

Rachel Moll PhD. Supervisor
Faculty of Education
Vancouver Island University
Rachel.moll@viu.ca
250-753-3245 ext.2161

This research study will investigate how grade eight science students in two different classes feel about learning science through guided inquiry and traditional instruction. This study will be conducted between September and December 2014. This research study is being conducted in partial fulfillment of the requirements of my Master’s in Educational Leadership Degree.

As a student in my class, you will be taught two separate science units, one on the Human Body and one on Water. Each science unit will take about 4 weeks to complete. You will be taught one of the science units by guided inquiry, and the other science unit by traditional instructional methods.

As a student in my class you will participate in all of the learning activities which will include completing a survey at the end of each science unit. The surveys will be handed out by my research assistant while I am out of the room. All surveys will have number codes instead of names so that I will not know which survey is yours. All open-ended responses will be typed into Word documents by my research assistant so that I will not be able to identify your handwriting. If you and your parent give me consent, then your survey data will be used to write my Thesis.

Your participation in this research study is completely voluntary. There will be no penalty for not participating. If you choose to participate, you may decide not to answer some of the survey questions, or you may decide to withdraw from the research study at any time, even if your parent gave consent. If you decide that you don’t want me to use your survey information, then my research assistant will remove your data.

There are no known risks to you for participating in this research study, and whether or not you allow me to use your data, your grade in science will not be affected.
If you have any questions or concerns about your treatment as a participant in this research study, please contact the Vancouver Island University Ethics Officer at 250-753-3245 ext. 2665, or by email at reb@viu.ca.

If you have any questions about this research project, please feel free to contact me at the phone number or email below:

Clarice Tyce
Woodlands Secondary School
clyce@sd68.bc.ca

Name (please print)

I have read the above Assent Form. I understand what will happen during this research study and I understand what my role will be in this research study. I understand that my participation in this research study is completely voluntary. I understand that I can choose to withdraw from this research study at any time. **I consent to participate in this research study.**

______________________________  ____________________
Signature  Date

OR

**I do not consent to participate in this research study.** I understand that I will be expected to complete the same work as those students who do participate in the study, but my individual survey data will not be used by the researcher.

______________________________  ____________________
Signature  Date
Appendix E- Student Survey #1  Human Body Unit

The following survey consists of two parts, each in a separate section. At the top of each survey section there will be a code written in the top right hand corner. This code identifies you to my research assistant, but not to me. Do not put your name on the survey pages.

The first part of the survey asks 15 questions which use a ranking scale that goes from -3 to +3. There is a description at -3 and a description at +3 to explain the two extremes of the ranking. Choosing a score of 0 indicates a neutral response (no real opinion one way or the other). Read the question and circle the number that best describes your answer to that question.

The second part of the survey has three open-ended questions so you can write your thoughts and feelings about the questions that are being asked. Read the questions carefully and provide your answers in the spaces provided.

Your survey has been anonymized. This means that you have been given a code by my research assistant so that I will not know which survey belongs to you. Do not write your name anywhere on your survey. I will also be out of the classroom while the surveys are being done. The open-ended answers will be typed up by my research assistant so that I will not be able to recognize your handwriting. I will never know what you said on either section of your survey. I am hoping that you will be honest in your answers as this will help me the most in my research. You do not need to share your answers with any adult or with any other student in the class. Complete the survey quietly and by yourself, then hand the survey into the designated bin.

I will not look at any of the survey results until after this research study is over, so you do not need to worry that what you say on your survey will affect your science grade. And whether or not you and your parent have consented to allow me to use your survey data, your science grade will not be affected.

Thank you for participating,

Mrs. Tyce
Student Survey #1 Human Body Unit – Part 1

Circle the number on the scale which best answers each question. There are 15 questions in this section.

1). How much did you enjoy learning about the Human Body as a science topic?

<table>
<thead>
<tr>
<th>Unenjoyable</th>
<th>Very enjoyable</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td>+2</td>
</tr>
<tr>
<td>-1</td>
<td>+1</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

2). How interesting did you find the Human Body Unit?

<table>
<thead>
<tr>
<th>Uninteresting</th>
<th>Very Interesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td>+2</td>
</tr>
<tr>
<td>-1</td>
<td>+1</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

3). How interesting do you find science class (in general)?

<table>
<thead>
<tr>
<th>Uninteresting</th>
<th>Very Interesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td>+2</td>
</tr>
<tr>
<td>-1</td>
<td>+1</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

4). How motivated were you to participate in the daily activities in this Human Body Unit (in general, since the activities changed from day to day)?

<table>
<thead>
<tr>
<th>Unmotivated</th>
<th>Very motivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>I didn’t want to participate in anything</td>
<td>I wanted to participate in everything</td>
</tr>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td>+2</td>
</tr>
<tr>
<td>-1</td>
<td>+1</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
5). How motivated are you to participate in the daily activities in science class (in general, since the activities may change from day to day)?

<table>
<thead>
<tr>
<th>Unmotivated</th>
<th>I don’t want to participate in anything</th>
<th>Very motivated</th>
<th>I want to participate in everything</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td>+3</td>
</tr>
<tr>
<td>+1</td>
<td>+2</td>
<td>+3</td>
<td></td>
</tr>
</tbody>
</table>

6). How motivated are you to participate in the daily activities in all school subjects?

<table>
<thead>
<tr>
<th>Unmotivated</th>
<th>I don’t want to participate in anything</th>
<th>Very motivated</th>
<th>I want to participate in everything</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td>+3</td>
</tr>
<tr>
<td>+1</td>
<td>+2</td>
<td>+3</td>
<td></td>
</tr>
</tbody>
</table>

7). How much do you like or dislike the way that this Human Body Unit was taught to you?

<table>
<thead>
<tr>
<th>Disliked</th>
<th>Liked a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
<tr>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>+2</td>
<td>+3</td>
</tr>
</tbody>
</table>

8). How easy or how difficult was the material in this Human Body Unit for you to understand?

<table>
<thead>
<tr>
<th>Very difficult to understand</th>
<th>Very easy to understand</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
<tr>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>+2</td>
<td>+3</td>
</tr>
</tbody>
</table>

9). Rank how much you like working with other students (either as pairs or as larger groups).

<table>
<thead>
<tr>
<th>Dislike</th>
<th>Like a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would rather work alone</td>
<td>I would rather work in a group</td>
</tr>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
<tr>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>+2</td>
<td>+3</td>
</tr>
</tbody>
</table>

10). Does discussing the work with other people help you to understand the topic better?

<table>
<thead>
<tr>
<th>Discussing the work does not help me to understand better</th>
<th>Discussing the work helps me to understand better</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
<tr>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>+2</td>
<td>+3</td>
</tr>
</tbody>
</table>
11). Rank how well you understand the Human Body Unit right now.

<table>
<thead>
<tr>
<th>I am totally confused</th>
<th>I understand everything</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>+2</td>
<td></td>
</tr>
</tbody>
</table>

12). How much would you like to learn the next science unit in the *same way* as you are currently being taught this science unit?

<table>
<thead>
<tr>
<th>I never want to learn this way again</th>
<th>I want to learn another unit this way</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>+2</td>
<td></td>
</tr>
</tbody>
</table>

13). How would you rank your effort during this human body unit?

<table>
<thead>
<tr>
<th>I didn’t try very hard in any of the activities</th>
<th>I always worked my hardest to do my best</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>+2</td>
<td></td>
</tr>
</tbody>
</table>

14). How would you rank your effort in science class in general?

<table>
<thead>
<tr>
<th>I don’t try very hard in any of the activities</th>
<th>I always work my hardest to do my best</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>+2</td>
<td></td>
</tr>
</tbody>
</table>

15). How would you rank your effort in school (in all subjects) in general?

<table>
<thead>
<tr>
<th>I don’t try very hard in any of the activities</th>
<th>I always work my hardest to do my best</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>+2</td>
<td></td>
</tr>
</tbody>
</table>

This is the end of Part 1
Student Survey #1 Human Body Unit – Part 2

Please read the questions carefully and answer honestly about how you feel. Your answers will be typed up by my research assistant, so I will have no way of knowing which thoughts were yours. Write as much or as little as you like, but explain your ideas clearly to me so that I am able to understand. Please don’t write anything that would identify you or anyone else in the class. If you run out of room, please ask my research assistant for more paper. There are 3 questions in this section of the survey.

1). Please describe your favourite way or ways to learn science. Think about methods like taking notes, doing worksheets, reading the textbook, doing labs, group work, class discussions, research projects, creating mind maps, etc. Please explain what it is that you like about some methods and not others.
2). Think about the way in which this science unit was taught to you. Did you like how we learned this unit? What kinds of activities did you like? Dislike? Please *explain why* you liked or disliked certain activities in this unit.

3). Do you have a really good understanding of the concepts in this unit or do you feel like this unit has been difficult and hard to understand? Tell me what has been easy to learn and what has been difficult to learn, and please *explain why* the certain parts were either easy or difficult for you.
The following survey consists of two parts, each in a separate section. At the top of each survey section there will be a code written in the top right hand corner. This code identifies you to my research assistant, but not to me. Do not put your name on the survey pages.

The first part of the survey asks 15 questions which use a ranking scale that goes from -3 to +3. There is a description at -3 and a description at +3 to explain the two extremes of the ranking. Choosing a score of 0 indicates a neutral response (no real opinion one way or the other, with regards to that question). Read the question and circle the number that best describes your answer to that question. There is also a 16th question which asks you to circle one of three choices.

The second part of the survey has four open-ended questions so you can write your thoughts and feelings about the questions that are being asked. Read the questions carefully and provide your answers in the spaces provided.

Your survey has been anonymized. This means that you have been given a code by my research assistant so that I will not know which survey belongs to you. Do not write your name anywhere on your survey. I will also be out of the classroom while the surveys are being done. The open-ended answers will be typed up by my research assistant so that I will not be able to recognize your handwriting. I will never know what you said on either section of your survey. I am hoping that you will be honest in your answers as this will help me the most in my research. You do not need to share your answers with any adult or with any other student in the class. Complete the survey quietly and by yourself, then hand the survey into the designated bin.

I will not look at any of the survey results until after this research study is over, so you do not need to worry that what you say on your survey will affect your science grade. And whether or not you and your parent have consented to allow me to use your survey data, your science grade will not be affected.

Thank you for participating,

Mrs. Tyce
**Student Survey #2 Water Unit – Part 1**

Circle the number on the scale which best answers the question.

1). **How much did you enjoying learning about Water as a science topic?**

<table>
<thead>
<tr>
<th>Unenjoyable</th>
<th>Very enjoyable</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
</tbody>
</table>

2). **How interesting did you find this Water Unit?**

<table>
<thead>
<tr>
<th>Uninteresting</th>
<th>Very Interesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
</tbody>
</table>

3). **How interesting do you find science class (in general)?**

<table>
<thead>
<tr>
<th>Uninteresting</th>
<th>Very Interesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
</tbody>
</table>

4). **How motivated were you to participate in the daily activities in this Water Unit (in general, since the activities changed from day to day)?**

<table>
<thead>
<tr>
<th>Unmotivated</th>
<th>Very motivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>I didn’t want to participate anything</td>
<td>I wanted to participate in everything</td>
</tr>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
</tbody>
</table>

5). **How motivated are you to participate in the daily activities in science class (in general, since the activities may change from day to day)?**

<table>
<thead>
<tr>
<th>Unmotivated</th>
<th>Very motivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t want to participate anything</td>
<td>I want to participate in everything</td>
</tr>
<tr>
<td>-3</td>
<td>-2</td>
</tr>
</tbody>
</table>
6). **How motivated are you to participate in the daily activities in all your school subjects?**

<table>
<thead>
<tr>
<th>Motivation Level</th>
<th>Unmotivated</th>
<th>Very motivated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I don’t want to participate anything</td>
<td>I want to participate in everything</td>
</tr>
<tr>
<td>Rating</td>
<td>-3</td>
<td>+3</td>
</tr>
</tbody>
</table>

7). **How much did you like or dislike the way that this Water Unit was taught to you?**

<table>
<thead>
<tr>
<th>Liked a lot</th>
<th>Disliked</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
</tr>
</tbody>
</table>

8). **How easy or how difficult was the material in this Water Unit for you to understand?**

<table>
<thead>
<tr>
<th>Very easy to understand</th>
<th>Very difficult to understand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
</tr>
</tbody>
</table>

9). **Rank how much you like working with other students (either as pairs or as larger groups).**

<table>
<thead>
<tr>
<th>Like a lot</th>
<th>Dislike - I would rather work alone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
</tr>
</tbody>
</table>

10). **Does discussing the work with other people help you to understand the topic better?**

<table>
<thead>
<tr>
<th>Discussing the work helps me to understand</th>
<th>Discussing the work does not help me to understand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
</tr>
</tbody>
</table>

11). **Rank how well you understand the Water Unit right now.**

<table>
<thead>
<tr>
<th>I understand everything</th>
<th>I am totally confused</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
</tr>
</tbody>
</table>

12). How much would you like to learn the next science unit in the same way as you were taught this science unit?

I never want to learn this way again

I want to learn another unit this way

-3 -2 -1 0 +1 +2 +3

13). How would you rank your effort during the Water Unit?

I didn’t try very hard in any of the activities

I always worked my hardest to do my best

-3 -2 -1 0 +1 +2 +3

14). How would you rank your effort in science class in general?

I don’t try very hard in any of the activities

I always work my hardest to do my best

-3 -2 -1 0 +1 +2 +3

15). How would you rank your effort in school (in all subjects) in general?

I don’t try very hard in any of the activities

I always work my hardest to do my best

-3 -2 -1 0 +1 +2 +3

16). Now that the two units in this research study are concluded, which teaching method did you prefer? Consider how the unit was taught rather than what topics were covered in each unit. Circle your preference.

Guided Inquiry Prefer both methods equally Traditional instructional methods
Student Survey #2 Water Unit – Part 2

Please read the questions carefully and answer honestly about how you feel. Your answers will be typed up by my research assistant, so I will have no way of knowing which thoughts were yours. Write as much or as little as you like, but explain your ideas clearly to me so that I am able to understand. Please don’t write anything that would identify you or anyone else in the class. If you run out of room, please ask my research assistant for more paper. There are 4 questions in this section of the survey.

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3). Do you have a really good understanding of the concepts in this unit or do you feel like this unit has been difficult and hard to understand? Tell me what has been easy to learn and what has been difficult to learn, and please explain why the certain parts were either easy or difficult for you.

4). In question #16 of Part One of the survey, you were asked to choose your preferred method of instruction, guided inquiry or traditional instructional methods. Please explain why you chose one method over the other. Or, if you picked no preference, please explain why you have no preference.
Appendix G – Recruitment Email Message

Dear Parent,

My name is Clarice Tyce and I am your son/daughter’s Math-Science teacher for this school year. I am currently enrolled in my second year of the Masters in Educational Leadership Program at Vancouver Island University and I will be conducting a research study in your child’s classroom this fall.

Today in class we discussed my research and I have given your child the following documents to bring home and discuss with you; a Parent/Guardian Information Letter, a Parent/Guardian Consent Form and a Student Assent Form.

In case any or all of these documents do not make it home with your child today, I have also sent them to you attached to this email.

Please read all the documents carefully. If you and your child decide to consent to participate in my research study, then all signed documents need to be returned to the Woodlands School Office. Please feel free to email or phone me if you have any questions.

Thank you. I look forward to a fun year of science and math with your child!

Clarice Tyce

Woodlands Secondary School
ctyce@sd68.bc.ca
Appendix H: Question One Written Responses

Figure H1. Percentage of written responses showing the preferred methods of learning science from Class 1 students after inquiry instruction (Human Body Unit). (n = 45)
Figure H2. Percentage of written responses showing the preferred methods of learning science from Class 1 students after traditional instruction (Water Unit). (n = 58)

Figure H3. Percentage of written responses showing the preferred methods of learning science from Class 2 students after traditional instruction (Human Body Unit). (n = 51)
Figure H4. Percentage of written responses showing the preferred methods of learning science from Class 2 students after inquiry instruction (Water Unit). (n = 50)
Appendix I: Question Two Written Responses

**Figure I1.** Percentage of Class 1 written responses showing a like or dislike of the inquiry unit. (n = 59)

**Figure I2.** Percentage of Class 1 written responses showing a like or dislike of the traditional unit. (n = 36)
Figure I3. Percentage of Class 2 written responses showing a like or dislike of the traditional unit. (n = 42)

Figure I4. Percentage of Class 2 written responses showing a like or dislike of the inquiry unit. (n = 39)
Appendix J: Question Three Written Responses

**Figure J1.** Percentage of Class 1 written responses indicating that the human body inquiry unit was easy, difficult or moderate in difficulty. (n = 38)

**Figure J2.** Percentage of Class 1 written responses indicating that the traditional water unit was easy, difficult or moderate in difficulty. (n = 34)
Figure J3. Percentage of Class 2 written responses indicating that the traditional human body unit was easy, difficult or moderate in difficulty. (n = 31)

Figure J4. Percentage of Class 2 written responses indicating that the water inquiry unit was easy, difficult or moderate in difficulty. (n = 40)
Appendix K: Question Four Written Responses

Figure K1. Percentage of written responses for Class 1 favoring either no preference, traditional instruction or guided inquiry instruction. (n = 23)
Figure K2. Percentage of written responses for Class 2 favoring either no preference, traditional instruction or guided inquiry instruction. (n = 30)