2. Literature Review

2.1 Overview

Key areas covered in this literature review include attitudes, confidence, culture of teaching, writing, collaboration, blogging, and ability groupings in the domain of mathematics. Learning performance is discussed in each of the above areas of the literature review. Finally, the methodological limitations or previous research in blogging in mathematics will be discussed. The information contained in this literature review ranges from 1982 to 2014. Although this review spans a large time period, limited research on secondary school students and blogging exists.

2.2 Attitudes toward Mathematics

Students hold diverse attitudes about mathematics that can impede learning. First, students perceive learning mathematics as challenging, and therefore it is feared by many (Burns, 1998; Furner & Gonzalea-DeHass, 2011; OECD, 2014). According to the 2005 Gallup Youth Survey conducted in the United States, students believed that mathematics was the most difficult subject to learn (Furner & Gonzalez-DeHass, 2011). In addition, the Programme for International Student Assessment (PISA) reported that 30% of students felt helpless when doing mathematics (OECD, 2014). Two-thirds of Americans fear math, and this fear is often transferred to their children (Burns, 1998 cited in Furner & Gonzalez-DeHass, 2011).

Second, students sometimes have a fixed mindset, meaning they believe that their ability to learn mathematics is limited (Ciobanu, 2013; Dweck, 2008). Dweck and colleagues observed 373 students through grade 7 and 8 (Dweck, 2008). Students with a

growth mindset had higher mathematics grades, compared to those students with a fixed mindset after two years because those students with a growth mindset cared more about the learning process (Dweck, 2008). Ciobanu's (2013) qualitative blogging research in her own secondary school classroom lead her to conclude that having a growth mindset leads to increased success. She notes how most students enter the mathematics classroom with a fixed mindset (Ciobanu, 2013).

Finally, many students have math anxiety, which can be defined as "feelings of tension and anxiety that interfere with the manipulation of numbers and solving of mathematical problems in a wide variety of ordinary life and academic situations" (Furner & Gonzalez-DeHass, 2011, p. 228). Anxiety can lead to negative attitudes toward mathematics and result in less success on mathematics tasks (Devine, Fawcett, Szucs, & Dowker, 2012; Mutodi & Ngirande, 2014; Park, Ramirez, & Beilock, 2014). Devine et al. (2012) confirmed negative correlations between math anxiety and mathematics performance by showing that grade 7, 8 and 10 students with high math anxiety had significantly lower mathematics scores on mathematics tests. A survey of 120 high school students indicated that math anxiety negatively affects achievement (Mutodi & Ngirande, 2014). Park et al.'s (2014) study of 80 university students demonstrated that students who were suffering from high anxiety were less successful on a mathematics exam, compared to students who had their anxiety lowered through writing prior to the exam. Mutodi and Ngirande (2014) concluded through their study on high school students that math anxiety is a learned behaviour that can be unlearned by understanding the factors that trigger the anxiety.

2.3 Confidence in Mathematics

Self-confidence can play a critical role in learning mathematics (Stuart, 2000). A survey completed by fifth graders indicated that the majority of students had low self-confidence, disliked and felt they performed worse than their classmates (Stuart, 2000). Stuart (2000) concluded that students will only learn mathematics if they are confident in their ability to learn. The Programme for International Student Assessment (PISA) reported that 30% of grade 9 students indicated they feel helpless when doing mathematics (OECD, 2014). The Trends in International Mathematics and Science Study (TIMSS), which assesses grade 4 and 8 students in over 40 countries, reported that only 34% of fourth graders and 14% of eighth graders expressed confidence in their mathematical abilities (Mullis et al., 2012). This finding indicates that students' mathematical confidence may decrease as students' progress through their educational careers. Only 6.7% of high school students in the Mutodi and Ngirande (2014) study indicated they were confident speaking up in mathematics class. Mathematics is a cumulative discipline -therefore it is critical to build self-confidence early in the learning process (Mutodi & Ngirande, 2014).

Student confidence in mathematics may be increased through certain classroom activities (Kalchaman, 2011; Ku et al., 2014; Veggel & Amory, 2014). The results of the Ku et al. (2014) study indicated that grade 4 students of all ability levels were able to increase their confidence through game-based learnings. Kalchman (2011) observed 70% of the grade 5 students in one classroom increased their mathematical confidence through a weekly 'Math in Everyday Life' assignment, as students could build their mathematics skills

through relevant and meaningful activities. First-year university students who attended voluntary mathematics tutorials were able to increase their confidence from an average of 3 to 7 out of 10, due to the small group learning setting created by the tutorial (van Veggel & Amory, 2014). It appears then that students need an appropriate learning environment to build mathematical confidence.

2.4 Culture of Teaching Mathematics

Teaching is a culturally transmitted practice and a number of instructors will teach the same way they were taught (Furner & Gonzalez-DeHass, 2011; Skemp, 2006; Stigler & Hiebert, 2004). Teachers demonstrate at least two different fundamental approaches to learning mathematics. One is from an *instrumental* perspective, which involves solving questions using facts and procedures, and the other is from a *relational* perspective, which involves solving questions by selecting different strategies and skills (Skemp, 2006). Unfortunately, some teachers were not taught mathematics in a meaningful way (Koirala, 2002). Journal entries by pre-service teachers stated that they themselves had a hard time explaining their thinking to mathematics questions as they were taught to accept rules and procedures without understanding why they work (Koirala, 2002). It is challenging for teachers to change from an instrumental to a relational teaching approach (Koirala, 2002). Only 53% of students reported that their teacher presented them with questions that required them to think (OECD, 2014). The instrumental approach to teaching mathematics can create a situation where students produce correct answers without knowing why the answer is correct (Burns, 1995; Cooper, 2012; Kostos & Shin, 2010; Richhart et al., 2011). Learning mathematics for understanding is fundamentally different from memorizing

mathematical procedures. Therefore it is essential that we continue to investigate new avenues to increase relational learning in the mathematics classroom.

2.5 Writing in Mathematics

2.5.1 Benefits

The National Council of Teachers of Mathematics (NCTM) recommends that written communication should be encouraged in mathematics, as it increases understanding (Cooper, 2012). Learning through writing can be described as a "meaning-making process," whereby the learner is actively building connections between what they are learning and what they already know (Alterman & Larusson, 2013; Borasi & Rose, 1989; Cooper, 2012). Restating facts, concepts and rules in one's own words can facilitate internalization, as students have an inner conversation with themselves to make their understandings concrete and their own (Albert, 2000; Borasi & Rose, 1989; Burns, 2004). According to Koirala (2002), construction of knowledge is a continuous process, therefore it must be regularly communicated and reflected. Communication through writing is a key part of developing mathematics understanding (Carley, 2011).

A number of studies have reported that journaling can be used to communicate and learn mathematics (Albert, 2000; Borasi & Rose, 1989; Koirala, 2002; Kostos & Shin, 2010; Morris, 2006). A review of the literature identified at least five main benefits to students who participate in journal writing in mathematics class. First, journaling can increase students' mathematical understanding. In a mixed methodology study by Kostos and Shin (2010), 13 out of 16 primary students increased their understanding of mathematical vocabulary through teacher-prompted journaling. A case study conducted by Albert

(2000) reported that grade 7 students increased their mathematical understanding through writing. Quinn and Wilson (1997) surveyed teachers at the second, fifth and eleventh grade levels. The majority of teachers indicted that they felt writing was extremely beneficial to students mathematical understanding, as it allowed them to identify mistakes and solidify new knowledge (Quinn & Wilson, 1997).

Second, journaling can increase students' thinking and problem solving skills. Carter (2009) found that grade two students' thinking and problem solving skills increased when journaling became part of the regular classroom routine. Grade 7 students examined in a case study developed more clear and concise strategies to solve mathematical problems through writing (Albert, 2000). Thirteen out of 16 grade 2 students examined in a mixed methodology study increased their mathematical thinking from the pre- to post-assessment (Kostos & Shin, 2010).

Third, journaling allows students' to self-monitor their learning. Grade 7 students participating in a case study by Albert (2000), reported they felt that writing helped them keep track of their thinking and solutions when solving mathematical problems. Koirala (2002) observed that pre-service teachers increased their mathematical understanding through journal writing, as it required them to monitor their own mathematical thinking on a regular basis. Pre-service teachers expressed how they liked journaling in mathematics, because it gave them time to reflect on what they learned and ask questions before the next class (Koirala, 2002).

Fourth, journaling can increase students' mathematical communication. In a case study by Baxter et al. (2005), three out of four grade 7 students who never spoke up in

class were able to explain their understanding and thinking in their mathematics journals. Morris (2006) observed post-secondary students using the writing center to improve their mathematical communication and thinking, as it allowed them to build their writing skills and then apply those skills in mathematics class.

Fifth, journaling allows students to express their feelings about mathematics. In a study by Borasi and Ross (1989), journaling had a therapeutic effect on college students, as it helped to reduce the emotional components of learning mathematics. Journaling helped build mutual trust between the student and teacher, leading to a more caring classroom atmosphere (Borasi & Ross, 1989). Park et al. (2014) examined how college students used expressive writing prior to stressful situations to increase success, as it increased working memory. Pre-service teachers developed sufficient confidence to express concerns, excitements, concepts and questions in their mathematics journals as the course progressed (Koirala, 2002). When students are given the opportunity to share how they feel, a more positive atmosphere is created, and math anxiety can be reduced (Koirala, 2002; Quinn & Wilson, 1997).

2.5.2 Challenges

Although clear benefits to students exist when writing in the mathematics classroom, relatively few teachers few are actually using this strategy (Baxter et al., 2005; Koirala, 2002; Kosta & Shin, 2010; Quinn & Wilson, 1997). There are at least three documented challenges inhibiting teachers from using mathematics journaling: lack of time, limited writing ability of students, and student resistance. Mathematics journals take a lot of time for students to write, and teachers need a lot of time to read and respond to

every student's journal (Baxter et al., 2005; Koirala, 2002; Kosta & Shin, 2010; Quinn & Wilson, 1997). The Baxter et al. (2005) study, where grade 7 students were writing in journals, reported that teachers did not like that the journals added to their daily workload. Kosta and Shin (2010) reported that the use of journals by pre-service teachers put a substantial work demand on the instructor. Quinn and Wilson (1997) reported that the grade 2, 7, and 11 teachers surveyed stated that there is not enough class time for students to write in journals, as there is too much curriculum to cover.

Some students do not have the writing ability to be able to express their mathematical thinking effectively making journaling a less than ideal option (Kostos & Shin, 2010; Quinn & Wilson, 1997). Kostos and Shin (2010) expressed that grade 2 students could only communicate effectively if they used pictures and symbols in their journals. The survey of grade 2, 7 and 11 teachers by Quinn and Wilson (1997) indicated that students with inadequate writing skills deterred teachers from using journaling in their classrooms, as they felt students needed outstanding English skills to be able to use journals in mathematics class effectively.

Finally, students are not always able to see the benefits that come with journal writing, therefore they are resistant to put effort into their writing (Borasi & Ross, 1989). In a study of college mathematics students by Borasi and Ross (1989), only one-third of students mentioned that journaling was beneficial in their course evaluation.

2.6 Collaboration and Mathematics

2.6.1 Benefits

Peer collaboration can be defined as students working together to complete a task by exchanging ideas and opinions (Fawcett & Garton, 2005; Koijiri, Murase & Watanabe, 2006; Samuelsson & Frykedal, 2014). Collaboration with discussion can lead to deeper understanding and academic gains, as students need to compare their ideas to others, and restructure their understandings in the process (Carley, 2011; Gupta, 2008; Fawcett & Garton, 2005; McCrone, 2005; Teasley, 1995; Vidakovic & Marton, 2004). Carley (2011) found that kindergarten and grade 3 students increased their mathematics vocabulary through regular group discussions in the classroom, leading to increase understandings. Grade 2 students who worked collaboratively in discussion groups, obtained a significantly higher number of correct responses on a sorting activity, compared to students who worked alone (Fawcett & Garton, 2005). Grade 4 students who communicated with each other during group work were able to generate higher quality hypotheses on an open-ended task, then those who worked alone (Teasley, 1995). McCrone (2005) observed grade 5 students building a shared understanding in mathematics class through group discussions. Vidakovic and Martin (2004) noted instances where group discussions influenced individual thinking in university mathematics students, which led to increased learning, and problem-solving skills. According to a literature review by Gupta (2008), if students have a chance to explain their thoughts to someone else, they can solidify their learning.

Collaboration in mathematics classrooms has been associated with increases in confidence (McCrone, 2005; Vidakovic & Martin, 2004). McCrone (2005) observed grade 5 students taking more intellectual risks in the classroom as the year progressed because they were able to build confidence in their small collaborative groups. In whole class discussion, a number of students remained silent and did not collaborate. Deep mathematical understanding did not develop until small collaborative groups were created in the classroom thereby allowing student discussion (McCrone, 2005). Group discussions influenced individual mathematical thinking for university students, leading to increased self-confidence (Vidakovic & Martin, 2004).

2.6.2 Challenges

The success of peer collaboration depends on a number of factors including grouping arrangement and the assigned task (Fawcett & Garton, 2005; Gupta, 2008; Samuelsson & Frykedal, 2014; Teasley, 1995). Research on children's collaboration over the past two decades has shown that merely putting children together is not enough (Teasley, 1995). The benefit of collaborative work is dependent upon student participation in the group (Johnson & Green, 2007; Teasley, 1995; Webb, 2009). Meaningful participation occurs when a group has had extensive and relevant interactions about an assigned task (Vidakovic & Martin, 2004). In Vidakovic and Martin's (2004) study, university mathematics students' collaborative sessions were rated as meaningful when students had an extensive interaction that addressed the problem and lead to a solution. Tasks that arrange grade 5 students into small cooperative groups lead to more meaningful mathematics discussions than large group arrangements (McCrone, 2005).

Teachers must prepare students for effective collaboration, by training them how to work effectively in a group (Gupta, 2008; Fawcett & Garton, 2005; Webb, 2009). Fawcett and Garton (2005) stated that children need training in interactive skills, such as how to explain ideas, how to give and receive feedback and how to be sensitive to others, to be successful in collaborative work. Webb (2009) notes that teachers muct teach collaborative strategies and listening skills directly, as well as provide regular prompting in the early stages of collaboration. In a study by Golbeck and Sinagra (2000), collaboration among university students failed to show an increase in learning as the peer roles were too loosely established. Students did not understand their responsibilities within the group, and therefore limited collaboration occurred (Golbeck & Sinagra, 2000). According to Gupta (2008) a great deal of practice is needed to develop the skills for any discipline, and collaboration is no exception.

Open-ended tasks that allow multiple ways to produce an answer are optimal for collaborative work, as the different opinions that are expressed can help lead to an answer (Webb, 2009). Difficulty level of a collaborative task can also have an impact on success. Samuelsson and Frykedal (2014) found that when a task is too easy or too difficult, grade 9 students were unable to work collaboratively and complete the task. Fawcett and Garton (2005) observed that grade 2 students did not increase their knowledge if the sorting task was too difficult for the pair. Students can acquire knowledge through collaboration and discussions, however, the knowledge they can gain is limited if they are unable to reach the answer. Therefore monitoring by the teacher is essential for success to ensure a task is at an appropriate level for students (Koijiri et al., 2006).

2.7 Blogging and Mathematics

2.7.1 Overview

In the past 10 years, there has been a steady increase in the use of web 2.0 technologies, with a focus on participation over presentation (Cooper, 2012; Deng & Yuen, 2011). Blogging, defined as online journals or diaries that are logs (weblogs) of thoughts, reflections, and events in the writer's life are particularly popular as millions of people worldwide have blogs, and millions more read them (Davi et al., 2007; Downes, 2004; Ellison & Wu, 2008; Nair et al., 2013; Nehme, 2011; Pedersen & Macafee, 2007; Williams & Jacobs, 2004). For young adults, using technology for self-expression is a deeply engaging part of their lives (Ellison & Wu, 2008). Approximately 50% of blog authors are under the age of twenty (Davi et al., 2007; Ellison & Wu, 2008; MacBride & Luehmann, 2008; Pedersen & Macafee, 2007). Blogging can also support student learning in the classroom, as it capitalizes on interest and familiarity with online communication and extends learning beyond the classroom (Glogoff, 2005; MacBride & Luehmann, 2008; Williams & Jacobs, 2004).

2.7.2 Benefits

Blogs are a powerful platform in mathematics classrooms allowing students and teachers to engage in rich conversations that support student learning (Ciobanu, 2013; Johnson & Green, 2007). There are at least four benefits to using blogging in the classroom. First, blogging creates a community of learning outside the classroom**,** making the learning process student-centered and interactive (Glogoff, 2005; MacBride & Luehmann, 2008). Glogoff (2005) found that using blogging in his university courses extended the classroom

into the virtual world, making the learning in his courses more student-centered as blogging utilized the social component of learning. MacBride and Luehmann (2008) found blogging encouraged grade 11 students to reflect and discuss mathematics content beyond a lesson on the blog. Students develop a better connection with their teacher and other students through blogging, which allows them to feel more comfortable on the blog and in the classroom (Cuhadar & Kuzu, 2010). University students in the Cuhadar and Kuzu's (2010) study pointed out that increasingly positive relationships were built on the blog, as students were more intimate with their other classmates through the blogging activities. In a study of 48 British bloggers, Pedersen and Macafee (2007) noted that blogging can be a good support network for people.

Second, blogging increases collaboration. Blogging allows students and teachers to collaborate outside the classroom and gives students access to curriculum content and support 24/7 (Alterman & Larusson, 2013; Cuhadar & Kuzu, 2010; MacBride & Luehmann, 2008). The 25 university students in the Alterman and Larusson (2013) study were able to use the blogging content throughout the semester as a resource for other learning activities because the blog content remained throughout the semester. University students in the Cuhadar and Kuzu (2010) study noted that they were able to reach course content on the blog for classes that they were unable to attend, therefore making the learning process more effective. Students also felt they interacted more with their teacher on the blog then they would in the regular classroom (Cuhadar & Kuzu, 2010). Grade 11 mathematics students commented that the blog helped them complete their homework at night (MacBride & Luehmann, 2008). Williams and Jacobs (2004) suggested that students learn

as much from each other as they do the textbook through collaboration activities, like blogging (Yang & Chang, 2012).

Third, considerable research suggests that blogging supports student learning. Blogging requires students to write, read, reflect and question (Downes, 2004). Knowledge is shared on the blog as students post their own thoughts and read the various perspectives of others (Alterman & Larusson, 2013). University students in the Alterman and Larusson (2013) study built common knowledge through the social interactions on the blog. Over 70% of fifth grade students who completed a survey on their blogging experiences indicated that blogging was important, interesting and useful to their learning (Nair et al., 2013). A mixed-methodology study by MacBride and Luehmann (2008) reported that grade 11 students believed that their learning was being supported through peer-to-peer interactions on the blog. Davi et al. (2007) conducted a blogging study in five college classrooms. Students reported that they enjoyed blogging, because it exposed them to a variety of opinions and perceptions, thereby improving their learning (Davi et al., 2007). Over 95% of students in a university mathematics course felt reading other students' blog posts was beneficial to their learning, as it presented different perspectives (Nehme, 2011). In a qualitative blogging study by Ellison and Wu (2008), 52 university students reported that reading other students' blogs was most helpful for understanding course content. Seventy percent of education university students in a qualitative study by Deng and Yuen (2011) found that reading blog posts helped with their professional growth. Blogging can develop critical thinking skills as students must carefully reflect and evaluate their own work and the work of others (Davi et al., 2007; Downes, 2004; Hehme, 2011; Williams &

Jacobs, 2004). Metacognition naturally develops as students compare their understandings with others in the online environment (Cooper, 2012).

Finally, blogging can create a safe space for learning. Blogs can help students who are uncomfortable speaking up in the classroom, as they can become active participants in the online world (Johnson & Green, 2007). Johnson and Green (2007) observed that when university students used online discussion forums, students who were unwilling to speak up in the classroom were able to find a voice online. Davi et al. (2007) noted that the blogging required college students who were not likely to participate in class to post some of their thoughts and reflections on the blog, which allowed them to contribute to the discussion. They also saw an increase in the length of the blog posts over the semester (Davi et al., 2007). Cuhadar and Kuzu (2010) also observed university students writing more on the blog as the 10-week study progressed. Blogging has the potential to benefit to all students, even the inactive online learner who just reads the blog posts (Davi et al., 2007; Deng & Yuen, 2011). Over 70% of college students in the Davi et al. (2007) study stated that just reading blog posts assisted in their learning. Similarity in the Deng and Yuen (2011) study, around 70% of university participants felt the reading the blogs of their peers contributed to their professional learning. Blogging is unique because it gives students the opportunity to think and reflect before responding to a question, reducing the pressures that students can feel within the classroom (Brescia & Miller, 2006; Johnson & Green, 2007; Yang & Chang, 2012). University students using online discussion forums were able to organize their ideas before responding, increasing the depth of their responses (Johnson & Green, 2007). Nearly 70% of student teachers in the Deng and Yang

(2012) study acknowledged that blogging allowed them to self-reflect. Professors who participated in the Brescia and Miller (2006) survey noted that the major benefit to blogging is that participates have time to synthesize information before responding, which increases engagement and reduces anxiety. Students can feel secure during their learning journey, knowing they do not have to meet a certain deadline on the blog. Although many benefits to using blogging in the mathematics classroom have been identified, research is still rather limited at the secondary school level.

2.7.3 Challenges

Wide-spread use of blogs in educational settings is relatively limited for at least five reasons. First, teachers have a somewhat restricted understanding of how to use blogs effectively in the classroom (Yang & Chang, 2012). A review of the literature by Yang and Chang (2012) notes that educators understanding of social software and how to use discussion forums and blogs effectively are minimal at best. The benefits of classroom blogging depend largely on how the teacher structures and uses the blog (MacBride & Luehmann, 2008; Nair et al., 2013). In the grade 11 mathematics class MacBride and Luehmann (2008) observed the need for ongoing awareness of students' strengths and needs and regular planning for blogging to be successful. Teachers commented that closer monitoring and prompting were needed for grade 5 students to make successful blog submissions (Nair et al., 2013). Mathematics activities in the 'Talking Math, Blogging Math' curriculum still needed to be scaffolded to allow students in grade 7, 8 and 9 to be successful (Mathews, 2009). Teachers who use technology in their classroom want to

know how to use it more effectively, so that students' learning is better supported (Brescia & Miller, 2006).

Second, the learning that can be accomplished through blogging depends largely on student interactions, however, successfully promoting discussions in a virtual classroom can be challenging as some students just sit back and do not participate (Deng & Yuen, 2011; Glogoff, 2005). Deng and Yuen (2011) reported that over half the posts made by education students did not receive any comments. Glogoff (2005) reported that within in his own university classrooms he was unable to lure lurkers into participating in the discussion forum or blogs, even with incentives.

Third, there is the potential for students to be rude or mean on the blog (Ellison & Wu, 2008; Nair et al., 2013). University students felt that their blogging work was not good enough when they received a negative comment or no comment at all (Ellison & Wu, 2008). The six grade 5 teachers in the Nair et al. (2013) study all agreed that close monitoring and prompting was needed for blog success, as the teacher needs to ensure content is positive and helpful to students learning.

Fourth, there is always a risk of technology not work effectively, which can frustrate teachers and students (Davi et al., 2007; Ellison & Wu, 2008; Nair et al., 2013). Eight out of 18 grade 5 students interviewed in the Nair et al., (2013) study reported they were frustrated by blogging due to the technical and logical issues. Undergraduate university students in the Ellison and Wu (2008) study noted various technical concerns, such as uncertainty as to whether or not their work had been received by the teacher. Davi et al. (2007) reported that 22% of college students said they have trouble posting or responding

to a post on the blog. Finally, university mathematics students commented that blogging was not enjoyable because it took too long to upload attachments (Nehme, 2011).

2.8 Academic vs. Applied Classrooms

2.8.1 Benefits

Ability grouping can be defined as the practice of organizing students into homogeneous groups based on perceived skill (Ansalone, 2010; Chmielewski, Dumon, & Trautwein, 2013; Kulik & Kulik, 1982; McCarter, 2014; Slavin, 1990; Tiesco, 2003). Ability grouping may also be called streaming or tracking (Ansalone, 2010; Chmielewski et al., 2013). Placing students into groups for learning is a common practice worldwide (Ansalone, 2010; Chmielewski et al., 2013; McCarter, 2014). In secondary schools, students are often placed in either a university or vocational track (McCarter, 2014; Slavin, 1990). However, in the last decade, schools have developed more flexible streaming, allowing students to move between levels for different subject areas (Ansalone, 2010; Dulfo, Dupas & Kremer, 2009; McCarter, 2014).

In Ontario, students in grade 9 and 10 mathematics are placed into two different streams, academic or applied. According to the Ministry of Education (2005), the academic course focuses on essential mathematical theories and abstract problems to develop students' knowledge and skills, whereas the applied course develops students' mathematical knowledge and skills through practical applications and concrete examples. The mathematical process, though, is considered to be essential in both streams (Ministry of Education, 2005). Ability grouping is implemented in areas such as mathematics to help teachers differentiate instruction (Ansalone, 2010; McCarter, 2014; Slavin, 1990). Hunt

and Preston (2014) define differentiated instruction as a method of instruction where teachers modify the curriculum and their method of teaching to meet the needs of the students. When a teacher provides the correct content, at an appropriate level and pacing, students will experience success (Hunt & Preston, 2014; Tiesco, 2003; Walters, 2014). Research into ability grouping has shown that homogenous grouping can be effective in certain areas including mathematics and gifted programs (Ansalone, 2010; Kulik & Kulik, 1982; McCarter, 2014; Slavin, 1990).

2.8.2 Challenges

Although homogeneous grouping benefits some students, other students are more successful in heterogeneous classroom settings. According to a study by Hunt and Preston (2014), grouping students in grades 4 to 6 based on their mathematics level had positive impact on high-achieving students, but not on low-achieving students. On the other hand, Wang (2013) and Slavin (1990) noted that low-achieving secondary and college students needed stronger students to stimulate and encourage them. With heterogeneous classrooms, low- achieving students may have the support they need to be successful (Wang, 2013). Chmielewski et al. (2013) observed that high-track students on the PISA reported high mathematics self-concept, compared to low-track students who reported low mathematics self-concept. Self-concept can be defined as a person's perception of their abilities (Chmielewski et al., 2013). Grouping practices have different effects on student achievement based on the type of curriculum that is developed for each group (Tiesco, 2003). Slavin (1990) states that unless teaching methods are systematically changed,

ability grouping has little impact on student achievement. To date no research has been conducted on ability group's use of blogging in the mathematics classroom.

2.9 Limitations and Methodological Issues

There are at least six limitations in previous research focusing on blogging in educational settings. First, based on a review of the literature, 75% of educational blogging studies are conducted in post-secondary institutes (Alterman & Larusson, 2013; Brescia & Miller, 2006; Cuhadar & Kuzu, 2010; Davi et al., 2008; Deng & Yuen, 2011; Ellison & Wu, 2008; Glogoff, 2005; Nehme, 2011; Williams & Jacobs, 2004; Yang & Chang, 2012). Second, educational studies which have examined blogging focused on language or business, not mathematics (Alterman & Larusson, 2008; Brescia & Miller, 2006; Cuhadar & Kuzu, 2010; Davi et al., 2008; Deng & Yuen, 2011; Ellison & Wu, 2008; Glogoff, 2005; Nair et al., 2013; Williams & Jacobs, 2004; Yang & Chang, 2012). Third, a number of studies on blogging contained anecdotal data from personal observations but no empirical data (Brescia & Miller, 2006; Ciobanu, 2013; Glogoff, 2005; Nehme, 2011). Fourth, although both qualitative and quantitative data were collected in a number of studies through interviews and surveys, some studies neglected to analyze the actual content of the blog (Ciobanu, 2013; Davi et al., 2007; Ellison & Wu, 2008; Williams & Jacobs, 2004). Fifth, educational blogging studies have focused exclusively on single ability groups (Alterman & Larusson, 2013; Brescia & Miller, 2006; Ciobanu, 2013; Cuhadar & Kuzu, 2010; Davi et al., 2008; Deng & Yuen, 2011; Ellison & Wu, 2008; Glogoff, 2005; MacBride & Luehann, 2008; Nair et al., 2013; Nehme, 2011; Williams & Jacobs, 2004; Yang & Chang, 2012). Finally, no studies

have examined the impact blogging could have on a student's confidence within the subject area

In addition, only one study, looked at blogging in secondary school mathematics classrooms (MacBride & Luehann, 2008). Students' blogged throughout the year, but only the blog content from the analytical geometry unit was analyzed in the study. The analytical geometry unit lasted 27 days. During the 27 days the students made 30 posts and 26 comments, and the teacher made 11 posts and 3 comments. The blog had a number of features including reflective posts, resources, and problem-solving activities. The blog site was used regularly, even when the teacher was absent from school. The blog posts were analyzed and the teacher was interviewed to collect data. The results indicated that classroom blogs capitalized on students' cultural literacies, and were a useful learning tool, however, success depended on how the teacher structured the blog. Although the MacBride and Luehann (2008) study is most similar to the current research study, some limitations are present. This study only looked at one class of the same ability, during one unit. They did not investigate student attitudes toward blogging, or whether blogging influenced student confidence. These items are addressed in the current research study.

2.10 Research Questions

Five research questions guide this study:

1. What are grade nine students' attitudes toward using blogging in mathematics class?
2. What is the impact of blogging on grade nine students' confidence in mathematics?
3. What is the impact of blogging on grade nine students' communication of

mathematical thinking?

4. What is the impact of blogging on grade nine students' mathematics knowledge?
5. What is the impact of ability level (applied vs. academic) on the use of blogging in the mathematics classroom?