1. Introduction

1.1 Overview

Today's mathematics classroom must prepare students for their future roles in society, as mathematics is a fundamental skill needed in out daily lives (Boaler, 2008; Jordan, Glutting & Ramineni, 2010; Ku, Chen, Wu, Loa & Chan, 2014; Ministry of Education, 2005). However, many students are unable to link what they do in the classroom to their everyday lives therefore they do not see mathematics as useful (EQAO, 2014; Furner & Gonzalez-DeHass, 2011; Johnston-Wilder & Lee, 2010). Reports all over the world indicate that students are having difficulty with mathematics (EQAO, 2014; Mullis, Martin, Foy & Arora, 2012; OECD, 2012). The field of mathematics is an abstract area of study which students find challenging (Nehme, 2011). The Programme for International Student Assessment (PISA) reported that 32% of all participating students did not reach the baseline level 2 in the mathematic assessment (OECD, 2012). Only one in five students were able to solve the problem-solving questions on the PISA (OECD, 2012). Trends in International Mathematics and Science Study (TIMSS) reported that more countries demonstrated relative strengths in knowing mathematics, such as recalling and computing, but not in applying mathematical reasoning (Mullis et al., 2012). In 2013-2014, EQAO data from Ontario, the largest province in Canada, indicated 15% (academic level) and 49% (applied level) of grade 9 students failed to achieve the provincial standard in mathematics (EQAO, 2014). Grade 9 students performed least well on questions assessing the skill of problem-solving (EQAO, 2014). Carley (2011) adds that primary students in New Mexico are specifically lacking in the area of mathematical communication.

Limited ability to problem-solve, communicate and link mathematics to authentic tasks may be partially explained by the way students are encouraged to learn. As students travel through their educational journey, they learn to play the "game of school" where the primary focus may be biased toward memorizing facts, concepts and procedures to achieve good grades (Richhart, Church, & Morrison, 2011; Skemp, 2006). Children can acquire the belief that getting the correct answer is the most important part of learning and that working alone is best for success with limited emphasis placed on the learning process (Richhart et al., 2011; Whitin & Whitin, 2000).

According to Skemp (2006), there are at least two types of learning in mathematics: instrumental and relational learning. Instrumental learning is the memorization of facts and procedures, whereas relational learning involves selecting different strategies and skills to solve new, complex problems (Skemp, 2006). Although instrumental learning has the potential to increase self-confidence, as students can often get the correct answer more quickly, it does not allow students to develop a deeper understanding of the mathematical content (Baxter, Woodward & Olsen, 2005; Kostos & Shin, 2010). Some evidence suggests that students who follow an instrumental learning regime are less able to problem solve and think mathematically as they have not developed sufficient mathematical learning strategies and have limited opportunities for communication in the classroom (Borasi & Rose, 1989; Kostos & Shin, 2010; Richhart et al., 2011).

Mathematical communication, defined as "the process of expressing mathematical ideas and understanding orally, visually, and in writing, using numbers, symbols, pictures, graphs, diagrams and words" (Ministry of Education, 2005, p.16), has the potential to

promote relational learning, as described by Skemp (2006). Researchers hypothesize that students are able to reflect upon and clarify their ideas, understanding of mathematical relationships, and mathematical arguments when they are encouraged to communicate (Ministry of Education, 2005). The ability to think, problem-solve, and communicate in mathematics does not come naturally, and educators play a big part in developing these skills within the classroom (Carley, 2011; Evans, 2002; McCrone, 2005).

Technology has the potential to support and enhance mathematical communication within the classroom and help build relational learning skills (Cheung & Slavin, 2013; Ellison & Wu, 2008; Ministry of Education, 2005). Technology has infiltrated numerous aspects of modern life, and the classroom is no exception (Brescia & Miller, 2006; Cheung & Slavin, 2013; Delen & Bulut, 2011). According to a 2008 study in the US, 83% of students aged 12-17 use the internet for communication regularly, 71% have their own cell phones, and 59% have their own computers (Cooper, 2012). Brescia and Miller (2006) report that 74% of teens use instant messaging as a major communication tool. Technology may be important in the teaching and learning of mathematics, as it could impact how mathematics is taught and enriches students' learning (Cheung & Slavin, 2013).

Blogs are one type of educational technology that has the potential to promote written communication, foster interaction, and stimulate collaborative learning to increase relational learning (Ciobanu, 2013; Deng & Yuen, 2011; Glogoff, 2005). Blogging is defined as online journals or diaries that are logs (weblogs) of thoughts, reflections, and events in the writer's life (MacBride & Luehmann, 2008).

Writing in mathematics has been studied as a tool to decrease math anxiety and increase mathematical learning and communication (Albert, 2000; Baxter et al., 2005; Borasi & Rose, 1989; Burns, 1995; Koirala, 2002; Kostos & Shin, 2010; Quinn & Wilson, 1997). Psychologists and educators have suggested powerful connections between writing and learning (Borasi & Ross, 1989). Writing has been shown to help students to think more deeply and clearly about mathematical ideas and their own learning, thereby increasing overall success in the mathematics classroom (Albert, 2000; Borasi & Rose, 1989; Burns, 1995; Koirala, 2002; Kostos & Shin, 2010; Quinn & Wilson, 1997).

Blogging allows students to participate and share their thinking at any time, from anywhere and at their own learning pace, thereby increasing overall student interactions (Alterman & Larusson, 2013; Brescia & Miller, 2006; Ciobanu, 2013; Downes, 2004). Blogging allows both peer-to-peer and peer-to-teacher interactions, thus increasing mathematical communication (Davi, Frydenberg & Gulati, 2007; Yang & Chang, 2012).

Blogging also promotes collaboration and the exchange of ideas (Davi, et al., 2007; Yang & Chang, 2012). Promoting discussions and argumentation of mathematical ideas improves learning and communication (McCrone, 2005; Webb, 2009). Blogging has been identified as one educational tool that can support student learning (MacBride & Luehmann, 2008). Research on blogging in the mathematics classroom is emerging, as educators look to increase mathematical success through the use of collaboration and technology (Alterman & Larusson, 2013; Brescia & Miller, 2006; Davi, et al., 2007; Deng & Yuen, 2011; Ellison & Wu, 2008; MacBride & Luehann, 2008; Nair, Tay, & Koh, 2013; Nehme, 2011; Williams & Jacobs, 2004; Yang & Chang, 2012). Blogging in the mathematics

classroom promotes sharing, reflection, thinking and learning (Daviet al., 2007; Downes, 2004).

Mathematics achievement is a top priority worldwide (Mutodi & Ngirande, 2014), therefore it is essential that we continue to investigate new avenues to increase mathematical success in the classroom. Blogging is a new avenue that has the potential to increase mathematical communication and build relational learning through writing and collaboration while also increasing mathematical confidence, collaboration and basic mathematical knowledge.

1.2 Gaps and/or Problem Areas

The majority of research on blogging in the mathematics classroom has occurred in post-secondary educational settings (Alterman & Larusson, 2013; Davi et al., 2007; Deng & Yuen, 2011; Ellison & Wu, 2008; Johnson & Green, 2007; Nehme, 2011; Williams & Jacobs, 2004) with only one study in a secondary school environment (McBride & Luehmann, 2008). Although higher education studies have identified benefits and challenges of blogging with respect to student learning, the results cannot be readily generalized to secondary school students as their learning environment and needs are very different from students in post-secondary settings. In addition, no research could be found examining the differential impact of blogging on different ability groups.

1.3 Research Goal

The current study investigates the use of blogging in grade nine applied and academic classrooms to support communication of mathematical thinking. Specifically, the

goal of the research was to identify student attitudes toward blogging, and the potential of blogging to improve mathematical confidence and learning performance were assessed.