Exploring Wellness Practices with Pre-Service Teachers to Manage Mathematics Anxiety

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Abstract

In this work-in-progress paper, we discuss our development and implementation of wellness strategies to address pre-service teachers’ mathematics anxiety. Mathematics anxiety is prevalent in all levels of education, and often inhibits students’ abilities to learn mathematics. Emerging research in mindfulness, Cognitive Behavioural Therapy, and other wellness techniques are making their way into classrooms to remedy long-held feelings of anxiety. In our study, we analyzed current research on how wellness approaches can be harnessed in the mathematics classroom to mitigate the onset and effects of mathematics anxiety, and then implemented these approaches in a mathematics education course for pre-service teachers at a Canadian faculty of education. We are collecting pre-and post-course surveys to investigate how the strategies affect the mathematics anxiety of pre-service teachers.

1. Introduction

Anxiety has been defined as “an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure” [1]. Mathematics anxiety (MA) is a subset of anxiety that “hinders a person’s ability to learn and perform math activities” [2] (p.2). The concept of MA was first articulated (as “number anxiety”) in 1957 by Dreger and Aiken [3], is often associated closely with attitudes (e.g., [4]) and a wealth of research (e.g., [5], [6], [7], [8], [9]) has been conducted on this topic since, with students and teachers at various educational levels and in various geographic locales. Important here, researchers have found that elementary teachers tend to have high levels of mathematics anxiety, and these anxieties can be passed along to students, which can impact their achievement in mathematics (e.g., [5], [10], [11]).

With regard to interventions to address mathematics anxiety, current literature on MA tends to focus on in interventions that place emphasis on instructional or classroom changes [2]. Typically, these suggestions offer alternative to the traditional lecture. They include the use of manipulatives and highlighting, as well as using students’ mathematical ideas. Though these practices help create a supportive learning environment, “the interventions seem to neglect the physiological and emotional aspect of math anxiety” [2] (p.4).

Addressing mental health and emotions in mathematics learning has become an integral component of recent initiatives. For example, the
Ontario Ministry of Education is very explicit in their renewed mathematics strategy that they are committed to supporting teachers to develop and implement wellness practices [12]. These wellness practices include strategies that help students manage and cope with emotions and address mental health. Both Cognitive Behavioural Therapy (CBT) and mindfulness have been used to manage emotions and treat mental health issues ([13], [14]). Specifically, both are utilized as treatments to remedy the symptoms of anxiety ([13], [14]).

Unfortunately, much of the literature around anxiety and psychological and emotional interventions does not encompass MA [2]. Consequently, we are conducting a study where we have developed these interventions for the specific context of mathematics learning. In this work, we connect two prominent research themes: mathematics anxiety and wellness practices (such as CBT and mindfulness). Our goal is to connect what is known about the CBT and mindfulness in an effort to alleviate mathematics anxiety in classrooms. Guiding the proposed research are the core questions: How can CBT and wellness strategies be developed to specifically address mathematics anxiety? How do CBT and mindfulness strategies influence pre-service teachers’ mathematics anxiety?

More specifically, we are aiming to achieve the following objectives:
1. Develop anxiety interventions, such as CBT and mindfulness, to address mathematics anxiety.
2. Enact the interventions in a mathematics methods course for pre-service teachers
3. Measure pre-service teachers’ mathematics anxiety before and after the interventions, via surveys.

This research is currently in progress. Data collection will be complete in April 2018 and we will share our preliminary results at the conference in June.

2. Related Research

Here, we provide an overview of the research on mathematics anxiety and CBT and weave together literature in mathematics education and CBT.

2.1 Mathematics Anxiety

There are various ways of measuring mathematics anxiety, several different definitions accompanying these studies, and many causes of mathematics anxiety. Most definitions of MA contain at least one of the following components: feelings of helplessness, stress, panic, fear, mental disorganization, tension, and apprehension in relation to mathematics ([2], [15], [16], [17]).

There are various causes for mathematics anxiety including parental influences, negative past experiences in mathematics, avoidance of mathematics, and teachers passing on mathematics anxiety to their students ([18], [19], [2]). Researchers (e.g., [5], [11], [19]) suggest that MA is passed from mathematically anxious teachers to students because these teachers tend to teach differently (e.g., [19]). For example, math anxious teachers tend to devote less class time to mathematics learning and their pedagogy typically emphasizes rote learning and individual seat work as opposed to developing students’ relational understanding ([20], [19]). Additionally, students can develop MA through their teacher’s example, particularly in same-gender pairings, where gender modelling occurs (e.g., [5]).

Although researchers have used several instruments to measure MA, the Mathematics Anxiety Rating Scale (MARS; [15]) is one of the most frequently used scales to measure MA. MARS is an instrument containing 98 five-point Likert-scale items that researchers use to explore issues related to everyday life and academic situations pertaining to mathematics [15]. Scores range from 98 to 490, where higher scores correlate with higher levels of MA. The statements in the MARS survey were created in 1972 and recent researchers have begun to shorten the MARS, creating the RMARS, to make a more efficient index [21].

2.2 Cognitive Behavioural Therapy and Mindfulness

Cognitive Behavioural Therapy (CBT) is a therapeutic strategy that addresses the cognitive and behavioural aspects of anxiety, by restructuring schemas in order to manage emotional responses to stimuli [22]. Beck asserts that anxiety can occur when an individual has a maladaptive response due to a misperception of a situation [22]. The occurrence of a negative situation may also create predictive behaviour, and the assumption that something negative will be happening in the future [22].

The literature around CBT shows that it significantly reduces anxiety and depression in students, ultimately improving their performance [23]. CBT aims to teach
individuals tools, such as identifying irrational thoughts and beliefs and creating replacement thoughts to challenge problematic schemata [22]. According to Alexander & Tatum, those who underwent CBT continued to catch and dispute thought distortions beyond their initial treatments [14].

Mindfulness is another cognitive practice, focussing on managing ruminations and thoughts that exacerbate anxieties [14]. Techniques include controlled breathing and relaxation practices that help individuals live in the moment and harness their emotions [14]. This practice is similar to CBT in that it involves taking control of one’s thoughts, and selecting behaviours that elicit calm emotions.

2.3 Mathematics Education and CBT

Finlayson states that, teachers should be able to identify symptoms and indicators of MA in their students [24]. These notions complement the process presented through CBT whereby irrational thoughts, anxious behaviours, and feelings must be identified and discussed [13]. Furthermore, these ideas are complementary to those presented through the work of Dweck [25] and Boaler [26], who encourage educators to celebrate mistakes as evidence of learning because these will make students feel more comfortable when doing mathematics.

Similarly, Kulkin suggests that as educators, we must address students’ emotional needs as part of their learning needs: “Once their emotional block is addressed, students are less likely to impose self-limiting beliefs that they don’t ‘fit the math mold’ or ‘can’t learn math.’” [27] (p.23) The data from that study shows a high correlation between students’ emotions about math and a reduction in MA. Therefore, if we can address how students feel about mathematics, we can help reduce their anxiety. CBT offers two routes to help students manage their feelings; through changing their beliefs and emotions [22].

3. Methods

We have decided to have volunteer pre-service teachers from all grade levels as our research participants because MA teachers are one of the leading causes of mathematics anxiety in students. The study is taking place in four sections of elective mathematics education courses. Pre-service teachers are required to take one mathematics elective, but have the choice from three courses. Each section of a mathematics elective course is meeting once a week for 12 weeks.

A survey was administered to all pre-service teachers enrolled in elective courses (approximately 200 pre-service teachers). The survey comprised of seven Likert-scale statements with answers ranging from “Strongly Agree” to “Strongly Disagree” and three open-ended questions. The Likert-scale statements were either taken directly from Kulkin’s study or adapted from MARS [27]. For instance, MARS includes the statement “realizing that you have to take a number of mathematics classes to fulfill the requirements of your major” and our adapted statement on our survey is “I am excited to take the required math courses of my program”. As anxiety is often considered to be related attitude, we included an open ended question similar to ones used by other researchers (e.g., [28]) to examine students’ attitudes toward mathematics. Specifically we included the question: “How would you describe your relationship with math?”

We chose to ground our survey in Kulkin’s work because she administered her survey to young students and the hope was for the pre-service education students to be able to use the same statements (from our survey) in their own classes to identify math anxiety in their students [27]. As there was limited time to conduct the survey within the 120 minutes of instruction time per session, we decided to have a shorter survey than MARS.

To analyze differences, the survey was administered as a pre-course survey during the first week of classes (early January 2018); the same survey will be administered as a post-course survey at the end of the 12-week semester. A two-way analysis of variance (ANOVA) statistical test will be conducted to examine pre-course and post-course differences in reported levels of MA.

The open-ended questions will be analyzed through an emergent coding process ([29], [30]). We will begin by increasing our familiarity with the responses provided through carefully reading the surveys multiple times. Next, we will independently code the responses using an emergent process. Additionally, the first two authors will discuss the codes with the other authors of this paper to determine overlaps or additional categories. Once a list of codes is developed, all authors will re-code the data together.
3.1 Example of CBT Lesson

We used a series of CBT group lessons that were designed to address social anxiety [31] and adapted the lessons to address MA.

In the original CBT lesson that addressed social anxiety, students were given a list of anxious thoughts and beliefs, taken from Antony and Swinson [32]. Students then classified these irrational thoughts into categories provided by Merrell, e.g. Black & White thinking [33]. In the MA adapted version, lesson two focused on assisting pre-service teachers in addressing irrational thoughts and beliefs that relate to mathematics. The pre-service teachers were asked to journal MA thoughts, feelings, and behaviours that they noticed in themselves and their students over the week prior to the lesson. The lesson began by pre-service teachers selecting thoughts and beliefs that they felt were irrational and compiled these ideas to create a master list. The master list was classified using the handout by Merrell to determine thinking errors and dispute irrational thoughts [33]. Lastly, the pre-service teachers were asked to dispute their irrational thoughts by creating replacement thoughts, e.g. practicing this skill will help to get better at it. Pre-service teachers were asked to consider focusing on documenting where they have used replacement thoughts in their journaling for the following week.

4. Conclusion

The proposed research will inform educators of practical, research-inspired strategies to reduce MA during the learning and teaching of mathematics. Our hopes are to extend the research on the strategies currently situated within wellness and MA research. We believe that this study may help assist educators to manage MA in their classroom, addressing concerns beyond the level of structural change, and address the wellness of students in mathematics classrooms.

5. References


