Reducing Pre-service Teachers' Public Speaking Anxiety through a Virtual Reality Intervention

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ABSTRACT

It is well documented that teachers experience a plethora of emotions in their work including anxiety. While most research has focused on anxiety regarding curricular areas, teachers may also experience public speaking anxiety. Unlike curricular anxiety, public speaking anxiety permeates all aspects of a teacher's work, thereby potentially exerting negative consequences for their own well-being and their students' learning. This multi-method pre-post single-group pilot study aimed to explore sources of pre-service teachers' public speaking anxiety and to test the utility of a virtual reality (VR) intervention to reduce public speaking and social appearance anxiety. Participants (n = 7) described three sources of public speaking anxiety: communication difficulties, expectations of others, and judgment of others. Participants delivered three lessons over a period of about 5 weeks to a VR classroom simulated by the Virtual Orator© program. There were 22 student avatars representing various genders and ethnicities. Avatars were programmed to be informal in their actions and generally friendly, but they could not interact with the participant. The results of paired-samples t-tests showed that public speaking and social appearance anxiety were significantly reduced following the VR intervention. Participants described the VR as realistic and useful for real life. We discuss the results from the perspective of the control-value theory of emotions with implications for teacher education programs.

Introduction

Pre-service teacher education programs are brimming with knowledge, skills, and attitudes that beginning teachers need to accumulate before licensure. In addition to these common curricular competencies, some pre-service teachers need support in areas not formally addressed by their programs: public speaking may be one such area. While all pre-service teachers benefit from strong communication skills, only some pre-service teachers face public speaking anxiety that may interfere with their ability to teach well (see Byrne et al., 2012). The purpose of the current pilot research study was to explore sources of pre-service teachers' public speaking anxiety and to evaluate the utility of a virtual reality (VR) intervention for reducing pre-service teachers' public speaking and social appearance anxiety.

Teaching and Anxiety

Darling-Hammond (2006) describes three components that contribute to a high-quality teacher education program: coherence between courses and clinical work, links between theory and practice in supervised clinical work, and proactive relationships with schools that serve diverse learners. This framework deals directly with the competencies pre-service teachers need to develop, but it does not provide space for addressing anxieties that may be relevant to the profession. As the growing body of research on teachers' emotions attests, teachers experience a wide range of emotions while teaching that influence their own well-being and their professional aptitudes (Frenzel et al., 2021). Although researchers use any number of theoretical approaches to study teacher emotions, Pekrun's (2006) control-value

theory remains one of the most common. According to Pekrun (2006), anxiety occurs when situations are appraised as highly valuable but low in control. For teachers, anxiety has been found regularly in the curricular area of mathematics (Ramirez et al., 2018; Schaeffer et al., 2021) and in regards to technology implementation (Henderson & Corry, 2021) - two areas that are often viewed as very important (i.e., high value) but that teachers may feel underprepared to deliver well (i.e., low control). In addition to the emotional labour attached to regulating their anxiety in a profession that has high display rules (Chang, 2020), teachers' anxiety has been shown to be positively associated with students' levels of anxiety above and beyond the effects of instructional practices (Becker et al., 2014) and to be negatively associated with the quality of student-teacher relationships (Frenzel et al., 2020). Arguably, anxiety attached to curricular expertise or instructional practices can be somewhat contained - an anxious mathematics class does not have to spill over into social studies. However, if teachers experience public speaking anxiety, the ramifications transcend any specific curricular area because all teaching requires public speaking.

According to the American National Institute of Mental Health, the fear of public speaking is known as glossophobia and is estimated to affect as much as 73% of the population (Montopoli, 2017). Bodie (2010) defines public speaking anxiety as "a situation-specific social anxiety that arises from the real or anticipated enactment of an oral presentation" (p. 72). We would further suggest that public speaking anxiety occurs when the oral presentation is appraised as high value and low control, as might be the case when teachers are responsible for imparting curricular content to students. Although most teachers appear to be able to speak with ease, Daud et al. (2019) observed that some pre-service teachers experience public speaking anxiety during their professional training and in their teaching activities. Additional empirical research on teachers' public speaking anxiety is sparse; however, its existence is reinforced by Reddit threads (https://www.reddit.com/r/TEFL/comments/9hanpv/any_teachers_here_with_social_anxiety_or_public), youtube videos (https://www.youtube.com/watch?v=7_zJPncIgC8), and countless blog posts offering both consolation and practical suggestions (Garcia, 2021; Goldberg, 2016). Aside from the negative personal toll of having to manage public speaking anxiety as a core component of their work, teachers who are anxious about speaking in front of students have been found to forget pertinent material when speaking to their students (Byrne et al., 2012) meaning that just like anxiety in a particular curricular area, teachers' public speaking anxiety may have detrimental effects on students' learning. Despite this, very little empirical research exists on why pre-service teachers experience public speaking anxiety, and no intervention work has been designed to support pre-service teachers specifically.

Treatments for Public Speaking Anxiety

Common treatments for clinical levels of public speaking anxiety include Cognitive therapy (CT; Anderson et al., 2016) and Cognitive Behavioral therapy (CBT; Safir et al., 2011) where the client is gradually exposed to feared social situations. Typically, exposure therapies include in-vivo and imaginal exposure. In-vivo exposure, that is, directly facing a feared object or situation or activity in real life, has been used to treat public speaking anxiety. In-vivo exposure allows individuals to experience public speaking in a controlled environment. However, in-vivo exposure requires coordination in terms of suitable venues and audiences, which can pose challenges to treatment time and cost. Likewise, if suitable audiences and venues are found, situational elements, including the reactions of others which cannot be controlled, may pose additional challenges to in-vivo treatment (Bouchard et al., 2014). Approaches to treatment for public speaking anxiety also include imaginal exposure or imagining the feared situation. Imaginary exposure can be facilitated through picture or video aids.

For subclinical public speaking anxiety, the most common recommendation is to practice. Indeed, groups such as Toastmasters International© were exclusively designed to help people overcome their fear of public speaking (see, e.g., Yee & Abidin, 2014). As a sub-clinical population, there are two ways in which pre-service teachers might have opportunities to practice public speaking: during their coursework and their practicum. As post-secondary students, pre-service teachers may have opportunities to practice public speaking during in-class presentations (Tsang, 2020); however, this type of speaking may differ from classroom teaching. For example, in teacher education classes, students may be more concerned about their academic performance and less about their professional teaching ability.

In fact, graded assignments like oral presentations motivate high-achieving students to continue to achieve high grades regardless of whether that goal overlaps with their learning (Schinske & Tanner, 2014). For struggling students, grading lowers interest in learning and enhances anxiety (Schinske & Tanner, 2014). As such, increasing the frequency of in-class presentations may not be an effective way of addressing pre-service teachers' public speaking anxiety in a way that carries into their professional work.

The second opportunity for addressing pre-service teachers' public speaking anxiety is during practicum placements. With the support of mentor teachers, pre-service teachers gain experience in planning instruction, teaching lessons, managing the classroom, assessing student progress and tailoring instruction to meet the needs of diverse learners. Currently, practicums are integral to all pre-service teacher education programs in Canada. Unfortunately, due to increasing enrolments and the limited availability of placements, pre-service teachers can be restricted in terms of accessing quality practicum experiences (Muir et al., 2013). In particular, there is limited support available to pre-service teachers during practicums due to the increased workloads of mentor teachers and their personal factors (Campbell & Uusimaki, 2006; Ralph et al., 2007). Even if opportunities are available, pre-service teachers might feel reluctant to discuss their public speaking anxiety due to feelings of embarrassment (Rickinson, 1998) and a strong desire to maintain appearances in the professional setting. Virtual reality (VR) may allow pre-service teachers to practice public speaking and minimize concern about maintaining social appearances (Reeves et al., 2021).

Virtual Reality Interventions

The purpose of virtual reality (VR) is to create immersive experiences that can be used to educate or entertain users. Regarding public speaking, VR allows users to experience situations similar to the real world, for example, by delivering an oral presentation in a virtual classroom. VR interventions typically involve a head-mounted display worn by users, which allows them to experience the 3D environment. Users experience the virtual environment by moving through space, examining objects from multiple viewpoints, and interacting with pre-programmed avatars. Previous research has shown that user experience and/or presence are related to treatment intervention outcomes (Wiederhold & Wiederhold, 2005). In particular, realistic environments influence user presence or the sensation of being in the environment, which has been shown to heighten emotional responses while using VR, including feelings of anxiety (Riva et al., 2007). Although VR has historically been resource-intensive (e.g., difficult to set up) and unaffordable, recent advances in technology have led to it becoming a more affordable treatment option (Maples-Keller et al., 2017).

Evidence Supporting VR Interventions

Previous research supports VR efficacy for fear of public speaking compared to traditional exposure techniques. Reeves, Curran, Gleeson, and Hanna (2021) meta-analyzed the effects of 11 VR exposure therapy interventions for public speaking anxiety consisting of a combined sample of 508 participants. They found an overall large significant effect for VR reducing public speaking anxiety (-1.39, Z = 3.96, $p < .001$) relative to control groups. Moreover, VR performed almost as well as in vivo exposure therapies for public speaking. The effect sizes persisted regardless of if the intervention was one or multiple sessions (range 4-12 sessions) and the diagnostic severity of public speaking anxiety. The authors caution that the number of studies in these finer-grained analyses is small and should be treated cautiously.

Empirical evidence also supports the efficacy of VR for public speaking anxiety in student populations specifically. For example, Hinojo-Lucena and colleagues (2020) conducted a systematic review of published work from 1997 to 2019 examining VR as a treatment for public speaking anxiety in high-school and university students. Thirteen articles with a combined sample size of 481 students were indexed from two databases. Eleven studies had university students as a sample compared to 2 studies where the population was high school students. In three of the studies, students were diagnosed with social anxiety disorder, while the rest showed symptoms but had not been formally diagnosed. The duration of treatment ranged from one day to three months (M = 20.25 days) while the number of

treatment sessions ranged from 1 to 12 sessions. Session length ranged from 5 minutes to 90 minutes (M = 19.76; SD = 23.26). The intervention environments included: virtual classroom (46.15%), auditorium (38.46%), everyday situations (7.69%), meeting room (7.69%), wedding reception (7.69%), and party and presentation environment (7.69%). Regarding their effectiveness, 10 interventions showed a positive effect (76.92%), while three studies showed a zero effect (23.07%) for VR as a treatment of public speaking anxiety.

VR in Teacher Education

Although the body of literature concerning VR in teacher education is limited, some research studies show that teacher educators have begun experimenting with the use of VR to supplement pre-service teachers' learning and as part of their professional training (see, e.g., Billingsley et al. 2019 for review). For example, Judge et al. (2013) investigated pre-service teachers' use of behavior management strategies in a simulated classroom. Pre-service teachers interacted with virtual avatars whose attributes were controlled by an external research assistant. Their results indicated that the majority of participants evidenced an increase in the use of differential reinforcement strategies to enhance student engagement in the classroom. Pre-service teachers also commented on the benefits of the simulator in making them "more aware of the options [teachers] have when dealing with student disruptions."

Similarly, Gregory and colleagues (2011) researched the experiences of pre-service teachers who undertook a teaching role-play activity in a virtual world. In the study, participants were tasked with teaching a seven-minute lesson in VR. When not teaching, pre-service teachers were asked to role-play "good" students (e.g., teacher pleasers) or "bad" students (e.g., back talkers) while other pre-service teachers delivered their lesson. The study found that 40% of the pre-service teachers found the activity to be useful. Unfortunately, some pre-service teachers were unable to role-play the part of the teacher due to technical difficulties. Of these teachers, the vast majority indicated that they did not find the activity useful, suggesting the need to explore how pre-service teachers experience a VR classroom, particularly now that VR has become more commonplace.

The Current Study

Virtual Reality interventions for public speaking anxiety have yet to be studied amongst pre-service teacher populations. VR has several advantages over other treatment modalities, including eliminating the need to secure mentor teachers and suitable audiences. Furthermore, VR may reduce pre-service teachers' concerns about maintaining appearances in front of familiar people (Clemmensen et al., 2020) and reduce the chances of embarrassment (North et al., 1997). Thus, the purpose of this pilot study was to examine pre-service teachers' utility of a three-session virtual reality intervention. We posed the following research questions: (1) What sources do pre-service teachers describe as contributing to their public speaking anxiety? (2) Is a three-session VR intervention capable of reducing pre-service teachers' public speaking and social appearance anxiety? (3) What are pre-service teachers' experiences of the VR intervention?

Methods

Participants

Data were collected from a sample of pre-service teachers at a midwestern Canadian Research-Intensive University. Pre-service teachers who self-identified as having public speaking anxiety were eligible to participate in the study. Seven pre-service teachers (5 women, 2 men, age 19-24, M = 20.86) completed the full intervention consisting of three sessions. Three participants identified as Caucasian, two identified as Latin American, one identified as East Indian/Caucasian, and one identified as Southeast Asian. Five participants were enrolled in the secondary education

program, and 2 were enrolled in the elementary education program. Two participants were enrolled in their second year, three in their third year, one in their fourth year, and one student was enrolled in their fifth year of studies. None of the participants had any teaching practicum experience at the time of the intervention. We used a multi-method pre-post single-group design that was approved by the Research Ethics Board at the University of Alberta Pro00086675.

Procedure

We recruited pre-service teachers via posters in the Education Building and online through the Education Student Association and Undergraduate Student listservs. Pre-service teachers clicked the posted link and completed a pre-test questionnaire before deciding whether or not to pursue the VR intervention. The researchers contacted interested participants via email and provided information regarding the procedure for the VR intervention portion of the study, which consisted of three sessions.

Once they decided to participate, in advance of each session, the researchers sent the participant a preselected video on which to design a lecture that they would deliver to a VR classroom. In addition to delivering their prepared lesson in VR, participants completed a combination of questionnaires and/or an exit interview for each session. Session 1 began with a pre-VR interview, followed by participants delivering a lesson on severe weather in VR and an exit interview. In Session 2, participants delivered their lesson about climate change in VR, followed by an exit interview. In Session 3, participants delivered their lesson on zodiac constellations in VR, followed by an exit interview and the post-test questionnaire. We chose the lecture content rather than allowing participants to teach in their subject areas to control for pre-existing comfort with the topic. Each VR session lasted approximately 15-20 minutes. VR sessions were scheduled based on participant availability and took place over five months, from October 2019 to February 2020. On average, participants finished the in-person sessions over five weeks.

Measures

We collected demographic data from participants and a combination of open-ended and Likert-scale questions to answer our three research questions.

Background Questions

Before the VR intervention, participants identified their age, gender, ethnic background, program, year of studies, and if they had completed any practicum placements. This information was used to describe the sample (see above). To get a sense of how anxious participants were, we asked them to indicate their public speaking anxiety on a "fear thermometer" from 0 to 100 and to indicate if they would value opportunities to practice public speaking before their practicum (yes, no). In the Session 1 pre-VR interview, we orally asked participants, "What makes you most anxious about speaking in front of students?" and recorded their responses.

Questionnaires

To measure the impact of the VR intervention on public speaking anxiety (Bartholomay & Houlihan, 2016) and social appearance anxiety (Hart et al., 2008), participants completed self-report scales before the first VR session and after the third VR session. Specifically, participants completed the 17-item Public Speaking Anxiety Scale (PSAS; Bartholomay & Houlihan, 2016) and the 7-item Social Appearance Anxiety Scale (SAAS; Hart et al., 2008). Participants responded to all items on a 5-point Likert scale 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Descriptive statistics are presented in Table 2. Despite strong reliability in existing studies, the PSAS demonstrated low reliability at the pre-

test and unacceptable reliability at the post-test (αs = .58 and .25). In response, we conducted separate principal component analyses on the PSAS pre-and post-test items. The results produced a 5-factor solution with eigenvalues > 1.0 for both surveys. Given the preliminary nature of the study, we focused on the first factor only, which had shared factor loadings > .60 for pre-and post-test items 1, 2, 3, and 10 explaining 36% of the variance for pre-test responses and 33% of the variance for post-test responses. Thus, we used this 4-item scale in all our analyses.

Intervention

Participants delivered three lessons to a VR classroom. This study used the Virtual Orator© program to simulate a school classroom. Virtual Orator© enables researchers to adjust audience size and avatar behavior to fit training needs and purposes. For the purpose of this study, we adjusted audience behavior to mimic the behavior of older students in a classroom as we did not have access to elementary student avatars at the time of the pilot. There were 22 male and female students in attendance representing various ethnicities for each session. The student avatars were informal in their actions and were friendly toward the pre-service teachers. The audience was generally unconcentrated due to frequent distractions, including students talking to one another and noise outside the classroom. However, some of the student avatars showed interest and engagement by nodding and maintaining eye contact. The student avatars could not raise their hands or ask or answer questions when asked.

Figure 1: *Image of the Virtual Reality Classroom from the Back of the Classroom*

VR Experience Questions

To understand participants' experiences with the VR classroom, they completed an adapted VR Presence scale (Witmer & Singer, 1998) after the third VR session and responded to three open-ended questions. We selected four presence items that were most relevant to our VR classroom and procedure, and participants responded to the items on a 7-point Likert scale (see Table 3). The open-ended questions asked participants to describe their VR experience in terms of the presence of the researchers, their comfort level, and its utility for real life.

Plan for Analyses

We conducted our data analysis in three stages. We examined pre-service teachers' responses to the various background questions to answer our first research question. Two research assistants independently coded the responses to the open-ended question, "What makes you most anxious about speaking in front of students?" The coders compared and discussed any discrepancies in their coding until consensus was achieved. To answer our second research question, we conducted paired samples *t*-tests to test for significant decreases (one-tail) on the Public Speaking Anxiety Scale (PSAS; Bartholomay & Houlihan, 2016) and Social Appearance Anxiety Scale (SAAS; Hart et al., 2008) following the VR intervention. Finally, to answer our third research question about the VR experience, we examined participants' responses on the Adapted VR Presence scale items (Witmer & Singer, 1998). We took a content analysis approach to the three open-ended questions that stayed close to participants' words, with language viewed as a mechanism for communication rather than a structure to be interpreted (Kim et al., 2017).

Results

Pre-service Teachers' Public Speaking Anxiety

All seven participants (100%) indicated that they would practice public speaking before their practicum placement if given a chance. Their public speaking anxiety on the fear thermometer ranged from 10 to 80. In terms of their oral responses to the question, the coders identified three sources of public speaking anxiety, as summarized in Table 1.

Table 1. *Sources of Public Speaking Anxiety*

Theme	Description	Sample Statement
Communication difficulties	Experiencing communication difficulties when speaking in front of students.	Um, normally forgetting what I am trying to say, and just like looking like I don't know the material very well.
Expectations of others	Fear of not meeting the expectations of other people when speaking in front of students.	I guess that it's the pressure that they expected you to do everything well.
Judgment of others	Fear of judgment from other people when speaking in front of students.	I want to teach junior high they tend to be quite judgmental, and so making a mistake in front of them gives them plenty of opportunity to judge you and make you know their judgment.

Pre-service teachers commented on *communication difficulties* as being one of their primary sources of anxiety when speaking in front of students. For example, one pre-service teacher commented, "you know the idea like going blank and forgetting what you are going to say because of the pressure." Aside from forgetting what they had planned to say, several pre-service teachers expressed the fear of not being able to explain the subject matter clearly. For example, one pre-service teacher expressed concerns over "being able to deliver [the subject matter] without like stuttering and stuff," while another worried about their "thoughts not coming out coherently" and "not going to be able to explain, um what you need to explain properly, that it will be all jumbled up."

Pre-service teachers also commented on the *expectations of others* as being a source of anxiety when speaking in front of students. For example, one pre-service teacher commented, "they expect you to know what you are doing," while others mentioned, "that they expect you to do everything well" and "to know everything." Finally, several pre-service teachers expressed concerns about being *judged by others* when speaking in front of students. As an example, one pre-service teacher commented, "Um just like I guess if you were to make a mistake, especially at the grades I want to teach like junior high, they tend to be quite judgmental and so making a mistake in front of them gives them plenty of opportunity to judge you." Similarly, another pre-service teacher commented, "I'm scared that they are going to judge me."

Pre-service teachers also expressed concerns about not being prepared for their lesson, not being familiar with the subject matter, having difficulties with classroom management, and being at the center of the students' attention when speaking in front of students as contributing to their public speaking anxiety.

Utility of a Brief VR Intervention

Our results indicated significant changes in participants' public speaking anxiety and social appearance anxiety after the three-session VR intervention (see Table 2). In particular, participants experienced lower public speaking anxiety and lower social appearance after the three sessions of the VR intervention compared to before the intervention.

Table 2. *Mean differences in mindsets and public speaking anxiety at pre-test and post-test*

Variables	Pre-test			Post-test			*t*-statistics	
	α	*M*	*SD*	α	*M*	*SD*	*t(df)*	*p*
Public Speaking Anxiety	.79	4.11	.59	.80	3.25	.89	2.20(6)	.035
Social appearance anxiety	.92	3.10	1.04	.91	2.41	1.02	3.85(6)	.004

Note. One-sided *p-value*

Pre-service Teachers' Experiences of the VR Intervention

From a quantitative perspective, participants had relatively high scores on the Adapted VR Presence Scale items (Witmer & Singer, 1998). Participants scored above the midpoint on all items, with the average highest agreement with the item "How quickly did you adjust to the virtual environment experience." Individual scores and means for the seven participants are displayed in Table 3.

Based on their oral responses, we determined each participant's overall agreement or disagreement with each question and examined the content of their responses. In terms of agreement, pre-service teachers were split on the effect of having the researchers in the room with them. Three out of the seven pre-service teachers commented that they did not feel more anxious having the researchers in the room. Four pre-service teachers commented that they did feel more anxious having researchers in the room. Some reasons for heightened anxiety included, "I think if it were just me in this room alone, it would have been a little easier," while another pre-service teacher commented, "It is still a little bit nerve-wracking cause like you know there is someone else in the room still with you."

All seven of the pre-service teachers explained ways that they liked the intervention. Four pre-service teachers commented on the level of *realism of the VR classroom* relative to a classroom. One pre-service teacher commented, "Yah, it kind of gets you first-person perspective, from like what it would actually be like with like students like looking at you." Similarly, another pre-service teacher mentioned, "I feel like it creates like an atmosphere where like it feels pretty real like there are students right in front of you." The realism of the student avatars was also a major

contributor. For instance, one pre-service teacher commented, "It looked like actual students doing their own thing, it looked like some of them weren't paying attention, some of them looked bored, some of them looked like they were paying attention." Even though they overall liked the program, some pre-service teachers described ways to improve the Virtual Orator© program. For example, one pre-service teacher commented, "It doesn't replicate the real scenario perfectly," while another commented, "It's not as convenient because you can't really move around and do like activities where the students are like discussing with you."

All seven pre-service teachers described how they believed VR intervention would benefit them in practice. Four pre-service teachers commented on the benefit of having *more opportunities* to practice public speaking. One pre-service teacher commented, "I think it was a good practice just to come in and talk in front of people, or like even if they aren't real people just having something there to you know help yourself prepare to feel what it's like to have to teach a lesson." Similarly, another pre-service teacher expressed, "Any time you are practicing lecturing or speaking it's going to help."

Table 3. *Participants' Individual Experiences of the Brief VR Intervention*

Participant:	A	B	C	D	E	F	G	*M*	*SD*
Adapted VR Presence Scale – Likert Questions									
How quickly did you adjust to the virtual environment experience? Anchors 1 = Not At All 7 = Less Than One Minute	7	7	6	4	5	7	6	6	1.16
How proficient in moving and interacting with the virtual environment did you feel at the end of the experience? Anchors 1 = Not Proficient 7 = Very Proficient	7	6	6	5	7	5	5	5.86	.90
How involved were you in the virtual environment experience? Anchors 1 = Not Involved 7 = Completely Engrossed	7	5	6	7	6	5	4	5.71	1.11
How much did your experiences in the virtual environment seem consistent with your real-world experience? Anchors 1 = Not Consistent 7 = Very Consistent	7	6	5	4	4	3	6	5.00	1.41
Open-ended oral questions									
Did you feel more nervous having us [the researchers] in the room?"	No	No	Yes	Yes	Yes	Yes	No	--	--
Did you like the VR intervention?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	--	--
Will it benefit you in real life?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	--	--

Additionally, pre-service teachers commented on the benefit of VR in helping them to develop their teaching abilities. In particular, one pre-service teacher commented, "With actually teaching in a classroom timing is pretty unpredictable right so I think this is a good way to um practice actually sticking to your lesson plan as you plan it,"

while another commented on the benefit of being able to use VR to prepare them to, "[Deal] with uncertainty of what's going to happen, whether you have answers or not, interruptions, and distractions."

Discussion

In this discussion, we focus on three main findings. First, we discuss how our findings elaborate on pre-service teachers' sources of public speaking anxiety. Second, we describe the utility of the VR intervention and participants' responses to it. Third, we offer suggestions as to how teacher educators might incorporate our findings when developing training opportunities for pre-service teachers. In closing, we also discuss the limitations of our research and recommendations for future research.

Sources of Pre-Service Teacher Anxiety

The pre-service teachers who participated in this study described experiences with public speaking anxiety centered around *communication difficulties*. In particular, pre-service teachers worried that they would experience communication issues (e.g., stuttering, mind going blank, not being coherent) when speaking in front of their students. To some extent, pre-service teachers may view these communication difficulties as instances of low control (Pekrun, 2006) if they seem to be challenges they cannot predict or regulate. It is important to note that we do not have an objective measure of speaking performance. Thus, we are unable to comment on the extent to which the participants had actual communication difficulties. For example, Hasibuan and Irzawati (2020) found that English as a Foreign Language (EFL) university students' speaking anxiety was negatively correlated with their speaking performance, which measured pronunciation, grammar, vocabulary, and comprehension. Regardless of their communication skills, previous research has shown that self-confidence is positively correlated with speaking achievement (Tridinanti, 2018). As such, it may be beneficial to emphasize self-confidence regardless of public speaking skills during teacher education. This may also help with the social appearance component of public speaking anxiety that also came through as sources of anxiety.

More specifically, pre-service teachers explained that their public speaking anxiety was also rooted in *expectations of others* and being *judged by others,* both of which are related to social appearances. This finding is consistent with work by Kim and Kim (2004), who examined anxiety-provoking situations for foreign language pre-service teachers in Korea. Their study identified several sources of foreign language teaching anxiety, including being compared to native English-speaking teachers (i.e., expectations) and fear of negative evaluation by students. Research on teachers' emotions more generally reveals the importance of adhering to particular display rules according to which pleasant emotions such as happiness and enthusiasm are expected to be present even if faked, and unpleasant emotions such as anxiety and anger are expected to be hidden (Taxer & Frenzel, 2015). This may in part be because of the social appearance elements of negative emotions. Taxer and Frenzel (2015) additionally found that genuinely expressed anxiety, albeit not public speaking anxiety specifically, was the most detrimental emotional experience for teachers' mental and physical health. Insomuch as public speaking anxiety was somewhat conflated for teachers with anxiety related to curricular issues such as being under-prepared for their lesson, not being familiar with the subject matter, or having difficulties with classroom management, the relevance of all forms of teacher anxiety is important to consider in future research. Finally, from a control-value theory perspective, we would suggest that these types of descriptions indirectly convey that pre-service teachers' highly value (Pekrun, 2006) meeting their professional obligations.

VR Intervention: Effectiveness and Experience

Our results indicated that there were significant reductions in pre-service teachers' public speaking and social appearance anxiety after the three VR sessions. This extends current research findings with students in general (Hinojo-

Lucena et al., 2020) to pre-service teachers in particular. The success of the virtual reality intervention may, in part, be due to the pre-service teachers' experiences with the Virtual Orator© program. Pre-service teachers expressed that they enjoyed the *realism* of the virtual reality classroom compared to a conventional classroom. Moreover, pre-service teachers believed that the VR intervention was consistent with their real-world experience. Our findings support previous research by Witmer and Singer (1998), who found that the effectiveness of virtual reality is linked to the presence or sensation of its users. Similarly, previous research found that users of a digital mental health intervention for depression liked interventions with interactive relatable content and a game-like feel (Garrido et al., 2019). Overall, all seven pre-service teachers had positive perceptions of the Virtual Orator© program, even though they had ideas for how to improve it in the future. Although we assume that VR helped increase pre-service teachers' perceptions of control related to public speaking, we did not explicitly measure control and value appraisals (Pekrun, 2006). As VR continues to show success, understanding its mechanisms will become more important.

Moreover, all seven pre-service teachers indicated that they believed that the brief VR intervention would benefit them in practice. Together, these findings lend support to the control-value theory of emotions (Pekrun, 2006), which postulates that anxiety should be reduced by enhancing opportunities to experience control over a valued situation. Although we did not specifically ask participants if the VR intervention increased their sense of control, their reductions in public speaking anxiety and open-ended responses suggest that, indeed, it did help them feel more in control of a valued situation - namely speaking in front of students. Building additional control-enhancing elements directly into future VR interventions may make pre-service teachers more likely to access support with their public speaking anxiety in the future.

Implications for Practice and Research

Previous research suggests that teacher training programs could integrate VR into their education programs to support learning and aid in preparation for practicum (e.g., Gregory et al., 2011; Judge et al., 2013). Our results highlight an additional benefit of VR can be to reduce public speaking and social appearance anxiety. For students who suffer from these forms of anxiety, it might be beneficial for students to practice lessons in VR before delivering their lesson to a group of students. VR allows pre-service teachers to engage with the student avatars in a similar manner to which a teacher would engage with their students (e.g., posing questions, discussion facilitation, behavior management). Aside from students, teachers are required to speak with staff and parents. VR might provide pre-service teachers with the opportunity to practice public speaking in other anxiety-provoking situations, for example, discussing differences of opinion with colleagues or parents. Likewise, it may make these situations faced in real life feel less daunting.

The brief nature of this VR intervention, in terms of the number of sessions and overall time, makes this an economical choice for pre-service teachers and educators alike. It would be important, however, especially in light of recent meta-analytic results suggesting that at times one VR session is sufficient, for future research to consider testing the minimal number of exposures needed to help pre-service teachers gain confidence in public speaking. If it is possible for pre-service teachers to experience reductions in public speaking and social appearance anxiety through even one session, the utility of the technology further increases. Finally, it may also be essential to consider if the VR intervention could reduce other forms of anxiety, such as those attached to curricular areas. If, indeed, teachers' experiences of anxiety are more generalized than discrete, VR teaching experiences maybe even more valuable than currently understood. Overall, we suggest researchers continue to pursue VR not only for the treatment of public speaking anxiety but for other forms of anxiety that can be so detrimental to teachers' own wellbeing (Taxer & Frenzel, 2015) and their students' learning (Ramirez et al., 2018).

Limitations and Future Directions

While the results of this pilot study provide important insights on the experience and utility of VR for pre-service teacher education, four limitations should be mentioned. First, we recruited pre-service teachers from one Canadian

institution who chose to participate out of personal concerns with public speaking, meaning we have no evidence of the severity of their anxiety other than their own admission. Future research may want to partner with student services on campus to recruit students more proactively and to locate students with documented public speaking anxiety. Moreover, even for a pilot study, the sample is small in part because the study was interrupted by the public health restrictions that emerged in response to the COVID-19 pandemic.

Second, we did not include a control group, and the primary measure of public speaking anxiety (Bartholomay & Houlihan, 2016) had weak psychometric properties. Future research will want to include a control group to ensure that it is the VR experience itself that is reducing public speaking and social appearance anxiety but will require more proactive recruitment. Moreover, while the poor reliability of the PSAS may have been related to our small sample size, researchers may want to exert caution with this scale in the future.

Thirdly, although participants liked the Virtual Orator© program and it was effective in bringing about our hypothesized results, it lacked the ability for participants to interact with the student avatars. Although the current study was designed to imitate a classroom environment, future research using VR to address public speaking anxiety may benefit from interactive features. This would allow the user to engage with the student avatars in a similar manner to which a teacher would engage with their students (e.g., discussion facilitation). An investigation by Pertaub and colleagues (2001) showed the effectiveness of real-time social interactions (e.g., animated group comments) between VR avatars and participants. It may be the case that pre-service teachers would feel more prepared to enter the classroom having had the opportunity to teach and manage classroom behaviours. Relatedly, the Virtual Orator© program lacked access to young (i.e., elementary) student avatars. As realism is related to VR intervention effectiveness, other interventions would benefit from access to young student avatars, particularly for pre-service teachers training to teach elementary education.

Lastly, several pre-service teachers expressed that they did not know what to expect regarding the VR program before beginning. Although preparation materials were given (see Appendix A), it would be beneficial for future researchers to give a more detailed description of the VR programs they will be using to reduce participant anxiety about the VR program itself as it could inflate baseline measures. Likewise, some pre-service teachers experienced anxiety when asked to teach content that they were unfamiliar with. Adapting content in future studies to match pre-service teachers' content area could reduce pre-service teachers' anxiety prior to delivering their lesson(s) in VR.

Conclusion

In closing, the results from our study provide researchers and teacher educators with valuable information to support pre-service teachers who struggle with public speaking anxiety. Although it may not be a top priority in preparing pre-service teachers, public speaking anxiety may represent an additional stressor for some who choose the profession. Given VR seems to be a viable treatment for public speaking as well as a space to develop additional skills (Cheong, 2010; Gregory et al., 2011), we encourage teacher educators to consider its potential for significant impact in the field of pre-service teacher education.

References

Anderson, P. L., Edwards, S. M., & Goodnight, J. R. (2016). Virtual reality and exposure group therapy for social anxiety disorder: Results from a 4–6 year follow-up. *Cognitive Therapy and Research*, *41*(2), 230-236. https://doi.org/10.1007/s10608-016-9820-y

Bartholomay, E. M., & Houlihan, D. D. (2016). Public speaking anxiety scale: Preliminary psychometric data and scale validation. *Personality and Individual Differences, 94,* 211-215. https://doi.org/10.1016/j.paid.2016.01.026

Becker, E. S., Goetz, T., Morger, V., & Ranellucci, J. (2014). The importance of teachers' emotions and instructional behavior for their students' emotions – An experience sampling analysis. *Teaching and Teacher Education*, *43*, 15-26. https://doi.org/10.1016/j.tate.2014.05.002

Billingsley, G., Smith, S., Smith, S., & Meritt, J. (2019). A systematic literature review of using immersive virtual reality technology in teacher education. *Journal of Interactive Learning Research*, *30*(1), 65-90. Waynesville, NC: Association for the Advancement of Computing in Education (AACE). Retrieved June 2, 2021 from https://www.learntechlib.org/primary/p/176261/.

Bodie, G. D. (2010). A racing heart, rattling knees, and ruminative thoughts: Defining, explaining, and treating public speaking anxiety. *Communication Education*, *59*(1), 70-105. https://doi.org/10.1080/03634520903443849

Bouchard, S., Wiederhold, B. K., & Bossé, J. (2014). *Advances in virtual reality and anxiety disorders*. Springer.

Byrne, M., Flood, B., & Shanahan, D. (2012). A qualitative exploration of oral communication apprehension. *Accounting Education*, *21*(6), 565-581. https://doi.org/10.1080/09639284.2012.725636

Campbell, M. A., & Uusimaki, L. (2006). Teaching with confidence: A pilot study of an intervention challenging pre-service education students' field experience anxieties. *International Journal of Practical Experiences in Professional Education, 9*(1), 20-32.

Chang, M.-L. (2020). Emotion display rules, emotion regulation, and teacher burnout. *Frontiers in Education*, *5*, 90. https://doi.org/10.3389/feduc.2020.00090

Cheong, D. (2010). The effects of practice teaching sessions in second life on the change in pre-service teachers' teaching efficacy. *Computers & Education*, *55*(2), 868-880. https://doi.org/10.1016/j.compedu.2010.03.018

Clemmensen, L., Bouchard, S., Rasmussen, J., Holmberg, T. T., Nielsen, J. H., Jepsen, J. R., & Lichtenstein, M. B. (2020). STUDY PROTOCOL: EXPOSURE IN VIRTUAL REALITY FOR SOCIAL ANXIETY DISORDER - a randomized controlled superiority trial comparing cognitive-behavioral therapy with virtual reality-based exposure to cognitive behavioral therapy within vivo exposure. *BMC Psychiatry*, *20*(1). https://doi.org/10.1186/s12888-020-2453-4

Darling-Hammond, L. (2006). Constructing 21st-century teacher education. *Journal of teacher education*, *57*(3), 300-314.

Daud, A., Ras, F., Novitri, N., & Audia, C. P. (2019). Factors contributing to speaking anxiety: A case study of pre-service English teachers. *Journal of Educational Sciences*, *3*(3), 412. https://doi.org/10.31258/jes.3.3.p.412-422

Frenzel, A. C., Fiedler, D., Marx, A. K. G., Reck, C., & Pekrun, R. (2020). Who enjoys teaching, and when? Between- and within-person evidence on teachers' appraisal-emotion links. *Frontiers in Psychology*, *11*, 1092. https://doi.org/10.3389/fpsyg.2020.01092

Frenzel, A. C., Daniels, L., & Burić, I. (2021). Teacher emotions in the classroom and their implications for students. *Educational Psychologist*, *56*(4), 250-264.

Garcia, A. R. (2021). Can a teacher be afraid of public speaking? The answer is yes, of course! Retrieved April 25, 2022 from https://www.linkedin.com/pulse/can-teacher-afraid-public-speaking-answer-yes-course-rivera-garcia

Garrido, S., Millington, C., Cheers, D., Boydell, K., Schubert, E., Meade, T., & Nguyen, Q. V. (2019). What works and what doesn't work? A systematic review of digital mental health interventions for depression and anxiety in young people. *Frontiers in Psychiatry*, *10*. https://doi.org/10.3389/fpsyt.2019.00759

Goldberg, D. F. (2016). Teachers: How to overcome your fear of public speaking. Retrieved April 25, 20222 from https://www.teachingvillage.org/2016/11/10/teachers-overcome-your-fear-of-public-speaking-by-david-f-goldberg/

Gregory, S., Campbell, M., Knox, V., Dalgarno, B., Reiners, T., & Masters, Y. (2011). Changing directions through VirtualPREX: Engaging pre-service teachers in virtual professional experience. Changing demands, changing directions: Proceedings of the Ascillite 2011 Conference, Hobart, pp. 491-501.

Hart, T. A., Flora, D. B., Palyo, S. A., Fresco, D. M., Holle, C., & Heimberg, R. G. (2008). Development and examination of the Social Appearance Anxiety Scale. *Assessment*, *15*(1), 48-59. https://doi.org/10.1177/1073191107306673

Hasibuan, A. R., & Irzawati, I. (2020). Students' speaking anxiety on their speaking performance: A study of EFL learners. *Proceedings of the 3rd International Conference on Innovative Research Across Disciplines (ICIRAD 2019)*. https://doi.org/10.2991/assehr.k.200115.017

Henderson, J., & Corry, M. (2021). Teacher anxiety and technology change: A review of the literature. *Technology, Pedagogy and Education*, *30*(4), 573-587. https://doi.org/10.1080/1475939x.2021.1931426

Hinojo-Lucena, F., Aznar-Díaz, I., Cáceres-Reche, M., Trujillo-Torres, J., & Romero-Rodríguez, J. (2020). Virtual reality treatment for public speaking anxiety in students. Advancements and results in personalized medicine. *Journal of Personalized Medicine, 10*(1), 14. https://doi.org/10.3390/jpm10010014

Judge, S., Bobzien, J., Maydosz, A., Gear, S., & Katsioloudis, P. (2013). The use of visual-based simulated environments in teacher preparation. *Journal of Education and Training Studies*, *1*(1). https://doi.org/10.11114/jets.v1i1.41

Kim, S.Y., & Kim, J. H. (2004). When the learner becomes a teacher: Foreign language teaching anxiety as an occupational hazard. *English Teaching*, *59*(1), 165-186.

Kim, H., Sefcik, J. S., & Bradway, C. (2017). Characteristics of qualitative descriptive studies: A systematic review. *Research in nursing & health*, *40*(1), 23-42.

Maples-Keller, J. L., Bunnell, B. E., Kim, S.-J., & Rothbaum, B. O. (2017). The use of virtual reality technology in the treatment of anxiety and other psychiatric disorders. *Harvard Review of Psychiatry*, *25*(3), 103-113. https://doi.org/10.1097/hrp.0000000000000138

Montopoli, J. (2017, February 20). *Public speaking anxiety and fear of brain freezes*. National Social Anxiety Center. Retrieved April 27, 2022, from https://nationalsocialanxietycenter.com/2017/02/20/public-speaking-and-fear-of-brain-freezes/

Muir, T., Allen, J. M., Rayner, C. S., & Cleland, B. (2013). Preparing pre-service teachers for classroom practice in a virtual world: A pilot study using Second Life. *Journal of interactive media in education, vol. Spring Issue.*

North, M. M., North, S. M., & Coble, J. R. (1997). Virtual reality therapy: An effective treatment for psychological disorders. In: Riva G., editor. *Virtual Reality in Neuro-Psycho-Physiology*. Ios Press.

Pekrun, R. (2006). The control-value theory of Achievement Emotions: Assumptions, corollaries, and Implications for Educational Research and Practice. *Educational Psychology Review*, *18*(4), 315-341. https://doi.org/10.1007/s10648-006-9029-9

Pertaub, D.-P., Slater, M., & Barker, C. (2001). An experiment on fear of public speaking in virtual reality. *PsycEXTRA Dataset*. https://doi.org/10.1037/e705412011-025

Ralph, E., Walker, K., & Wimmer, R. (2007). The practicum in professional education: Pre-service students' experiences. *Transformative Dialogues: Teaching & Learning Journal*, *1*(2), 1-17.

Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Math anxiety: Past research, promising interventions, and a new interpretation framework. *Educational Psychologist*, *53*(3), 145-164. https://doi.org/10.1080/00461520.2018.1447384

Reeves, R., Curran, D., Gleeson, A., & Hanna, D. (2021). A meta-analysis of the efficacy of virtual reality and in vivo exposure therapy as psychological interventions for public speaking anxiety. *Behavior Modification*, 0145445521991102.

Riva, G., Mantovani, F., Capideville, C. S., Preziosa, A., Morganti, F., Villani, D., Gaggioli, A., Botella, C., & Alcañiz, M. (2007). Affective interactions using virtual reality:The link between presence and emotions. *Cyberpsychology & behavior: the impact of the Internet, multimedia and virtual reality on behavior and society, 10*(1), 45. https://doi.org/10.1089/cpb.2006.9993

Rickinson, B. (1998). The relationship between undergraduate student counselling and successful degree completion. *Studies in Higher Education*, *23*, 95-102.

Safir, M. P., Wallach, H. S., & Bar-Zvi, M. (2011). Virtual reality cognitive-behavior therapy for public speaking anxiety. *Behavior Modification*, *36*(2), 235-246. https://doi.org/10.1177/0145445511429999

Schaeffer, M. W., Rozek, C. S., Maloney, E. A., Berkowitz, T., Levine, S. C., & Beilock, S. L. (2021). Elementary School Teachers' math anxiety and students' math learning: A large-scale replication. *Developmental Science*, *24*(4). https://doi.org/10.1111/desc.13080

Schinske, J., & Tanner, K. (2014). Teaching more by grading less (or differently). *CBE-Life Sciences Education*, *13*(2), 159-166. https://doi.org/10.1187/cbe.cbe-14-03-0054

Taxer, J. L., & Frenzel, A. C. (2015). Facets of teachers' emotional lives: A quantitative investigation of teachers' genuine, faked, and hidden emotions. *Teaching and teacher education*, *49*, 78-88.

Tridinanti, G. (2018). The correlation between speaking anxiety, self-confidence, and speaking achievement of undergraduate EFL students of private university in Palembang. *International Journal of Education and Literacy Studies*, *6*(4), 35. https://doi.org/10.7575/aiac.ijels.v.6n.4p.35

Tsang, A. (2020). The relationship between tertiary-level students' self-perceived presentation delivery and public speaking anxiety: A mixed-methods study. *Assessment & Evaluation in Higher Education*, *45*(7), 1060-1072.

Wiederhold, B. K., & Wiederhold, M. D. (2005). *Virtual reality therapy for anxiety disorders: Advances in evaluation and treatment.* American Psychological Association.

Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and Virtual Environments, 7*(3), 225-240. https://doi.org/10.1162/105474698565686

Yee, K. M., & Abidin, M. J. (2014). The use of public speaking in motivating ESL learners to overcome speech anxiety. *International Journal on Studies in English Language and Literature, (2)*11, 127-135.