Comparison of the anxiety levels of teacher candidates during actual and 360° video virtual reality presentations

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Highlights	Abstract
• Public speaking anxiety can be reduced for teacher candidates. • 360° video VR creates a level of anxiety in candidates similar to the real presentation. • 360° video VR can be an alternative technology to provide an authentic experience in teacher education.	This study considers if the 360° video Virtual Reality (VR) environment is a less stressful alternative to giving actual presentations, and thus better able to support the development of the presentation skills of teacher candidates. Mixed method research was conducted in which 12 teacher candidates gave an average of 5 minutes of presentations on different days, both in a virtual and in a face-to-face school environment, before a group of listeners whom they hadn't seen before. The candidates' pulses were compared during presentations conducted in both environments, and the audio recordings were analysed with the PRAAT program. Further evaluation was conducted at the end of the process using an opinion form and interviews. No significant differences were found between the two groups, except in 2 of the 9 different voice analysis variables related to anxiety and the pulse of the candidates. The candidates generally felt that the 360° video VR experience was quite realistic, and that it could be an effective method of addressing concerns about giving presentations. It was therefore concluded that 360° video VR environments could be effectively used in teacher education as an alternative to the actual presentation experience.

1. Introduction

Anxiety about public speaking is a problem often faced by both educators and teachers, particularly novice teachers who often have limited opportunities to practice and may only receive minimal support (eg. Creţu, 2017; Daud et al., 2019; Mohammadi et al., 2020). These high levels of anxiety are a clear indicator that trainees, in addition to readings and theory, require active practice of presenting in an actual classroom environment. Gaining such experience is essential to enable the effective management of stress and the improvement of presentation skills through provided guidance. However, the recent pandemic, and forced distance learning, forced educators into using distance education and remote assessment, and have made it difficult to provide field experience of actually presenting to a real group (Rahmawati et al., 2021; Şenel & Şenel, 2021). This situation has motivated researchers to search for alternative methods that will provide

candidates with unlimited scope to practice and develop their presentation skills (Brinia & Psoni, 2021; Bryce et al., 2021).

This research compares the presentation anxiety levels of candidates in both classroom environments (actual and VR) to consider whether 360° video virtual reality (VR) technology, which has recently been used effectively in the field of education, can provide a way of overcoming the difficulty of obtaining real-life presentation practice.

2. Literature

2.1. Public Speaking and Presenting Anxiety

In addition to professional qualifications, future practitioners should have personal qualities, such as communication skills, which will allow them to effectively convey their message and influence their audience (Ivanova et al., 2020). Public speakers who are skillfully able to control factors such as their voices and presentation speed, eye contact with their audience during the presentation, and avoid the use of filler words that prevent effective communication, are able to more effectively convey the message they want to give (Palmas et al., 2021).

However, for those for whom such skills are difficult to acquire, public speaking is a cause of anxiety and stress (Harris et al., 2002). In fact, a fear of public speaking is, according to the National Social Anxiety Center, listed with other common phobias such as spiders, heights and death (National Social Anxiety Center, 2016). Public speaking anxiety can be defined as a "threat of unsatisfactory assessments from the audience" (Schlenker & Leary, 1982). According to Bodie (2010), public speaking anxiety (PSA) is a subtype of communication-based anxiety, in which physiological arousal (for example, increased pulse), negative self-focused cognition (for example, thoughts such as "I'm worried that I will look inadequate"), and behavioral changes (such as tremors) are experienced. While it is normal to experience some degree of anxiety before and after giving a speech, the levels of anxiety can be so high that they can weaken interpersonal relationships; damage professional life and affect academic performance (McCroskey et al., 1975; Dwyer et al., 2002; Goberman et al., 2011). For this reason, it is extremely important that individuals with high levels of anxiety receive suitable support.

2.2. Determining and Treating Public Speaking Anxiety

There are many individual indicators of public speaking anxiety, and different approaches are used in the literature to determine the level of anxiety being experienced. According to the three-system model utilized by many researchers from Lang (1968) to Bodie (2010), people react to stressful situations, such as public speaking, in three areas: physiological, cognitive and behavioral. The physiological reactions of individuals can be seen in physical changes such as body temperature, blood pressure, and pulse. In cases of fear, anger, anxiety, etc., the pulse values of individuals increase (Al-Ayadi et al., 2011; Hartando et al., 2014; Lang et al., 2009; Ravaja, 2004). Different devices are used in the literature to measure these values. For example, Takac et al. (2019) measured pulse data with a pulse monitor, Hartanto et al. (2014) use a finger pulse oximeter, and Wijaya et al. (2014) and Sülter et al. (2022) a digital wristwatch. In each case, the anxiety levels of individuals were evaluated according to the results of the measurements; while cognitive and behavioral responses are collected through a combination of questionnaires, individuals' self-evaluations (eg, Ezrati-Vinacour & Levin, 2004), and the assessments of observers (Savitsky & Gilovich, 2003).

Acoustic measurements have also been used in various studies to gauge changes in anxiety levels. According to Goberman et al. (2011), anxiety and stress conditions cause changes in voice tone, and there are several studies in the literature which consider speech rate, loudness, voice frequency, and many other variables that emerge from technical voice analysis (Al Ayadi et al., 2011; Goberman et al., 2011; Hagenaars & van Minnen, 2005; Postma-Nilsenová et al., 2016; Sondhi et al., 2015; Sülter et al., 2022). Hagenaars and van Minnen (2005), for instance, used speed and frequency (f0) measures to assess anxiety during oral tasks, and reported that these variables were good indicators of speaker stress. In their research,

Al-Ayadi et al. (2011) conducted voice analysis of jitter, shimmer, noise ratio (HNR), formant values (f0, f1, f2, f3) and mean pitch values to determine levels of anxiety, while Sondhi et al. (2015) examined mean pitch and formant values, Postma-Nilsenová et al. (2016) loudness of voice, and Goberman et al. (2011) speech rate and mean pitch values. Values were obtained by these studies with a voice analysis program such as PRAAT and Speech Tool.

Conclusions about the relationships between variables relating to voice analysis and anxiety can be summarized as follows: Van Puyvelde et al. (2018) suggest that as anxiety increases, there is a decrease in voice intensity, while some researchers (Al Ayadi et al., 2011; Hoffman et al., 1997; Laukka et al., 2008; Sondhi et al., 2015) point to increases in the mean pitch value. Another considered variable is pausing. According to Guitar (2006), fluent speech contains no pauses, and speech fluency and anxiety are inversely proportional. According to Hoffman et al. (1997) and Laukka et al. (2008), when participants feel anxious, it is expected that there will be more pausing in their speech.

Other noteworthy variables associated with anxiety are voice vibration, shimmer, and the HNR value. According to Brenner and Shipp (1988), as anxiety increases, the vibration of the voice and the shimmer value decrease, while the HNR value increases (Van Puyvelde, 2018). Moreover, the most obvious features in voice analysis are the formant values, which are the high-energy sections seen in spectra. There are 4 or 5 formant values, f0, f1, f2, f3 and f4, in the human voice (Erdur, 2019). The f0 formant value is seen as a universal indicator of anxiety by many researchers (Brenner & Shipp, 1988; Mendoza & Carballo, 1998; Tolkmitt & Scherer, 1986), and there are many reports of f0 values increasing with anxiety (Demenko & Jastrzêbska, 2012; Hagenaars & van Minnen, 2005; Hansen & Patil, 2007; Hoffman et al., 1997; Laukka et al., 2008; Ruiz et al., 1996; Sigmund, 2006; Sondhi et al., 2015). However, there are also studies that consider the opposite relationship between f0 and anxiety (Hecker et al., 1968).

For many years, different treatment methods have been used to reduce anxiety levels determined by different methods and processes, including online environments, videos, and technologies such as VR (Khoshnama et al., 2021; Myers et al., 2016; Rector et al., 2008). In these studies, individuals are repeatedly exposed to stressful situations in a direct or indirect/imaginary form using the technology-supported exposure method. The aim is to reduce anxiety and stress by allowing users to become accustomed to such situations (Khoshnama et al., 2021; Vardarlı, 2021).

In order to reduce the speaking and presentation anxiety experienced by teachers and teacher candidates, educators recommend the extensive use of various educational processes (Doğan, 2009,19; Fawcett & Miller, 1975, as cited in Palmas et al., 2019; Yee & Abidin, 2014). However, due the limited availability of school experience and teaching practice in preparing candidates for professional roles (Gregory et al., 2011), the need for new practice-focused approaches, in addition to in-class presentations to help alleviate public speaking anxiety, becomes even more apparent (Dueck, 2021). Such an approach could be the VR technology which has recently been used, especially in the field of psychology, to reduce, or even eliminate, the anxiety and phobias faced by individuals.

2.3. VR Technology and 360° video VR

VR in its simplest form can be defined as a computer-generated three-dimensional (3D) environment that allows the user to perceive content more realistically (Araiza-Alba et al., 2022). Furthermore, according to Carrozzino and Bergamasco (2010), VR is defined as three-dimensional practices where individuals can have real-life experiences in a virtual environment through interaction through a variety of tools, such as computers, mobile devices, databases and the internet. VR technology has two main features, Immersive and Presence, which relate to the illusion of actually being physically present. 'Immersive' is used to refer to the software and technology used to detect and interact with a particular environment. 'Presence', on the other hand, is concerned with the experience of 'being there' and can be defined as a user response that depends on the individual and the context (Slater & Wilbur, 1997). VR environments can be divided into different computer-based system and Immersive Virtual Reality (IVR) groups according to the presence, feeling of immersion and interaction possibilities they provide (Araiza-Alba et al., 2022). Among these

classifications, a sub-dimension of IVR: 360° video VR (or 360° video-based VR), has attracted attention, especially in recent educational literature, as a new technology that combines the strengths of 360° videos and VR (Mathende, 2021).

Hosseini and Swaminathan (2016) have defined 360° video VR as an immersive global video in which the user can freely explore a video environment using a head-mounted display or VR headset. VR headset technology allows individuals to look in any direction, focus on required objects, and make choices to play an active part in the environment (Rupp et al., 2019; Walshe & Driver, 2019). VR headsets can offer users immersive 3D experiences with high motivation and realism in VR applications (Çankaya, 2019). If real video images are used, the environment provided is particularly realistic and the feeling of immersion especially strong. (Rupp et al., 2019; Walshe & Driver, 2019). However, as the technology used in such applications is not completely computer-designed, as in other immersive VR environments, only minimal interaction is possible, and it can be quite difficult to act and react using avatars. However, the sense of realism and presence that the technology can provide outweighs these disadvantages and so it is considered effective in reducing the presentation concerns of prospective teachers.

Research exists in the literature on the subject which suggests that VR technology, although not specifically 360° video VR technology, can be used to reduce anxiety. For example, a study by Anderson et al. (2013) finds that virtual exposure and real exposure therapy, in which VR technology is used to eliminate the fear of public speaking, are equally effective. Sülter et al. (2022) used VR technology to reduce the anxiety of speaking in public with 40 children aged 9-12 and stated that a significant decrease was observed in children's anxiety after the 3rd session. In research conducted by Hartonda et al. (2014), individuals participated in a job interview developed with VR technology. The anxiety levels experienced by participants when dealing with the negative behavior of the virtual character were measured, and it was found that the values decreased after several trials.

All these studies show that VR technology can be effective in reducing anxiety about public speaking. However, there are also a large number of multi-test studies that similarly aim to reduce public speaking anxiety with teacher candidates (Frisby et al., 2020; Dueck, 2021; Lindner et al., 2021). Due to the strong sense of presence that it provides and considering that existing research on its use is based on IVR, it is thought that 360° video VR technology may be a better alternative to the actual presentation experience.

However, before further integrating 360° video VR technology use in the teacher education process to reduce presentation anxiety, it considered important to examine the effective and physiological reactions of candidates to this technology. After all, as emphasized by Pertaub et al. (2002) and Slater et al. (2006), the more similar the reactions of individuals to listeners both in the virtual and in the real environment, the more confident we can be that this technology will be useful in the training of social skills. In other words, if the appropriate physical responses and subjective perceptions of both environments can be similarly created, it could be said that VR technology could be a viable alternative for use in teacher training. In order to try and measure the level of similarity, the following questions are asked to determine the situations that cause teacher candidates' anxiety about making presentations to adults, and to test whether 360° video VR technology creates a realistic experience:

1. What are the sources of anxiety and stress experienced by teacher candidates about making presentations to adults?

2. Are there significant differences in the anxiety levels of teacher candidates presenting for actual and in the 360° video VR environment?

3. What are the strengths and weaknesses of 360° video VR technology used to support presentation skills to adults?

3. Methodology

3.1. Research Model

A mixed methodology was used through a concurrent triangulation design in this study. The concurrent triangulation design referred as a simultaneous attempt (Newman & Ridenour, 2008) is one of the mixed methods (Creswell, 2009). In this design, to get an in-depth understanding of the research questions, quantitative and qualitative data are collected concurrently and analyzed separately and the data from the two methods are then interpreted together (Creswell, 2009). Based on this design, in this study the qualitative (interview and evaluation forms) and quantitative data (pulse and voice) were analyzed separately and then interpreted together.

3.2. Study Group

The study group in the research consists of 12 teacher candidates, 7 females and 5 males, who are studying in the Computer and Instructional Technologies Education (CEIT), Music, Literature and Psychological Counselling and Guidance (PDR) departments of different state universities in Ankara. Only 8.3% of these candidates had experience of presenting to adults. About 25% of the candidates considered themselves fairly able to make an effective presentation, about 41.7% considered themselves unable, and 33.3% were undecided. When the candidates were asked about their anxiety and stress levels in general, 50% of the candidates admitted that they were stressed while presenting, 16.7% said that they were comfortable, and 33.3% said that they were undecided.

3.1. Data Collecting Tools and Process

The research process consisted of two parts: Preparation and data collection. In the first stage, the participants, the target audience, the real (physical) classroom environment and the 360° video VR environment in which the candidates will make presentations, were all prepared. This involved organizing the actual meeting in an actual classroom environment, as well as selecting the real audience (who acted as parents). To enable teacher candidates to experience a real parent meeting, two different topics were selected. The audience who was to take part in the actual presentation process were informed about the process. The audience was told to behave naturally, and at times to play with their phones, look outside, or listen attentively.

After the actual presentation environment was ready, preparations for the 360° video VR environment began. A different audience were asked to pretend to be listening to a teacher standing in the middle of the classroom and giving a presentation, and again to give natural reactions, as other audience did during the actual classroom presentation. These listening behaviors of the viewers were recorded in 360° video format for an average of four minutes with a Samsung Gear 360 camera. These videos were then edited using Unity and finalized for use with a mobile VR headset. After the environments had been prepared, the participants were given VR headsets one week in advance of the test to get used to using the VR headset and experiencing different 360° VR environments. The second data collection stage is carried out in four stages, as shown in Figure 1:
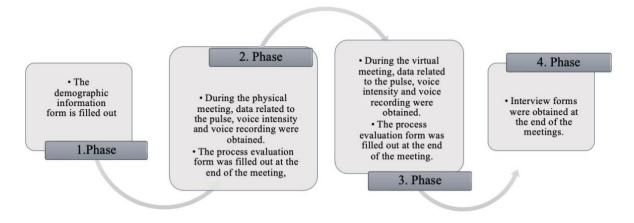
Fig. 1. The data collection process

During the first stage of data collection, the candidates arrived at the secondary school where one of the researchers had arranged for presentations to be given in a real school setting. The process was again explained to the candidates before the presentations. Consent forms were then completed, as were demographic information forms that also included information about the candidates' experiences of giving presentations and their levels of anxiety. The second stage included an audience of 8-10 individuals acting as parents in an actual environment. The candidates' pulses were taken immediately before entering the meeting. The Apple IWatch 3rd series digital watch was used for this as it has been found in studies to be 97% accurate at measuring pulses (Arbit & Leibzon, 2020; Tison et al., 2018). The voices of the participants were also recorded from the moment they started the meeting with a 3.5 mm head microphone and a mobile phone. At the end of the meeting, the average and final pulse values were measured and recorded. The participants then completed a process evaluation form.

The 360° video VR experience, the third stage of the data collection section, was conducted a week after presentations had been given in an actual classroom. The 360° video VR environment was created for the candidates using an Android mobile phone attached to Samsung Gear VR headsets, with each candidate being alone in an empty room. During the presentation, the candidates were given the option of ending the process if they did not feel comfortable or if there were any other problems. Figure 2 shows images of candidates giving their VR presentations.

Fig. 2. Candidates giving their VR presentations

As in the actual presentations, pre-meeting pulse data, a post-meeting pulse data and audio recordings were taken during the process, and candidates completed an evaluation form after the VR presentation. The headsets used during the VR presentation, as well as the equipment used for data recording, are shown in Figure 3.

Fig. 3. The headset, cell phone and microphone used during the VR presentations

In the fourth and final stage of data collection, candidates were interviewed about their impressions of the VR experience, and they completed semi-structured interview forms. The 5-to-12-minute interviews were audio recorded.

3.2. Data Analysis

In order to determine levels of anxiety, the PRAAT audio analysis program was used to measure values often referred to in the literature in the context of voice analysis, namely mean pitch, pauses, jitter, shimmer, HNR, f0, f1, f2 and other values in the voices. The PRAAT audio analysis program is a free application that allows detailed voice analysis (Boersma & Weenink, 2009). In addition, Speech Rate Meter and Decibelx software were used to determine the speed and intensity of voices. For the change in pulse, a smart watch was used to measure the start, end, and average pulse values. Although the sample consisted of 12 participants, there were technical problems with the data of 3 participants, and so only the audio recordings of 9 participants could be analysed.

In order to determine whether there is a difference in anxiety levels during the actual and the VR presentation, the measured pulse values and voice analysis values were compared using the SPSS program. As the number of participants was small, it was felt that there was no need to establish normality in the analysis, and so the data was only analysed using descriptive analysis and the non-parametric Wilcoxon signed-ranks sum test.

For the analysis of qualitative data, audio recordings were first transcribed, and then both the responses to the review form and the interview transcribed were analysed through the ATLAS.ti qualitative analysis program. In the qualitative analysis stage, open coding was initially performed, and the codes were then brought together to create categories and themes. During analysis of the data, the researchers worked together to ensure validity and reliability. To check inter-rater reliability, an independent researcher was invited to code %10 of qualitative data independently using these categories and sub-categories. Inter-rater reliability was analyzed using Cohen's kappa coefficient (Cohen's kappa = 0.92). The process of analyzing the data and preparing reports was discussed in detail, and the qualitative findings were supplemented with citations.

3.3. Results

The results are presented on the basis of the research questions.

3.3.1. The sources of anxiety and stress experienced by teacher candidates about making presentations to adults

The reasons for the anxiety experienced by the candidates participating in the study, especially in terms of presenting with adults, are shown in Table 1.

Table 1.

Sources of Teacher Candidates Being Anxious about Making Presentations to Adults

Main source of anxiety	Sub-sources of anxiety	n
Lack of practice	Limited real practice	10
Target audience	Failure to attract the attention of the target audience	6
	Inability to communicate effectively with the target audience	4
	Not knowing the target audience well enough	4
Knowledge of the subject and methodology	Inability to effectively present content	5
	Lack of content knowledge	3
	Not knowing how to start the presentation	2
Individual characteristics	Inability to adjust the volume and speed of speech	5
	Inability to control excitement	4
	Inability to manage time	3
	Inability to make eye contact	3
	Anxiety about receiving negative evaluation	2
Technical issues	Having technical problems during the presentation	2

According to Table 1, it was seen that the most important cause of anxiety was a lack of actual practice in teacher education (n=10). The majority of the candidates stated that although they received plenty of theoretical knowledge in the teacher education process, they were very anxious about not being able to have any presentation experience in an actual environment with the target audience. For example, K2 said that *"Since teacher education teaches us adolescent and adult psychology and the level of readiness, it enables me to see and realize how to approach the target audience. However, I think that I am not ready because we do not do practice adult presentation skills at school or internships. It makes me feel pretty inadequate."*

Another cause of stress for teacher candidates stems from not knowing enough about the target audience and its characteristics. Candidates mostly experience anxiety due to not being able to sufficiently command attention (n=6), not being able to communicate effectively (n=4) and not getting to know the audience well enough (n=4) during the presentation. For example, K1 explained the stress and anxiety he experienced about the subject as follows: *"their expectations, what they want to hear may be different, they may give different reactions. And I think it's harder to get their attention. This situation creates more stress for me."* K12 said, *"Not knowing who they are and having to present to them for the first time makes me more anxious."*

Another dimension that causes anxiety in prospective teachers is related to their subject and knowledge of methodology. The possibility of not being able to present the content effectively due to the limits of the presentation (n=5) and not having sufficient content information in accordance with the characteristics, needs and expectations of the target audience (n=3), was seen to be a cause of anxiety for candidates. Finally, a few teacher candidates stated that they felt stressed due to a lack of self-confidence (n=2), and due to a fear that technical problems may occur during the presentation (n=2). The candidate responses relating to these concerns are: *K 10: "The inability to control my voice and the fear of unnecessarily prolonging the topic makes me nervous"*; *K8: "It is important to speak the same language as them, to know the subject they want to learn, to plan and present it effectively, and I think considering all of these things is quite stressful"*; *K3: "I find the idea of explaining a topic to people older than myself stressful due to my lack of self-confidence. Just the idea makes me more anxious and worried"*

3.3.2. *Differences in the anxiety levels based on physiological measurements and the voice analysis*

In order to compare the anxiety levels in presentations carried out in actual and VR environments data, including pulse values and voice intensity, voice speed, mean pitch, jitter, shimmer, HNR, f0, f1 and f2 values obtained after voice analysis are all shown in Table 2.

When Table 2 is examined, it is seen that the average pulse value in the actual environment is higher than in the VR group. However, there were individual candidates with higher pulse rates in the VR group. As a result of the voice analysis of the candidates during presentations in both environments, it is observed that there are very small differences between both groups according to the values studied. However, in order to determine whether the difference between the measurements made in both groups is significant or not, the Wilcoxon signed-sum test was applied to determine whether the data of the participants differed significantly between both meetings, and the results are presented in Table 3. It can be seen from the table that there are no significant differences in the candidates' pulse values, speech rates, mean pitch, pause times, shimmer, HNR values, f0, f1 and f2 values in both environments ($p > 0.05$). It can also be seen that significant differences ($p < 0.05$) are only apparent when the candidates' averages of voice intensity and jitter values in two different environments are considered. In other words, it can be concluded that VR environments have a significant negative effect on the voice intensity values of candidates, and a significant positive effect on the vibration values in voice acoustics.

Table 2.

Comparison of Physical Measurements and Voice Dec between Two Groups

Participant	Pulse		Speed of voice (wpm)		Voice Intensity (dB)		Mean Pitch		Degree of Voice Breakage		Jitter		Shimmer		HNR		f0		f1		f2	
	AE	VRE	AE	VRE	AE	VRE	AE	VRE	AE	VRE	AE	VRE	AE	VRE	AE	VRE	AE	VRE	AE	VRE	AE	VRE
K1	95	98	126	94	80	74.6	260	237	52.3	55	1.7	2.6	12.3	18.4	10	5.7	253	237	730	832	1.8	2
K2	132	130	97	114	80	76.3	117	120	55.4	50.7	2	2	15.2	15.7	7.4	7.1	120	124	665	824	1.8	1.8
K3	175	168	87	71	78.2	73.8	133	191	50.9	70.9	2	3	15.9	21	7.7	3.9	137	233	694	807	1.9	1.8
K4	100	102	110	124	85.5	84.1	246	248	18.3	23	1.3	1.8	13.3	14.5	10	9.5	237	230	667	732	1.8	1.8
K5	118	125	105	113	85.4	79.9	159	133	37.4	22.5	1.8	2.5	15.6	16.1	6.5	7.8	149	129	747	628	2	1.7
K6	106	101	107	157	89.6	86.1	284	299	17.1	26.6	2.1	2.1	16	12.3	9.1	10.7	278	307	675	705	1.6	1.7
K7	128	131	120	140	81.9	78.5	246	221	31.4	28.5	1.6	2.4	15.8	15.3	8	9.6	236	219	736	569	1.9	1.8
K8	128	112	95	120	83.2	67.1	232	209	36.5	28.6	2	2.6	15.1	16.1	8.3	8.3	231	202	682	626	1.8	1.7
K9	119	111	114	105	80	74	245	184	32.9	33.8	1.7	2.2	13.6	14.2	7.8	6.6	183	187	622	636	1.8	1.5
K10	103	107																				
K11	112	118																				
K12	119	113																				
Ort	91.8	89.8	106.8	115.3	82.6	77.2	213.6	204.7	36.9	37.7	1.8	2.4	14.8	16	8.3	7.7	202.7	207.6	690.9	706.6	1.8	1.8

* AE: Actual (Physical) Environment, VRE: Virtual Reality Environment

Table 3.

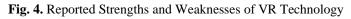The results of the Wilcoxon signed rank sum test

		N	Mean Rank	Sum of Ranks	z	p	r
Pulse_ VRE - Pulse_ AE	Negative Ranks	6d	7.83	47.00	0.628	0.53	0.129
	Positive Ranks	6e	5.17	31.00			
	Ties	0f					
	Total	12					
Speed of Voice _ VRE – Speed of Voice _ AE	Negative Ranks	3g	4.67	14.00	-1.007	0.314	0.237
	Positive Ranks	6h	5.17	31.00			
	Ties	0i					
	Total	9					
Voice intensity_ VRE - Voice intensity_ AE	Negative Ranks	9j	5.00	45.00	-2.668	0.008*	0.628
	Positive Ranks	0k	0.00	0.00			
	Ties	0l					
	Total	9					
Mean Pitch_Hz_ VRE -Mean Pitch_Hz_ AE	Negative Ranks	4m	5.50	22.00			
	Positive Ranks	4n	3.50	14.00			
	Ties	0o					
	Total	8					
Pause_ VRE - Pause _ AE	Negative Ranks	4p	4.25	17.00	-0.14	0.889	0.035
	Positive Ranks	4q	4.75	19.00			
	Ties	0r					
	Total	8					
Jitter_ VRE - Jitter_ AE	Negative Ranks	0s	0.00	0.00	-2.521	0.012*	0.63025
	Positive Ranks	8t	4.50	36.00			
	Ties	0u					
	Total	8					
Shimmer_VRE - Shimmer_ AE	Negative Ranks	2v	3.50	7.00	-1.54	0.123	0.385
	Positive Ranks	6w	4.83	29.00			
	Ties	0x					
	Total	8					
HNR_VRE - HNR_ AE	Negative Ranks	4y	5.00	20.00	-0.28	0.779	0.07
	Positive Ranks	4z	4.00	16.00			
	Ties	0aa					
	Total	8					
f0_ VRE - f0_ AE	Negative Ranks	5ab	4.00	20.00	-0.28	0.779	0.07
	Positive Ranks	3ac	5.33	16.00			
	Ties	0ad					
	Total	8					
f1_ VRE - f1_ AE	Negative Ranks	3ae	5.33	16.00	-0.28	0.779	0.07
	Positive Ranks	5af	4.00	20.00			
	Ties	0ag					
	Total	8					
f2_VRE - f2_ AE	Negative Ranks	6ah	4.50	27.00	-1.26	0.208	0.315
	Positive Ranks	2ai	4.50	9.00			
	Ties	0aj					
	Total	8					

*p<0.05.

3.3.3. Strengths and weaknesses of the VR technology

Interviews were conducted with teacher candidates to evaluate their presentation experiences in a VR environment and to compare the virtual and real experiences. Positive and negative comments received from the candidates during the interviews are shown in Figure 4.

+ Availability of a realistic environment	- Inability to have short conversations before the presentation
+ Ability to repeat the experience	- Lack of interaction
+ Supports decision-making skills	- Technical problems during the presentation
+ Helps to plan timing	- Health issues
+ Helps improves confidence	- Difficulties in designing the VR
+ Helps improve eye contact	- Difficulties in using the technology
+ Helps to control voice	- Takes time to get used to the technology
+ Helps to control excitement/stress	- Cost
+ Noticed improvement over time	- Lack of feedback
+ Chance to experience different environments and scenarios	
+ Supports professional development	

Fig. 4. Reported Strengths and Weaknesses of VR Technology

In the interviews, the teacher candidates reported that their experiences in the 360° video VR environment were quite realistic, and so they felt this technology could be used as an effective replacement for actual presentation experience. For example, emphasizing the feeling of reality created by using 360° videos, K10 stated that "*I have watched animation in a VR environment before, but I have not watched a 360° video. It's works well and looks so real, which is important when preparing a presentation.*" K3 had a similar opinion about 360° video VR technology being able to provide a lifelike experience: "*In a VR environment, it is very important that the image is clear, and people look real instead of just animations.*"

Another contribution expressed by the candidates is associated with being able to repeat the VR environment. K12, for example, stated that: "We can practice here (in VR) before we start our career. This is very useful for us and can reduce our presentation stress". Some candidates also felt that by being able to repeatedly experience this environment, they are able to prepare how they will present the content before the real lesson, rehearse the timing, and thus feel more confident when actually teaching. This feature was felt to be extremely important by K11, who finished his/her presentation early in both environments and said: "*I felt very nervous during the practices and finished the presentations very early. However, I can now rehearse the timing so that I won't have such problems again*".

Candidates also felt that another contribution of VR technology to presentation skills could be in helping make eye contact, appropriately adjust voice and speech speed, and control anxiety levels. K2 said, "*I normally hesitate to make eye contact when I'm talking, and the more excited I get, the faster I talk. We can learn this due to the headsets in the VR environment*." Some candidates, on the other hand, emphasized that it is extremely helpful for their personal development if processes are included in which they can self-evaluate after giving their presentations in a VR environment. K4 demonstrated this point with: "*If I could watch myself after presenting in a VR environment, I would be able to learn how I use my body language and voice, and so I could see my deficiencies better*".

According to several candidates' reflections on how more effective processes can be designed with the use of a VR environment, making presentations in a variety of VR environments could help them to prepare themselves for different situations and thus feel more powerful in their professional life. This view was supported by K3, who stated that "*If there are different audiences each time, and sometimes they listen well, sometimes they are indifferent, it prepares us better for each audience*".

In addition to the ability, highlighted during the interviews conducted with candidate teachers, of VR technology being able to improve presentation skills, some felt that the technology also had some limitations. The most common was a lack of interaction. Some candidates were frustrated that they were unable to have short conversations with the audience before the presentation, or that they couldn't interact with them by asking questions while presenting. Some comments which expressed this view are from K4, who stated that "*There is no opportunities to ask questions or receive answers during the presentation*" and K7, who said "*We can't talk to them, ask questions, see their reactions, like we would in an actual classroom. I think that if could we eliminate this limitation, the technology would be much more effective*".

Another highlighted limitation is that some candidates felt they got much more feedback from the real than the VR experience. For example, K4 said that "*After making a presentation in a real environment, our consultant evaluated us and explained what we did and didn't do well. However, we don't get this feedback after practicing in a VR environment.*"

The difficulty and cost of designing VR environments was also highlighted by some candidates, especially how these factors would be a handicap for the widespread use of such technology in the teacher education process. For example, if VR were to be used in a classroom environment, some candidates wondered at what stage of the lesson it could be used, and how the noise of the classroom could be overcome. For example, K4 drew attention to both economic and planning dimensions by saying "*They wouldn't be able to provide many VR headsets because they are expensive, and a limited number of headsets would mean trainees wouldn't be able to use them for long. We are in class. How could you plan the practice and use of headsets in the classroom? It is necessary to think very carefully about how time could be allocated.*"

Another concern expressed by some candidates was about the technical problems that may arise during the practice process, and health problems such as eye strain and dizziness. K2: "*There may be technological limitations, and there should be an environment on the internet for VR use.*" K9: "*Good headsets should be bought in order to get good results and avoid hurting the eyes.*"

4. Discussion and Suggestions

This study was conducted to determine the levels and causes of public speaking anxiety experienced by teacher candidates while giving presentations to adults. A further goal was to determine whether the physiological and emotional reactions experienced with VR technology are similar to those experienced during actual presentations. It was felt that if similar reactions were reported, this technology could be used as a viable alternative to actual presentation practice.

According to the results of the research, more than half of the candidates were worried about not being able to give effective presentations to adults. The most common reason for this anxiety was a lack of experience. The limited implementation process in teacher education and their inability to participate adequately in the processes of parent meetings, seminars, etc., which are presented to adults as both participants and servers, can all be causes of anxiety in candidates. This result shows that candidates need supportive processes in teacher education, such as VR technology, as an alternative to real-world experiences. Aware of this requirement, researchers have, particularly during the last 5 years, started using 360° video VR technology in teacher education as part of their professional training and to support the learning of candidates (Billingsley et al., 2019; Ye et al., 2021). Ye et al. (2021), for example, used VR technology to improve the teaching of classroom experience skills due to the limited chances to observe and provide practice for candidates. Their research revealed that the classroom management strategies of the candidates improved

at the end of the process. Similar research results confirm that 360° video VR technology can be used to provide valuable additional presentation practice.

In the study, no significant differences were found between the two presentation experiences in terms of the results of pulse, voice analysis, and all other variables, with the exception of voice intensity and jitter value. This can be interpreted as the candidates finding the presentation experience in the VR environment quite realistic, and it can thus be concluded that VR technology promises to be an alternative that avoids the limitations of providing actual practice.

The fact that the voice intensity is lower in VR environment can be interpreted as candidates feeling anxious about using new technology, despite having been given a week to familiarize themselves with the VR equipment. Discussions continue in the literature on the relationship between jitter value and anxiety. In a study by Postma-Nilsenová et al. (2016), it was observed that the level of jitter related to vibration increases with anxiety. However, Van Puyvelde et al. (2018), came to the opposite conclusion. However, we believe that candidates becoming more used to the technology and the VR environment will reduce anxiety over time and therefore increase the strength of their voices.

Clearly, there is no point conducting studies on reducing anxiety in a VR environment which candidates do not find realistic and so do not react in a way comparable way to a real environment (Clemmensen et al., 2020). However, both the quantitative and qualitative results of the research confirmed that the candidates had similar reactions in both presentation experiences, and it can therefore be inferred that they found the VR experience to be quite realistic. According to the results of research by Theelen et al. (2020), the immersive experience of presenting with 360° video VR can support candidates' interpersonal behavior by providing them with a realistic and original teaching environment, and thus have a positive effect on personal characteristics such as anxiety and self-efficacy. This paper has also argued that the ability of 360° video VR technology to present a realistic environment should be brought to the forefront in teacher education, and it is even proposed that teacher candidates should be provided with the chance to experience different conditions by creating a 360° video VR database that consists of a variety of audiences reacting in different ways. In this regard, experimental studies could be conducted to determine the varying effects on presentation anxiety and other concerns.

In addition to the above, it is also apparent that there are a number of other issues that need to be considered. One of them is the currently limited interaction available in 360° video VR technology. Since the current study uses a video-based technology designed to mimic the real environment, it is seen that this format severely limits opportunities to manipulate the scenario and provide interaction. It is hoped that future technological innovations will allow additional interaction, or perhaps an animated VR format which does allow extensive interaction, to be developed to a level where it is comparable to reality. A comparative study would help determine the most effective supporting process and technology.

In addition to technology concerns, it is also necessary to consider when, where, how, and how often technology can be effectively used in teacher training. For example, candidates, according to Schinske and Tanner (2014), focus on academic performance rather than professional teaching abilities as they are evaluated by mentor teachers when they make presentations during the teaching practice process, and this is often a cause of anxiety. To address this problem, it is suggested that VR technology could be used as an important part of the supporting of independent learning in the teacher education process. Moreover, we suggest that candidates being able to notice their own deficiencies and mistakes after recording presentations in the VR environment will aid their independent learning processes and reduce anxiety. As suggested by Jiyoon (2008), we think that candidates' teaching practice experiences can be supported through the planning of a virtual internship practice such as "Cyber Practicum".

Finally, it is clear that this research has a number of limitations. Firstly, the study was conducted with a small study group, and included only a single practice in each environment. In making this comparison, the most common voice analysis variables in the literature are taken as a basis. Due to these limitations, the

research can be considered as a pilot practice, and future studies can be conducted considering larger groups experiencing more numerous virtual environment practice sessions. This would allow the effect of this technology on reducing anxiety to be examined by repeated measurements within different scenarios. Furthermore, although the pulse of the candidates in this study was measured with a smartwatch, which is seen in the literature to be highly reliable, different measurement devices such as Electroencephalography (EEG) signals may be included in future comparisons.

5. Conclusion and Suggestions

In conclusion, it can be said that, despite the above limitations, the results of our study provide valuable information to researchers and teacher educators regarding how candidate teachers who are struggling with the anxiety of public speaking can be better supported. If it is considered that anxiety experienced by individuals may eventually become a social phobia, which would clearly negatively affect both academic and professional lives, the value of 360° video VR technology being used as an alternative medium for supporting public speaking skills in teacher education can be appreciated.

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