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Nursing Student Experience and Safety Awareness Using 360-Degree Immersive Video Simulation

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NURSING STUDENT EXPERIENCE AND SAFETY AWARENESS USING 360-DEGREE IMMERSIVE VIDEO SIMULATION

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ABSTRACT

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As the use of simulation in pre-licensure nursing education increases, it is important to evaluate new approaches to clinical simulation. A new technology called 360-degree immersive video has the potential to be used in nursing education but its use in nursing education has not been studied extensively. This study evaluated nursing student satisfaction and identification of risks to patient safety with 360-degree immersive video simulation when compared to conventional video simulation.

In this quasi-experimental quantitative study, 91 final semester nursing students viewed either a 360-degree immersive video simulation depicting multiple risks to patient safety or a conventional video of the same scene. Participants then completed the National League for Nursing (NLN, 2019) Student Satisfaction and Self-Confidence questionnaire and listed identified risks to patient safety depicted in the video. Additionally, participants who viewed the 360-degree immersive video simulation were asked four open-ended, written exploratory questions about their perceptions of the technology. Participants who viewed the 360-degree immersive video simulation had higher satisfaction scores on 3 of the 13 items on the NLN questionnaire than participants who viewed the conventional video simulation. There was no significant difference in the number of risks to patient safety identified between groups.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Simulation of clinical situations has become a widespread and important part of pre-licensure nursing education in the United States. While the amount of clinical time in simulation and approaches to simulation vary widely between nursing programs, the vast majority of schools of nursing in the United States use some form of clinical simulation to prepare students to be registered nurses. Nurse educators have a responsibility to prepare students to provide safe patient care in often challenging and even dangerous healthcare settings. As nursing programs throughout the United States continue to expand the use of simulation and to look for new strategies to promote safe nursing care, nursing research should evaluate novel strategies for improving the quality of simulation activities.

Background

Clinical simulation is a widely used approach to teaching pre-licensure nursing students; one nation-wide study found 87% of nursing programs used simulation (Hayden, 2010). Multiple approaches to simulation have been identified including the use of high-fidelity manikins, standardized patients, and computer simulations (National League for Nursing [NLN], 2015). Following the publication of the historic National Council of State Boards of Nursing's *National Simulation Study* (cited in Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014), the effectiveness of simulation as a student clinical experience was widely accepted in nursing education. Supporting the

use of up to 50% of clinical time in simulation (Hayden et al., 2014), the NCSBN study was widely considered practice-changing research (Jeffries, 2015). It is very likely the study will be used by pre-licensure nursing programs to significantly expand clinical simulation in coming years.

According to the Bureau of Labor Statistics (2013), the United States will face a significant nursing shortage and have over one million open positions for registered nurses by the year 2022. Pre-licensure nursing programs have identified lack of clinical sites as the most common obstacle to growing the number of new nurses in their programs (NLN, 2016). Significantly expanding the use of simulation in nursing education has been proposed as a potential way to address the nursing shortage and lack of clinical placements for nursing students (Institute of Medicine [IOM], 2010).

In the context of widespread current use and likely expansion of clinical simulation in nursing education, nurse educators should seek out opportunities to improve the quality, reliability, availability, and veracity of simulation activities. In recent years, a new technology called 360-degree immersive video has emerged as a way to experience audio and visual media in a unique way. In a 360-degree immersive video, the perception is created that the viewer is actually located within a video environment and the visual experience changes as the viewer looks in different directions while wearing a specialized headset.

While often referred to as virtual reality, 360-degree immersive video does not use computer-generated images; instead, it presents real-life video images and audio to the viewer. For example, 360-degree immersive video has been used to allow viewers all over the world to have the impression of taking a tour of the Eiffel tower, exploring the

architecture of Manhattan, and rock-climbing thousands of feet off the ground in Yosemite National Park. Immersive video must be filmed with a special type of camera to obtain the 360-degree field of vision and it must be played on a special viewer to obtain the desired user experience. While this specialized equipment can be quite expensive, recent improvements in the technology and decreases in cost have resulted in the availability of high-quality immersive video cameras and viewers at much lower price points. For example, a nursing program could now purchase five viewers and a 360-degree video camera for under $2,000.

Problem Statement

As the use of simulation in nursing education increases, nurse educators should identify ways to improve the quality of these simulation activities. The general consensus is improvements are necessary in the nursing education system, especially with regard to the preparation of new nurses to provide safe patient care (Bauchat, Seropian, & Jeffries, 2016; IOM, 2010). Additionally, medical error has been cited as a significant cause of death in the United States (Makay, 2016). Simulation has been identified as a potential tool to address these concerns (Agency for Healthcare Research and Quality, 2011; Bauchat et al., 2016). Schools of nursing need to identify novel educational strategies to improve the safety of graduates and simulation is a critical tool in that effort.

While 360-degree immersive video has incredible potential as a new technology in nursing simulation, very little is known regarding its use in nursing education. No research in the nursing literature has evaluated its effectiveness when compared to conventional video and only limited research has evaluated its educational use in general. The development of 360-degree immersive video simulation activities requires

significant faculty time and some financial cost; therefore, it is vital to evaluate its effectiveness when compared to conventional video before embarking on major immersive video simulation development.

Purpose of the Study

The purpose of this study was to evaluate the use of 360-degree immersive video among nursing students and to compare immersive video simulation to conventional video simulation. This study sought to learn if immersive video is a worthwhile tool in nursing education and to inform decisions by nursing departments and nurse educators regarding further investment and research into this emerging technology. Currently, no studies available in the nursing literature have compared 360-degree immersive video to conventional video in simulation activities. Additionally, the study evaluated the effectiveness of 360-degree immersive video in teaching nursing students to identify risks to patient safety and to compare safety risk recognition in 360-degree immersive video simulation to safety risk recognition in conventional video simulation.

Significance to Nursing Education

Immersive video simulation has the potential to cause a major transformation in nursing education by expanding what is possible in simulation, facilitating interprofessional training, and teaching students to identify risks to patient safety in actual healthcare settings. If immersive video was shown to be an effective approach to simulation, nursing programs could create realistic simulations of almost any healthcare scenario.

Expanding What is Possible

Currently, simulation in nursing education is largely limited to what can be done in existing laboratory space. While many schools of nursing have invested in state-of-the-art simulation facilities, there will always be limits to what types of simulation scenarios can be developed in these laboratories. While a simulation laboratory often has a simulated hospital room and clinic exam room, budget, space, and design limitations make it nearly impossible for any single simulation laboratory to provide physical space actually replicating most patient care settings. For example, simulated hospital rooms in academic settings might not truly resemble actual acute care hospital rooms in the area and the realistic replication of complex settings like intensive care units, catheterization laboratories, operating rooms, and emergency departments might be difficult to impossible to achieve in academic settings.

Within this context, 360-degree immersive video has incredible potential to expand what is possible in nursing education by incorporating diverse patient care settings into simulation activities. Rather than relying on physical spaces of schools of nursing alone for the settings of simulations, 360-degree immersive video simulations could be filmed nearly anywhere. Students could be given the impression of being present at the bedside to view scenarios featuring equipment and set in facilities that would cost millions of dollars to construct, which would otherwise be impossible to replicate in simulation laboratories.

Similarly, 360-degree immersive video could be used to recreate common errors in healthcare settings and safely place students at the bedside in these types of scenarios. Medical error is a profound problem in the United States and is associated with

significant patient morbidity and mortality (Makay, 2016). Debriefing and discussion of these types of simulations would allow students to identify risks to patient safety and strategize ways to prevent medical error.

Interprofessional Simulation

Immersive video could uniquely assist nurse educators in the development of interprofessional simulation activities. For example, a 360-degree immersive video of pre-hospital emergency care could give a nursing student the impression of being present in the field alongside paramedics enroute to the hospital. In this manner, immersive video could be used to set the stage for a high-fidelity simulation and the student could remove the immersive video viewer following the scene and assume care of a manikin in the school's simulation laboratory. Similar activities using 360-degree immersive video to incorporate intradisciplinary care into nursing simulation could be created with respiratory care, sonography, social work, radiology, and physical therapy.

Recording Actual Clinical Events

If in compliance with HIPPA regulations and conducted with high ethical standards, real clinical situations could be recorded and later viewed in an immersive format. For example, students could be given the impression of being at the bedside as a patient underwent a chest tube insertion or heart catheterization. These types of interventions are very difficult to simulate in educational settings but immersive video could make these experiences available on demand in any classroom or laboratory setting. Strict ethical and legal guidelines would need to be met for this type of immersive video simulation but there is a long history of conventional videos being filmed of medical care for educational purposes.

Awareness of the Patient Perspective

Another unique opportunity in nursing education with 360-degree immersive video is to encourage nursing students to consider the perspective of the patient. An immersive video filmed from the perspective of a patient could be used to help students better consider the patient experience, strategies to promote patient dignity, and subtle ways nursing care and communication impact patients. One of the few studies in the published nursing literature evaluating 360-degree immersive video demonstrated this type of use of immersive video resulted in an increase in nursing student empathy (Everson et al., 2015).

Other Uses

While not necessarily simulation, 360-degree could also be used in nursing education to facilitate instruction on the performance of nursing skills, orientation to clinical settings, and medical device use. In all of these types of uses, an immersive video would offer a unique perspective for the viewer and could be an effective tool in nursing student preparation for clinical care. Before investing in the development of 360-degree immersive videos, however, it is vital to learn more about student satisfaction with the technology and its effectiveness when compared to conventional video.

Research Questions

The following research questions guided this study:

Q1 What is the difference in scores on the National League for Nursing Student Satisfaction and Self-Confidence in Learning instrument between simulation using 360-degree immersive video and simulation using conventional video?

Q2 What is the difference in the number of risks to patient safety identified by nursing students between participants in a 360-degree immersive video simulation and a conventional video simulation?

Definition of Terms

360-degree immersive video. A video medium where the entire field of vision is filmed. The viewer controls the field of vision of the video but does not alter the content or course of the video itself. When watched on a specialized wearable viewing device, the impression is created that the viewer is within the video environment.

Immersive video viewer. A wearable device, similar in appearance to oversized ski goggles, that plays 360-degree immersive videos. An immersive video viewer may be designed to hold a smartphone, connect to an external computer, or be a freestanding media player device itself. Immersive video viewers are also often referred to as head mounted displays.

Nursing simulation. An activity occurring outside of an actual patient care setting designed to replicate nursing practice.

Virtual reality. An activity that uses computer generated images to create an interactive user experience approximating a real-life experience.

Theoretical Framework

The NLN Jeffries simulation theory (Jeffries, Rodgers, & Adamson, 2015) provided the theoretical framework for this study. The NLN Jeffries simulation theory centers the importance of a simulation experience "that is experiential, interactive, collaborative, and learner centered" (Jeffries et al., 2015, p. 293). In addition to considering individual learner outcomes in simulation, the NLN Jeffries simulation theory (Jeffries et al., 2015) emphasizes the importance of evaluating the impact of

simulation on system-wide outcomes and nursing practice more generally. As a new technology that makes simulation activities easy to replicate and to share, 360-degree immersive video has the potential of major outcome impacts on healthcare systems and could change the way nursing education programs and healthcare organizations train staff. Immersive video simulation could be used from nearly any location and at any time.

The NLN Jeffries simulation theory also states the necessity of improving "the authenticity of the experience and suspending disbelief" (Jeffries et al., 2015, p. 292) during simulation. Since almost any healthcare setting or situation could be simulated using 360-degree immersive video, this format has incredible potential in increasing the veracity of simulation activities.

In the context of rapidly expanding simulation use in nursing education, this study sought to learn more about the emerging technology of 360-degree immersive simulation. By comparing student satisfaction and recognition of risks to patient safety between 360-degree immersive video and conventional video simulation, nurse educators could consider how immersive video might be used in nursing simulation. While immersive video has major potential for use in nursing education, it is important to first learn more about student satisfaction with this emerging technology.

CHAPTER II

REVIEW OF THE LITERATURE

As pre-licensure nursing programs throughout the United States continue to expand the use of simulation, nurse educators should seek out new approaches to simulation. As a new technology with tremendous potential, 360-degree immersive video could play an important role in nursing education but little is currently known regarding its effectiveness. While much remains to be learned regarding the use of the technology, the results of the limited number of studies are promising. Additionally, previously published studies on immersive audio simulation, virtual reality simulation, and promoting safety through simulation provide a foundation for new research on immersive video use in nursing education.

Search Strategy

The terminology used to describe 360-degree immersive video is still evolving and the multiple terms used to describe 360-degree immersive video complicated a search of the literature. As a result, multiple search strategies were used to attempt to capture relevant studies on 360-degree immersive video. Any study using real image 360-degree immersive video in health care was included. The CINAHL database was searched with terms “360-degree” and “video,” which returned eight results; two actually addressed 360-degree immersive video and were included in this literature review. The CINAHL was also searched with the terms “immersive” and “video” and “simulation,” returning 17 results; two met inclusion criteria.

Additionally, PubMed was searched with the terms “360-degree” and “video,” returning 23 results—one met inclusion criteria. PubMed was also searched for the terms “immersive” “video” and “simulation,” returning 51 results; three met inclusion criteria. Finally, Google Scholar was used to identify articles that had cited a landmark study on the use of 360-degree immersive video in nursing education by Everson et al. (2015).

360-Degree Immersive Video Simulation

Only two studies in the published nursing literature have evaluated 360-degree immersive video simulation use in nursing education. In landmark research, Everson et al. (2015) conducted a large study on immersive video simulation with undergraduate nursing students in Australia. Everson et al. recruited 460 pre-licensure nursing students to undergo an immersive video simulation depicting a hospital scene in another country in a language other than English. By evaluating matched pretest/posttest scores on the Modified Kiersma-Chen Empathy Scale, Everson et al. found student empathy increased significantly after participation in the immersive video simulation. Mean pre-simulation scores were 47.86 (SD = 4.64) and mean post-simulation scores were 49.24 (SD = 5.18), showing a significant increase in student empathy on the measurement tool ($p < .001$; Everson et al., 2015).

While Everson et al. (2015) showed immersive video to be an effective approach to improving student empathy, the study did not compare immersive video to conventional video. In other words, there was no evidence in the study that immersive video would have been any more effective than a simulation of the same content using a traditional two-dimensional video. Additionally, Everson et al. focused exclusively on empathy scores and did not evaluate student perception or satisfaction.

Separately, researchers in Spain compared outcomes between a live clinical simulation of a mass casualty incident and an immersive video simulation of the same activity (Ferrandini Price et al., 2018). Participants in both groups were assessed after participation to evaluate their ability to correctly triage the simulated patients in the activity; no significant differences in triage success rates were found between the two groups (Ferrandini Price et al., 2018). In an analysis of salivary alpha-amylase, a stress marker, researchers found higher stress levels in the live clinical simulation than in the immersive video simulation. Researchers concluded the immersive video simulation activity was an effective method of training in mass casualty triage (Ferrandini Price et al., 2018).

Outside the field of nursing, 360-degree immersive video has been used in training physicians to conduct laparoscopic surgery and resulted in positive feedback from participants (Huber et al., 2017; Huber, Paschold, Hansen, Lang, & Kneist, 2018). Researchers had surgeons and medical students complete surgical tasks using virtual reality simulation and immersive video simulation (Huber et al., 2018). Participants reported preferring immersive video to computer-generated virtual reality for surgical simulation activities and described an increased likelihood of using immersive video training simulators (Huber et al., 2018). In the direct comparison of 360-degree immersive video and virtual reality surgical training techniques, 67% of participants (n = 30) preferred immersive video to virtual reality (Huber et al., 2018).

In a separate evaluation of physician training activities, 360-degree immersive video instruction was shown to be more effective than conventional video in teaching doctors knot tying skills (Yoganathan, Finch, Parkin, & Pollard, 2018). First year doctors

(N =40) were randomized to either instruction on how to tie a one-handed reef knot using 360-degree immersive video or traditional two-dimensional video (Yoganathan et al., 2018). After video instruction, an assessor, who was blinded to which type of training was used for each participant, evaluated performance on a 13-point maximum knot tying assessment tool (Yoganathan et al., 2018). The immersive video group had significantly higher performance scores on the knot tying assessment (mean score was 5) compared to the conventional video group (mean score of 4, p = .0396) (Yoganathan et al., 2018). Importantly, this study was the only research available in published literature that compared 360-degree immersive video to conventional video in a healthcare setting.

Finally, researchers outside of health care found viewing immersive images resulted in physiological responses among participants most similar to those created by reality (Higuera-Trujillo, Maldonado, & Millan, 2017). Importantly, immersive images outperformed conventional images and virtual reality when evaluating physiological responses among participants (Higuera-Trujillo et al., 2017).

Virtual Reality Simulation

While very different than 360-degree immersive video, previous research examined the use of computerized virtual reality simulation and demonstrated the success of simulation delivered in a video format. In a review of the literature, Irwin and Coutts (2015) examined 14 studies that evaluated the use of a virtual reality computer program called Second Life in nursing education. Irwin and Coutts concluded previous research demonstrated positive nursing student outcomes and experiences with the use of this virtual reality program. Other reviews have articulated the potential applications of

virtual reality simulation in nursing education and identified the need for ongoing development and research in the area (Kilmon, Brown, Ghosh, & Mikitiuk, 2010).

Immersive Audio Simulation

The widest body of research regarding immersive simulation in nursing has been conducted with immersive auditory simulations of mental illness. In these auditory simulations, which are frequently used in nursing education, nursing students listen to voices and noises that simulate disturbing voices heard by some mentally ill patients during a psychotic episode. Dearing and Steadman (2009) performed qualitative research to evaluate the impact of immersive audio simulation of mental illness on student empathy and patient relationship. Participants described being significantly impacted by the simulation experience, gaining insight into mental illness, and increasing empathy levels (Dearing & Steadman, 2009).

In a study of the impact of immersive auditory simulations on knowledge of mental illness, auditory simulation was used among nursing students ($N = 60$) as a learning activity (Mawson, 2013). Analysis of matched pre/post questionnaire results found auditory simulation significantly increased nursing student knowledge of auditory hallucinations (Mawson, 2013). Separately, Kidd, Tusaie, Morgan, Preebe, and Garrett (2015) found immersive audio simulation significantly impacted nursing students' ($N = 87$) perceptions of mental illness and increased nursing student empathy. In the study, immersive audio simulation significantly impacted scores on the Attitude Toward Mental Illness Questionnaire and qualitative results showed participants reported they would likely be "more tolerant, more considerate, more empathetic, more understanding" (Kidd et al., 2015, p. 114) toward people with mental illness.

Simulation and Safety

In a high quality, integrative review of evidence using simulation to teach patient safety in pre-licensure nursing education, Berndt (2014) examined 17 previously published articles on patient safety and simulation. Inclusion criteria for the integrative review included the topic of patient safety, simulation use in the study, and pre-licensure nursing education; exclusion criteria included post-licensure nursing education programs, medical education, and staff development (Berndt, 2014).

After detailed analysis of each of the 17 identified published studies and literature reviews, Berndt (2014) concluded the available evidence showed simulation to be an effective approach to teaching students about patient safety. Specific conclusions included simulation on patient safety topics was more effective than traditional lecture, had high student satisfaction, and was effective across levels in pre-licensure nursing education (Berndt, 2014). Berndt noted simulation was particularly effective regarding teaching about patient safety when other clinical opportunities were not available. Included in the review were studies that found fewer medication errors occurred after training with simulation (Sears, Goldsworthy, & Goodman, 2010) and better safety practices occurred among students who had participated in simulation (Ironside, Jeffries, & Martin, 2009). This integrative review provided significant support for the use of simulation on the topic of patient safety and showed multiple previous studies and literature reviews had already demonstrated the effectiveness of simulation activities in promoting patient safety in pre-licensure nursing education.

Summary and Analysis

While the nursing literature contained instances of successful use of 360-degree immersive video in nursing simulation, relatively little has been reported regarding its effectiveness. No available studies among nursing students have compared 360-degree immersive video simulation to conventional video simulation and no available studies have evaluated nursing student satisfaction with the technology. While tremendous potential for use of 360-degree immersive video in nursing education exists, additional research is needed to compare the new technology to conventional video and to learn more about student satisfaction with the approach.

CHAPTER III

METHODOLOGY

Research Design

A quasi-experimental, quantitative research design was used to evaluate the use of 360-degree immersive video simulation in pre-licensure nursing education. The study measured student satisfaction with simulation using the technology and ability to recognize threats to patient safety. The following research questions guided the study:

Q1 What is the difference in scores on the National League for Nursing Student Satisfaction and Self-Confidence in Learning instrument between simulation using 360-degree immersive video and simulation using conventional video?

Q2 What is the difference in the number of risks to patient safety identified by nursing students between participants in a 360-degree immersive video simulation and a conventional video simulation?

Overview

For this study, a simulation of a nurse and patient interaction in a hospital setting was developed by the researcher and recorded in both 360-degree immersive video and in conventional video. Both the 360-degree immersive video and the conventional video depicted the same simulated clinical scenario containing multiple risks to patient safety. A specialized camera was utilized to create video output of the same filmed scenario. Approximately half of the participants viewed the 360-degree immersive video and half of the participants viewed the conventional video.

Immediately after viewing the video simulation, participants completed the National League for Nursing Student Satisfaction and Self-Confidence in Learning survey (NLN survey; Jeffries & Rizzolo, 2006). The NLN (2019) granted use of this survey without charge or need to obtain additional permission for non-commercial research. This NLN survey has been used extensively in nursing education research and has been shown to be a reliable and valid tool (Franklin, Burns, & Lee, 2014). It has previously been used to evaluate differences in student satisfaction between different types of simulation activities (O'Donnell, Decker, Howard, Levett-Jones, & Miller, 2014). Following the simulation, participants were asked to list all risks to patient safety observed in the video simulation and the total number of identified risks to patient safety was recorded for analysis.

Setting

This research study took place at two campuses of a large associate degree registered nurse program in Texas. While the nursing program has three campuses, the study only occurred at two of the campuses as the researcher teaches pre-licensure students at the third site. The video simulation activities occurred in standard laboratory classrooms at the respective campuses and no specialized simulation laboratory equipment such as manikins, monitors, or other simulation equipment was required. The laboratory classroom was arranged so each participant was seated in front of a table with at least five feet between each participant. Participants were familiar with the setting of the study as it took place in the same buildings as nursing courses in the program.

Sample

A convenience sample of 91 pre-licensure nursing students enrolled in an associate degree registered nurse program at a community college in Texas were recruited for the study. Students enrolled in the final semester of the pre-licensure registered nurse program at two campuses of the college were invited to participate in the study. Students enrolled at the third campus were not recruited as the researcher teaches pre-licensure students at that campus. The study utilized a one-time measurement approach; therefore, participant retention was not an issue. All participants were 18 years of age or older. To avoid the possibility an individual participant could be identified and connected to completed surveys, demographic information was not collected in the study.

Potential participants were informed that their participation, or decision not to participate, had no impact on their evaluation or course grade. Based on a priori power analysis using GPower 3.1, 84 participants were needed for an effect size of .80 and an alpha level of .05. Cohen (1988) advocated using an effect size of .80 to establish desired power absent a compelling reason to choose another value.

Instrumentation

The principle instrument used in this quantitative study was the NLN Nursing Student Satisfaction and Self-Confidence in Learning instrument (Jeffries & Rizzolo, 2006). A 13-item Likert-scale questionnaire (see Appendix A), this instrument assesses student satisfaction with a simulation activity and student self-confidence in learning with a simulation activity (Jeffries & Rizzolo, 2006). The NLN (2019) instrument contains five items measuring student satisfaction and eight items measuring self-confidence (NLN, 2019).

The NLN survey has been used extensively in nursing education research and has been shown to be a reliable and valid tool (Franklin et al., 2014). Reliability testing using Cronbach's alpha was found to be 0.94 for the student satisfaction subscale and 0.87 for the self-confidence subscale (Jeffries & Rizzolo, 2006). The survey has previously been used to evaluate differences in student satisfaction between different types of simulation activities (O'Donnell et al., 2014).

Quantitative data were also collected regarding the number of identifiable risks to patient safety in the video simulation. The researcher identified multiple risks to patient safety purposefully depicted in the video. To establish the validity of the video and the identified risks to patient safety, five nurse faculty members were asked to view the simulation video and list risks to patient safety they believed to be present in the scene. Based on this expert review, the researcher created the following list of 23 risks to patient safety in the video, which was used to evaluate and quantify participant responses. All participant responses were evaluated against this master list of identified risks to patient safety and each validated identified risk was counted. This final numerical score of identified risks to patient safety was recorded for each participant. The researcher was blinded as to which video (360-degree immersive video or conventional video) each participant viewed while calculating the number of risks to patient safety identified. No demographic information was collected to avoid the possibility of potentially collecting identifying information regarding participants.

- Hand hygiene not performed
- Patient not identified appropriately
- Entry measures not performed

- Medication not checked against orders or Medication Administration Record (MAR)
- Patient not assessed appropriately before medication administration
- Side effects of medication not discussed
- Did not assess for allergies
- Medication not taken
- IV not cleaned before flushing
- Threw saline flush across room
- Left room with gloves on
- Status of side rails
- Bed elevated
- Pill bottle on table in room
- Items on the floor
- SCDs not on patient
- Nasal canula attached to wall but not patient
- Call light not in reach
- Sharp sticking out of sharps container
- No fall risk band
- No patient ID band
- Belongings not in reach
- Exit measures not performed

Finally, participants were asked four open-ended questions to learn more about the participants' experience with 360-degree immersive video simulation.

1. What are your thoughts on 360-degree immersive video use in nursing education?
2. In what ways, if any, would you like 360-degree immersive video to be used in your nursing education?
3. What did you like about 360-degree immersive video simulation?
4. What did you dislike about 360-degree immersive video simulation?

Data Collection Protocol

This study took place during multiple sessions in the fall 2019 academic semester at two community college campuses of the same nursing program in Texas. At least two weeks prior to the scheduled date of a session of the study, participants were invited to be part of the study via electronic message posted to the official online learning management system used in nursing courses. This message contained information about the study, potentials risks/benefits to participation, disclosure that participation was entirely voluntary, and assurance that the decision to participate, or not to participate, would in no way impact their course grade. Additionally, contact information for the researcher was provided to all potential participants so additional questions could be asked prior to the study date and an electronic copy of the consent form was provided (see Appendix B).

Immediately prior to participation in the study, all participants were given written information regarding the study consisting of the same text previously sent via the online learning management system (see Appendix C). Participants were reminded they could choose to end participation in the simulation at any time and should do so if they experienced any dizziness while viewing the 360-degree immersive video simulation. Additionally, all potential participants were again informed the study was voluntary and

copies of the consent form were given to each participant wishing to participate. All participants returned a signed copy of the consent form to the researcher prior to beginning the study. Participants were able to choose to withdraw from the study at any time without repercussions.

After signed consent documents were collected, the researcher familiarized the participants with the simulation activity. In this orientation, participants were informed all wearable equipment used in the simulation had been cleaned since last use and participants were asked to sit in chairs at tables throughout the room.

Participants were assigned to view either a 360-degree immersive video on a specialized immersive video viewer or to view a conventional video of the same scene on a laptop computer. The researcher alternated between assigning participants to view an immersive video or conventional video to ensure that similar numbers of participants in each group were obtained. Participants were not able to choose which video delivery method they viewed and no knowledge of individual participants played a role in assignment to each group. The researcher's intent was to assign participants at random. While wearing headphones, each participant then viewed either the 360-degree immersive video simulation on a 360-degree immersive video viewer or the conventional video simulation of the same scenario on a laptop computer.

Immediately following the completion of the video simulation, participants completed the NLN survey (Jeffries & Rizzolo, 2006). Additionally, participants were provided a sheet of paper and asked to list all risks to patient safety viewed in the video; no identifying information was collected but the sheet was marked to indicate if the participant viewed the 360-degree immersive video or the conventional video simulation.

The completed surveys were collected and the participants were thanked for their participation in the study. All wearable equipment was then cleaned by the researcher with disinfectant wipes.

Protection of Subjects and Institutional Review Board Approvals

Institutional Review Board approval was obtained from the University of Northern Colorado where the researcher is a doctoral student in nursing education conducting dissertation research (see Appendix D) and from the community college where the study took place (see Appendix E). There were minimal risks to participants in this study. While 360-degree immersive video is a widely used technology, it is possible participants could develop dizziness while viewing an immersive video. Participants were informed of this risk prior to the start of the study and were told to remove the immersive video headset if dizziness occurred. No other risks were anticipated greater than those encountered in typical nursing classroom instruction. Potential benefits to participants included increased instruction in recognizing risks to patient safety and gaining experience working with an emerging technology.

To avoid the perception that participation, or lack of participation, could influence course grade or status in the nursing program, students at the researcher's campus were not recruited for the study. The researcher did not have an instructional or administrative role with potential participants at the two campuses where the study occurred during the time the study took place. To protect participant confidentiality, no identifiable information was collected on surveys or instruments. Participants were informed they could choose to leave the study at any time without consequence.

No costs to participants were associated with this research study. Participants did not receive any money, refreshments, gift cards, extra clinical time, or extra credit for participating. The only identified possible compensation for participants came in the form of any additional knowledge gained on the subject of recognizing risks to patient safety or use of new technology.

Data Handling Procedures

Following any data collection event, completed surveys and signed consent forms were stored in a locked drawer in a locked private office on a campus of the community college where the study took place. Electronic data were stored on a password-protected computer and/or a password-protected, cloud-based electronic storage service. Only the researcher or research advisor had access to the completed surveys. Following final completion of the research project, the surveys will be destroyed via shredding or a secure document destruction service and the signed consent forms will be stored for a period of three years in accordance with research guidelines, copies of which will be stored in the research advisor's office at the University of Northern Colorado. No participant names were requested or collected on the surveys and there was no method by which a survey could be connected to a specific individual.

CHAPTER IV

RESULTS

Data Analysis Procedures

Collected survey data from the NLN survey were first transferred from the paper surveys into an Excel spreadsheet and then entered into Statistical Package for the Social Sciences (SPSS) Statistics 25. Once entered into SPSS, the original surveys were then compared to the SPSS data set to confirm participant responses were correctly entered. A convenience sample of 91 adult nursing students in their final semester from two campuses of a pre-licensure associate degree nursing program in Texas were recruited for the study. Additional demographic information was not collected as part of the study. Of the 91 participant surveys collected, 46 participants viewed the conventional video and 45 participants viewed the 360-degree immersive video. Prior to analysis, all surveys were reviewed to ensure participant responses were complete and clearly marked. The researcher determined six participant surveys contained one or more responses that were either blank or where the participant had marked more than one response. These six participant surveys were then excluded from analysis, leaving 42 participants in the conventional video group and 43 participants in the 360-immersive video group. The NLN survey could have a response range on each item between 1 and 5. Descriptive statistics confirmed all responses entered into SPSS were within this range of acceptable response scores. The range of responses and average by item among all respondents (n = 85) are presented in Appendix F.

On the second measurement of identified risks to patient safety, all 91 participants provided some manner of response and remained in the analysis. Descriptive statistics for responses to identified risks to patient safety are in Appendix G. Significance for this study was considered to be a $p < .05$ for both the NLN survey and identified risks to patient safety results.

Finally, 45 participant responses to the exploratory questions on perceptions of 360-degree immersive video were reviewed. Responses from each of the four open-ended questions for the 45 participants who viewed the 360-degree immersive video were entered into an Excel spreadsheet. Once assembled electronically, these responses were reviewed at length so they could be clearly described and the frequency of answers to these exploratory questions could be presented.

Normality of Results

Data collected from each item on the NLN surveys was analyzed for normality using the Shapiro-Wilk test. This analysis found the data on all 14 items of the scale were not normally distributed ($p = .000$ to $p = .001$). Additionally, aggregate results on the satisfaction in learning subscale, the self-confidence in learning subscale, and total scores on the 13-item instrument were analyzed for normality and were not found to be normally distributed ($p = .000$ to $p = .047$). The SPSS outputs for tests of normality on the NLN survey results, including the Shapiro-Wilk test, are located in Appendix H, and descriptive statistics for each item are located in Appendix I. Visual analysis of Q-Q plots was consistent with the Shapiro-Wilk tests, indicating the data were not normally distributed. The Q-Q plots for results of the NLN survey results are provided in Appendix J.

Analysis of the data on the number of identified risks to patient safety using the Shapiro-Wilk test showed normal distribution in both the conventional video group (p = .262) and in the 360-degree immersive video group (p = .322). The SPSS outputs for tests of normality on identified risks to patient safety results, including the Shapiro Wilk test, are located in Appendix K, and descriptive statistics are located in Appendix L. Visual analysis of Q-Q plots was consistent with the Shapiro-Wilk test, indicating the data were normally distributed. The Q-Q plots for results of identified risks to patient safety are presented Appendix M.

Since data from the NLN surveys were not normally distributed, the Mann Whitney U test was used to analyze the data. Since data on the number of identified risks to patient safety were normally distributed, an independent samples *t*-test was used for analysis on these results. After determining that the Mann-Whitney U test would be used to assess for differences between the immersive video and conventional video groups on the NLN survey, histograms of each response for each of the 13 items were created. On analysis, these histograms were found to be similarly shaped. As a result, the Mann Whitney U test was additionally used to compare medians of the results. Histograms for results on each item on the NLN survey are provided in Appendix N.

Results for Research Question One

Q1 What is the difference in scores on the National League for Nursing Student Satisfaction and Self-confidence in Learning instrument between simulation using 360-degree immersive video and simulation using conventional video?

The Mann-Whitney U Test was used to test for differences on the NLN survey between the 360-degree immersive video and conventional video groups. After excluding results from six participants due to unclear or absent results, 85 participant

surveys were analyzed with 42 participants in the conventional video group and 43 participants in the immersive video group. Each of the 13 items on the survey asked participants to mark *Strongly Disagree* (1), *Disagree* (2), *Undecided* (3), *Agree* (4), or *Strongly Agree* (5) in response to the item statement.

Total scores on the 13-item NLN survey were calculated and entered into SPSS. Since aggregate scores on the satisfaction with current learning subscale, the self-confidence in learning subscale, and the total scores on the entire instrument were not normally distributed, the Mann Whitney U test was used to analyze these aggregate scores. On the five-item satisfaction with current learning subscale, no significant difference was found between the median total score in the conventional group (20.5) and the median total score in the 360-degree immersive video group (23.0), U=733.5, z=-1.514, p = .130. On the eight-item self-confidence in learning subscale, no significant difference was found between the median total score in the conventional group (32.0) and the median total score in the 360-degree immersive video group (35.0), U=808.5, z=-.836, p = .403. Finally, on the total aggregate scores of the 13-item instrument, no significant difference was found between median total scores in the conventional group (53.0) and the median total scores in the 360-degree immersive video group (58.0), U=776, z=-1.120, p = .263.

Satisfaction with Current Learning

The first five items on the NLN survey evaluated student satisfaction with the simulation activity. Only Items 3 and 4 on this subscale were significantly different between video simulation groups (see Table 1 for further details).

Table 1

Satisfaction with Current Learning Subscale Results

Item		Group	Median	Mann-Whitney U Test
1	The teaching methods used in this simulation were helpful and effective.	CV	4	U=783, z=-1.14, *p* = .253
		IV	5	
2	The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.	CV	4	U=753, z=-1.39, *p* = .164
		IV	4	
3	**I enjoyed how my instructor taught the simulation.**	**CV**	**4**	**U= 656, z=-2.43, *p* = .015**
		IV	**5**	
4	**The teaching materials in this simulation were motivating and helped me to learn**	**CV**	**4**	**U= 695, z=-1.97, *p* =0.049**
		IV	**5**	
5	The way my instructor taught the simulation was suitable to the way I learn	CV	4	U=839, z=-.61, *p* = .545
		IV	4	

CV = Conventional Video, IV =Immersive Video. Bold font indicates significance.

Self-Confidence in Learning

Items 6 through 13 on the NLN survey evaluated student self-confidence in relation to the simulation and used the same scale as the first five items. Of the eight items on this part of the instrument, only Item 9 was found to be significantly different between the two groups (see Table 2 for details). The SPSS outputs for the Mann-Whitney U test can be found in Appendix O.

Table 2

Self-Confidence in Learning Subscale Results

Item		Group	Median	Mann-Whitney U Test
6	I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	CV	4	U=819, z=-.80, *p* = .425
		IV	4	
7	I am confident that this simulation covered critical content necessary for the mastery of the medical surgical curriculum.	CV	4	U=842, z=-.58, *p* = .565
		IV	5	
8	I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting.	CV	4	U=828, z=-.72, *p* = .472
		IV	5	
9	**My instructors used helpful resources to teach the simulation.**	**CV**	**4**	**U=686, z=-2.11, *p*= .035**
		IV	**5**	
10	It is my responsibility as the student to learn what I need to know from this simulation activity.	CV	4	U=862, z=-.40, *p* = .692
		5		
11	I know how to get help when I do not understand the concepts covered in the simulation.	CV	5	U=894, z=-.092, *p* = .927
		IV	5	
12	I know how to use simulation activities to learn critical aspects of these skills	CV	5	U=902, z=-.80, *p* = 0.988
		IV	5	
13	It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time.	CV	3	U=780, z=-1.12, *p* = 0.264
		IV	4	

CV = Conventional Video, IV =Immersive Video. Bold font indicates significance.

The reliability of the Satisfaction with Current Learning subscale (five items) and the Self-Confidence in Learning subscale (eight items) were analyzed using Cronbach's alpha. The Satisfaction with Current Learning subscale was found to be reliable with a Cronbach's alpha of .899. The Self-Confidence in Learning subscale was also found to be reliable with a Cronbach's alpha of .880. Cronbach's alpha coefficients between .7 and .9 have been described as "optimal" (Creswell & Creswell, 2018, p. 154) and are indicative of internal consistency. Measurements of Cronbach's alpha found in this study were similar to those reported previously in the nursing literature for the NLN survey (Jeffries & Rizzolo, 2006).

Results for Research Question Two

Q2 What is the difference in the number of risks to patient safety identified by nursing students between participants in a 360-degree immersive video simulation and a conventional video simulation?

The researcher, with the input of five nursing faculty members, identified 23 risks to patient safety depicted in the video simulation. After viewing the video simulation, each participant was asked to list all risks to patient safety depicted in the video on a largely blank form. Each response from participants that was present on this master list of faculty-identified risks to patient safety depicted in the video counted toward a total tally for each participant. This list was utilized to assign a single value of identified risks to patient safety in the simulation video for each participant who viewed the conventional video (n = 42) and the 360-degree immersive video (n=45). Since these results were normally distributed, an independent t-test was used for data analysis. There was no significant difference between the number of risks to patient safety identified by participants who viewed the conventional video (M = 5.7609, SD = 2.34932) and the

number of risks to patient safety identified by participants who viewed the 360-degree immersive video (M = 4.8444, SD = 2.34478; $t(89)=1.86$, p = .066). The SPSS outputs for the independent *t*-test on identified risks to patient safety can be found in Appendix P.

Open-Ended Exploratory Questions

All of the participants who viewed the 360-degree immersive video (n = 45) completed a four-question survey immediately after watching the video. The questionnaire had three lines allotted for participant responses for each of the four questions. More than adequate time was given for participants to answer the questions and none of the participants ran out of time while completing the questionnaire. Since the questions were specific to 360-degree immersive video, participants who viewed the conventional video were not provided this form and did not answer these questions. Following data collection, all responses on the four-question survey were entered into an Excel spreadsheet for further review.

Responses to each question were reviewed to learn more about participant perceptions regarding 360-degree immersive video use in nursing education. Specific focus was given to analyzing participants' thoughts on 360-degree immersive video, how participants would like immersive video used in nursing education, what participants liked about immersive video, and what participants disliked about immersive video.

Responses to First Open-Ended Question

The first open-ended question on the questionnaire asked participants to share their thoughts on the use of 360-degree immersive video in nursing education. Descriptions of participant responses to this open-ended question focused on identifying

positive and negative responses about the technology and on identifying common feedback from participants.

Positive responses. Of the 45 participants who viewed the 360-degree immersive video and completed the questionnaire, 37 provided primarily positive feedback regarding the technology in their responses to Question 1: What are your thoughts on 360-degree immersive video use in nursing education? Five participants used the word "cool" to describe the technology, two described it as "fun," and two said they "loved" the technology. Additionally, other participants used terms like "enjoyed," "effective," "innovative," and "interesting." A sample of positive participant responses can be found below.

- "I loved it! Great learning experience."
- "It was fun, and different from what we are used to."
- "I think it's a great way to combine technology and education."
- "It was innovative and I enjoyed this type of instruction."
- "Overall, excellent way of presenting clinical info/ scenarios."
- "I enjoyed this as a learning experience."
- "I think it would be cool to integrate this technology in nursing education."
- "I think it would be a valuable asset to our learning environment."
- "I think it's a really effective way to learn."
- "It's a good experience."

Negative responses. Of the 45 participants who viewed the 360-degree immersive video and answered the questionnaire, three provided primarily negative feedback regarding use of the technology in nursing education. One participant described it as "certainly not for me" and another participant stated that lacking interaction with the scenario, "it was no different than watching a flat video." Additionally, five responses

could not be characterized as either primarily positive or negative in nature or did not specifically address 360-degree immersive video. The negative participant responses can be found below.

- "I know there is potential to interact with 360-degree tech. Being this was just a video without interaction, I felt it was no different from watching a flat video."
- "It is different, might be interesting for some but certainly not for me. I felt a little bit dizzy watching it."
- "Not my kind of learning method."

Realistic. After thorough review of the responses to Question 1, the realistic nature of 360-degree immersive video emerged as common participant responses. Nine respondents specifically mentioned the simulation was "realistic" or could help with "real-life" experiences in nursing education. In addition to the participants who specifically used the words "realistic" or "real" in their answers, six respondents described similar benefits such as having the perception of having the nurse's point of view, being with the patient, and having the ability to scan the room. For example, participants mentioned the perception of being "there myself," and having the perception of being "with the patient." A selection of participant responses is provided below:

- "I felt I was with the patient."
- "The students can be presented real life experiences that you wouldn't have elsewhere."
- "I liked it and thought it was helpful. I like seeing it in real life."

- "I enjoyed it and felt as though the video was the next best thing to actually being in a live room."
- "Helpful to be able to view a real scenario."
- "I think it is an effective way to present several different real life nursing situations."
- "I was able to look around the room as I would be as if I was there myself."
- "I felt as if I was actually in actions with the nurse."
- "It gives a better 'real view' of a hospital room."

User video experience improvements. Another common response to Question 1 involved the potential to improve aspects of the video experience with the 360-degree immersive video. Ten participants reported varying issues with the user video experience when viewing 360-degree immersive video including needing more information on expectations with the simulation (2), obstruction to some of the viewing area in the video (2), the video was too short (2), dissatisfaction with the content of the video itself (2), and lack of interaction with the video (1). Additionally, two participants reported it took time to become accustomed to the immersive video experience. Some participant responses are provided as follows:

- "Visually takes a minute to get used to at first."
- "It was pretty cool. Just took some time to get used to it."
- "Being this was just a video without interaction I felt it was no different from watching a flat video."
- "Short. Not my kind of learning method."

- "It took me a minute to realize that if I turned my head I could see more."
- "I couldn't figure out how to move an image off screen & so I felt I missed some important things."
- "It is a good idea, however some of the viewing area was hard to see."
- "I like the use of the technology just with there was more information on what was expected."

Responses to Second Open-Ended Question

The second open-ended question for participants who viewed the 360-degree immersive video asked in what ways, if any, they would like 360-degree immersive video used in their nursing education. Of the 45 respondents, one participant stated they did not want the technology used in any way. The remaining 44 responses identified multiple ways the technology could be used in nursing education. Common suggestions for how the technology could be used in nursing education included simulation activities, to expand clinical scenarios, to teach about emergency situations, to identify clinical errors, and in nursing skills. Additionally, four participants expressed that 360-degree immersive video scenarios should be made interactive.

Simulation and scenarios. Fourteen of the 45 respondents specifically responded they would like 360-degree immersive video used in simulation in their nursing education. An additional 10 participants stated they would like it used in various "scenarios" in their nursing education. Finally, an additional 11 participants, while not using the terms simulation or scenarios, provided examples of how they would like 360-degree immersive video to be used that would most likely be a simulation experience. In total, 35 participants described wanting to use of 360-degree immersive video in a

manner descriptive of simulation activities in nursing education. Participant quotes included the following:

- "More in simulation days and possibly in labs."
- "I think it would be a helpful tool in our simulation training."
- "I think it would be good to include it in simulations…"
- "Monthly 360 encounters would enhance our simulation experience."
- "It will be nice for it to be use in simulations almost at all time. This will make learning impactful."
- "Used for demonstration of more scenarios we are likely to encounter."
- "I think how this was presented is a good start. I feel using this method to help students learn assessing pts in different scenarios would help as well."
- "I would prefer this to be incorporated so that we are exposed to more scenarios."
- "More scenarios/ different scenarios."
- "It could be helpful to experience potential dangerous situations we might face (e.g. aggravated patient)."
- "I can see this being useful for 60 sec. [seconds] assessments and students deciding on appropriate patients priority of care."
- "Patient-nurse interaction."

Emergencies. A common response of participants was they would like 360-degree immersive videos to be used in their nursing education regarding emergency situations. Nine participants specifically mentioned emergency scenarios or emergency

care as a way they would like this technology used in their nursing education. Some participant quotes included the following:

- "Assessments, triage, emergent scenarios, CPR."
- "Witnessing a crash or trauma in the ED would be interesting to see so I could look around at what each person is doing in the situation and learn roles."
- "Used in scenarios where emergent situations occurred."
- "Time sensitive scenarios. Codes."
- "It would be cool to use it in a ER fast pace situation."
- "Emergent care, assessments, other scenarios where we can experience real life situations."

Clinical errors. Another common response was the immersive video could be used to help identify clinical errors portrayed in a scenario. Four participants stated they would like 360-degree immersive video to be used to help identify clinical errors. Specifically, participants stated that the technology could be used to have students identify incorrect nursing skills performance and "wrong" findings in clinical settings. Participant quotes included the following: "In scenarios of 'what's wrong with this picture' and techniques," "Videos like these, quick short 'what is wrong'," and "I feel it would benefit future nursing students by allowing them to scan a room, what improper procedures look like."

Make interactive. Additionally, four participants expressed they would like to see an interactive version of 360-degree immersive video used in their nursing education. Potential examples of how this approach could be applied to immersive video included

pausing the immersive video to ask questions and having students make nursing decisions as part of the immersive video experience. Participants made the following comments:

- "I could see if we as students were making the nursing choices but just watching a video doesn't do much."
- "Video similar to what was provided are excellent. I might like to see pauses with questions in the video, to verify understanding."
- "More scenarios should be offered via VR with options to click different things and make clinical decisions within the scenario."

Skills/lab. Finally, some participants stated they would like 360-degree immersive video to be used for nursing skill performance or in the lab, which is where nursing skills are taught. Six participants identified skills or the lab as a potential use for the technology:

- "Skills."
- "Could be used in skills lab- maybe to demonstrate both good and bad nursing skills."
- "During simulations and skills check offs and in the classroom during the topic issue."
- "It's a nice change to sim. Maybe incorporating them into a lab."
- "Supplemental to lab."
- "More in simulation days and possibly in labs."

Responses to Third Open-Ended Question

For the third open-ended question, participants were asked to state what they liked about 360-degree immersive video after viewing the video scenario. The answers were reviewed in depth and the realistic nature of the technology, the ability to scan the environment, fewer distractions, individualized learning, and the novel nature of the technology emerged as common responses from participants. One participant did not identify anything they liked about 360-degree immersive video.

Realistic. Thirteen of the respondents used the words "real" or "realistic" to answer what they liked about 360-degree immersive video. An additional six participants, while not using the terms "real" or "realistic," described the feeling of being in the scenario as what they liked about the technology:

- "Felt very real."
- "I like that it feels realistic, you have a full view of the room to allow for a better assessment."
- "You could see what's happening in real life."
- "The realism of safety concerns that we will face."
- "It was like we are actually in the room, getting the experience."
- "It felt like a real scenario, and it was engaging."

Look around the room. Eight participants cited the ability to look around the room in 360-degree immersive video as something they liked about the technology. Six participants identified the ability to "scan" the room and "to look around yourself" as things they liked about 360-degree immersive video.

- "I liked that I could look around and felt like I was in the room."

- “That I could scan the room like I will do in real life, with a computer screen you don't have that option.”
- “It allows you to look around yourself and I don't have to be dependent on the camera's view.”
- “The ability to look around the patient's room as if I were there.”
- “It was nice to be able to scan the room at will.”
- “I liked that you can look around the room to assess the situation.”

User experience. Other common items the participants reported liking about 360-degree immersive video included fewer distractions, the individual nature of the experience, the video quality, and that it was a new/ different approach. Two participants cited the lack of distraction as something they liked about immersive video and two participants answered they liked the individual nature of the approach to simulation. Finally, three participants liked that the 360-degree video was new or different (see Table 3 for additional comments).

Table 3

Positive User Experience Regarding 360-degree Immersive Video Simulation

User Experience	Participant Comments
Fewer Distractions	"The immersiveness of it no distractions are possible."
	"Less distraction."
Learning Style	"It is 1 on 1 educational methodology."
	"It was used by 1 student at a time."
	"On my own time."
	"For visual learners, I think its great."
	"I'm a visual learner so this is perfect for me."
Video Quality	"Picture was clear."
	"The picture was clear. Felt real."
	"Video quality."
New/Different	"It was new."
	"New and different."
	"So realistic and different."

Responses to Fourth Open-Ended Question

While participant feedback on 360-degree immersive video was generally very positive, participants reported certain items they disliked about immersive video. The most common responses concerned disliking dizziness associated with 360-degree immersive video, video volume, aspects of the visual experience, and length of the video.

Dizziness. Although no participants withdrew from the study, 11 participants reported experiencing varying degrees of one or more of the following after watching the 360-degree video: dizziness (8), nausea (3), lightheadedness (2), motion sickness (1), and headache (1). Dizziness was a possible predicted effect disclosed to participants in the consent form and in the information provided to participants prior to the beginning of the study. Some participants commented as follows:

- "It made me feel dizzy and nauseated."
- "The fact that it made me dizzy because of the movements."
- "It did make me feel a little dizzy."
- "Mild dizziness."
- "The quality of the video was a bit blurry and the movement made me a bit dizzy."
- "A little motion sickness."
- "It was great, just developed some nausea/dizziness."

User experience. Three participants reported disliking the length of the video (two minutes), stating it was too short. A common dislike regarding the video itself was the presence of a menu bar that was obstructing the video for participants; four students reported this issue. Other participants disliked the lack of interaction within the immersive video simulation itself. Two participants also reported the volume of the video was too low and they had difficulty hearing the dialogue during the simulation. Table 4 provides comments regarding the user experience. Finally, nine participants reported they disliked "nothing" about 360-degree immersive video or they liked everything about the technology.

Table 4

Negative User Experience Regarding 360-degree Immersive Video Simulation

User Experience	Participant Comments
Volume	"It was a little hard to hear- don't know if there was a volume button I could have adjusted." "I couldn't hear it that well and I couldn't get an image off the screen to see all the nurse was doing. But overall liked the new material." "Short, volume is low that I couldn't hear much but I could see clearly. Would be great during Level 1-4."
Visual Experience	"It felt weird at first but then I got used to it." "Takes some getting used to when viewing wasn't sure how to get rid of the tool bar on screen." "Video quality could be better but for a system running independently from a PC w/ high-end CPU, not too bad." "There was a menu bar in the middle of the screen that did not allow me to see the entire thing- it would be nice if this menu could be minimized to the side." "There was a menu bar at the bottom of the screen so I couldn't see down there. Also, giving options for different actions would be a great tool." "The scenario was not helpful and we did not make any decisions as to the proper nursing care." "Some of the viewing area was hard to see, such as trying to look down."
Length	"It went by quickly." "Not long enough! It was great otherwise." "Short."

Summary

After analysis of the NLN survey, statistically significant increases in scores were found on Item 3 and Item 4 on the student satisfaction subscale among participants who viewed the 360-degree immersive video. Additionally, a statistically significant increase in scores among the 360-degree immersive video group on Item 9 on the self-confidence subscale was detected. On the remaining 10 items of the NLN survey, no significant

difference was detected between the conventional video group and the immersive video group.

After analysis of the number of risks to patient safety identified by participants after watching videos, no statistically significant difference was detected between the 360-degree immersive video group (n = 42) and the conventional video group (n = 46).

Finally, responses to exploratory questions of participant perceptions of 360-degree immersive video included positive feedback on the technology, particularly relating to the realistic nature of the technology. Common areas where participants described they would like the technology used included in simulation, teaching about emergency situations, and identifying clinical errors. Multiple participants reported opportunities for improvement on the video itself, specifically concerning the potential to make it interactive, the volume, visual obstructions in the video, and length. Finally, seven participants reported experiencing dizziness after watching the video.

CHAPTER V

DISCUSSION AND CONCLUSIONS

The purpose of this study was to learn more about nursing student perceptions of 360-degree immersive video use and to compare 360-degree immersive video to conventional video, especially with regard to student satisfaction and ability to recognize risks to patient safety. As nursing programs consider major expansions in the use of simulation, it is important to consider and to evaluate new approaches to simulation. Immersive video has tremendous potential to be incorporated into nursing education but as a new technology, there was limited information in the nursing literature regarding how it compared to conventional video and student perceptions of the technology. This chapter presents a summary of the findings of the study, discusses implications of the study, provides recommendations for additional research, and considers limitations of the study.

Summary

Research Question One

Q1 What is the difference in scores on the National League for Nursing Student Satisfaction and Self-confidence in Learning instrument between simulation using 360-degree immersive video and simulation using conventional video?

This study found scores on the NLN survey were higher on 3 of 13 items for participants who viewed the 360-degree immersive video than for participants who viewed the conventional video. Two of these items were part of the student satisfaction

subscale: Item 3—I enjoyed how my instructor taught the simulation and Item 5—The way my instructor taught the simulation was suitable to the way I learn (Jeffries & Rizzolo, 2006). The third item with a significant difference was part of the self-confidence in learning subscale: Item 9—My instructors used helpful resources to teach the simulation (Jeffries & Rizzolo, 2006). There were no other significant differences on the NLN survey were found for the remaining 10 items.

Research Question Two

> Q2 What is the difference in the number of risks to patient safety identified by nursing students between participants in a 360-degree immersive video simulation and a conventional video simulation?

This study did not find a significant difference in the number of risks to patient safety identified between participants viewing the 360-degree immersive video and the conventional video. While the average number of safety risks identified was higher in the conventional group, there was no statistically significant difference between the groups.

In responses to open-ended exploratory questions, written answers from participants provided significant insight into their perceptions of 360-degree immersive video. Participant feedback about the technology was generally very positive with some exceptions with important implications. Participants reported they would like the technology used in simulation and to use it to learn about emergency situations, skills performance, and identify clinical errors. Participants also discussed potential ways the 360-degree immersive video could be made more interactive.

When asked what they liked about 360-degree immersive video, participants frequently identified its realistic nature, the ability to look around a health care setting,

and the individual nature of the activity. Finally, seven participants reported varying degrees of dizziness associated with viewing the 360-degree immersive video.

Discussion

Student Satisfaction and Self-Confidence Subscales

In this study, participants in the 360-degree immersive video simulation group reported higher scores than participants in the conventional video on two of five items designed to measure student satisfaction. Interestingly, the third item with a significant difference between the two groups, Item 9—My instructors used helpful resources to teach the simulation (Jeffries & Rizzolo, 2006), could be considered more closely related to student satisfaction than self-confidence. This item asked the participant to evaluate the resources used in the simulation itself, which closely related to an evaluation of student satisfaction. These findings reflected slightly higher satisfaction scores among participants who viewed the 360-degree immersive video than among participants who viewed the conventional video.

Since the study design did not permit participants to view both video styles, it is possible a direct comparison of the two approaches to video simulation could have resulted in greater differences in student satisfaction and self-confidence scores. For example, if NLN surveys were completed separately for both the conventional video approach and the immersive video approach by a single participant, different results would be possible.

While these results showed higher satisfaction with 360-degree immersive video on two items, it is important to note the difference on these items, based on analysis of the median results, amounted to a difference between a “4- Agree” and a “5- Strongly

Agree." In other words, participant satisfaction was high with both conventional video and 360-degree immersive video and the relatively small difference in student satisfaction scores might not reflect a superiority of one approach.

As a new technology, it would have been reasonable to consider that participants might have lower scores on the self-confidence in learning subscale of the instrument; however, there was no significant difference on seven of the eight items on this subscale. The only significant difference on this subscale, Item 9, actually showed a higher score for the 360-degree immersive video group. Based on these results, it did not appear participants experienced less self-confidence in learning related to the simulation while using this new technology. It is possible satisfaction and self-confidence with this new technology could change with greater frequency of use while it is less likely satisfaction and self-confidence with conventional video simulation would change significantly with repeated use.

Identifying Risks to Patient Safety

Results showed no statistically significant difference in the number of risks to patient safety identified by participants between those who viewed a 360-degree immersive video and those who viewed a conventional video. While not a statistically significant difference, the mean number of identified risks to patient safety was higher in the conventional group than in the 360-degree immersive video group. It had been theorized the increased realism and ability to look around the room in 360-degree immersive video would result in an increased recognition of threats to patient safety but that was not the case in this study. It is possible the novel nature of 360-degree immersive video actually made it more challenging for participants to focus on the video

content and identify risks to patient safety. In fact, one participant who viewed the 360-degree immersive video reported that risks to patient safety were not identified because of distraction from using the new technology.

It is possible that with repeated use and exposure to 360-degree immersive video students could increase their focus on the content. However, study results did not connect the use of 360-degree immersive video to an increased ability to identify and recall risks to patient safety from a simulation activity. In fact, the difference in number of risks to patient safety identified between participants who viewed the conventional video (M = 5.7609, SD = 2.34932) and who viewed the 360-degree immersive video (M = 4.8444, SD = 2.34478; $t(89)=1.86$, p =.066) was very close to being statistically significant. While this study met the goal of 84 participants based on a priori power analysis for an effect size of .80 and an alpha level of 0.05, that goal was only exceeded by seven participants. In a larger sample size, it is possible a statistically significant difference would have been detected and shown a greater number of identified risks to patient safety in the conventional video group.

Participant Perceptions of 360-Degree Immersive Video

The most significant and clear implications of this study came from the open-ended written questions asked of participants who viewed the 360-degree immersive video. Participants provided generally very positive feedback on the use of the technology and demonstrated enthusiasm for its use in nursing education. Participant responses on how they would like this technology used in nursing education could help guide the development of 360-degree immersive video content. Specifically, the results suggested 360-degree immersive video development should incorporate emergency

situations, should be interactive if possible, and should involve the identification of clinical errors.

While participants did provide items they disliked about 360-degree immersive video, it is important to note that Question 4 of the open-ended questions was negatively worded and requested negative feedback. It is possible the wording of this question led to an overemphasis of responses on negative aspects of 360-degree immersive video in responses.

Eleven participants reported some degree of dizziness or similar symptom after watching the immersive video. Dizziness or vertigo has been described as mild, moderate, or severe in nature (University of Michigan, 2018). The dizziness experienced in this study, which did not result in vomiting or the need to lie down and where participants appeared well during and following the study, would best be described as mild in nature. Even with mild dizziness, however, there are significant implications of these results for the use of 360-degree immersive video in nursing education. While an overwhelming majority of participants reported largely positive perceptions of 360-degree immersive video, the dizziness experienced by some participants limits the potential uses of this technology in required activities in nursing education.

This finding corresponded with recent statements reported in the media involving 360-degree immersive video use at Stanford University's Virtual Human Interaction Lab (Marx, 2019). They described attempts to minimize dizziness with 360-degree immersive video use in their work and indicated the speed of immersive video delivery could impact the likelihood of dizziness (Marx, 2019).

Implications for Use in Nursing Education

Use in Simulation

Results from this study suggested participants generally had high satisfaction with 360-degree immersive video, at times had higher satisfaction with immersive video than conventional video, and would like it used in their nursing education simulation experiences. These findings supported additional development of simulations using 360-degree immersive video and suggested these simulations should include emergency scenarios, identifying clinical errors, and should be interactive when possible.

Simulation activities in nursing education, however, are typically mandatory, especially when they are part of required clinical time. Based on the finding that dizziness would be a very real possibility among at least some participants while viewing 360-degree immersive video, this technology should not be a required activity in nursing education at this time.

To address this issue, students could be given the option to choose between a 360-degree immersive video or a conventional video format of the same scene. Allowing students to choose between at 360-degree immersive video and a conventional video would allow students to gain positive benefits of immersive video when possible without causing dizziness among students who preferred not to use the technology. However, this approach would likely increase the complexity of simulation set-ups and increase the amount of equipment necessary to run the simulation. Nurse educators would need to consider carefully if the use of 360-degree immersive video in their simulation activities justified the added challenges of providing multiple options for video delivery.

Use as Instructional Adjunct

It is possible the 360-degree immersive video could be used for optional education opportunities. In this study, multiple participants indicated they would like immersive video used in nursing skills instruction and they liked the individual nature of immersive video. Students could be given the option of studying a new nursing skill individually through 360-degree immersive video. Since this would be an optional, individual activity, students who preferred not to use immersive video would simply not use this additional instructional resource. Similarly, 360-degree immersive video could be used as an optional part of clinical activities completed when students are absent from clinical activities and need to complete make-up hours. If used for clinical make-up work, 360-degree immersive video could help make these assignments more realistic in nature. Again, making the immersive video activity optional would allow students who experience dizziness while using the technology to choose another instructional delivery option.

Immersive Video Development

The video scenario used in this study was filmed from the point of view of the nurse in the simulated health care setting. While presenting the point of view of the nurse provided a more realistic depiction of a nurse's experience in a hospital setting, it is possible the frequent movement of the camera associated with this point of view increased the possibility of dizziness among viewers. Future 360-degree immersive videos could use a stationary camera to potentially decrease the possibility of dizziness while retaining the ability to be immersed in a clinical setting.

To provide an alternative for students not wishing to view an immersive video, a conventional video of the same scenario should be also created when an immersive video is developed. Some immersive video cameras allow a conventional video and 360-degree immersive video to be filmed at the same time, minimizing the amount of extra work required to produce two videos of the same video scene.

Consideration of Cost

Many schools of nursing have to consider carefully the cost of equipment used in their programs and make challenging decisions about spending priorities. While the cost of 360-degree immersive video cameras and viewers has been decreasing rapidly, the absolute minimum cost of purchasing 10 immersive video viewers and an immersive video camera would be over $2,000. If a nursing school wanted to use a higher quality viewer or camera, the expense would increase significantly.

While participants in this study showed greater satisfaction with 360-degree immersive video than conventional video on some items, generally high levels of satisfaction were also found with conventional video. While 360-degree immersive video has tremendous potential, it would also represent an additional expense due to the cost of the equipment involved. In this study, many of the suggestions for how 360-degree immersive video could be used could apply to conventional video as well. For example, many participants reported wanting video simulation to be interactive in nature and both immersive video and conventional video simulations could be made interactive. Due to familiarity with conventional video editing equipment, it would most likely be easier for nursing programs to develop interactive conventional video simulation activities than to develop interactive immersive video simulation activities.

Schools of nursing should carefully consider if the cost of 360-degree immersive video equipment is justified by how it would be used in their respective programs. Additionally, the development of immersive video scenarios takes significant time and video editing experience. Before purchasing immersive video equipment, schools of nursing would need to identify faculty and staff who could develop the content with the technology. This would likely be the greatest expense of using 360-degree immersive video in nursing education.

Recommendations for Additional Research

As a new technology, multiple opportunities exist for future research on the use of 360-degree immersive video in nursing education. Future research on this technology should focus on strategies to decrease the possibility of the development of dizziness by users. Before undertaking a full research study, a pilot study should be utilized to assess different strategies to decrease dizziness among viewers of 360-degree immersive video. For example, a pilot study could assess if a stationary 360-degree immersive video camera, rather than a point of view filming perspective, improved user experience. In point of view filming, the camera is typically in constant motion, approximating the first-person view of an individual in the scene. In a stationary filming approach, the camera itself does not move even when the people in the video scenario are in motion. A stationary immersive camera, which would still provide the ability to feel immersed within a healthcare scene but would not have the consistent movement of a point of view approach to filming, could decrease the possibility of dizziness developing among viewers. It is important that future research on 360-degree immersive video include qualitative data to learn about the user experience with the technology and to assess if

viewers experienced dizziness during use. Most quantitative measurement tools used in nursing education would not be designed to assess for dizziness so a mixed-methods approach to future research on 360-degree immersive video use is recommended.

Additionally, future research could examine the impact of immersive video on outcomes other than satisfaction and safety risk identification. For example, researchers could study if 360-degree immersive video improved student performance of nursing skills. Similarly, 360-degree immersive video could be used to teach about a specific disease process and then test student retention of information about the condition. Future studies could also more specifically connect evaluation tools used in the research to nursing student learning outcomes. Research evaluating the use of 360-degree immersive video to impact student performance in clinical care, achievement of learning outcomes, and clinical judgment would be of great value in nursing education.

This study sought to identify potential differences between immersive video and conventional video use in nursing simulation so independent groups were maintained and participants only viewed an immersive video or conventional video. In future research, however, it would be beneficial to have participants view both a conventional video and a 360-degree immersive video and ask which approach they preferred to use. While this study found some increases in participant satisfaction scores with 360-degree immersive video over conventional video, a study design that allowed students to view both approaches and state their preference could be helpful to nursing programs considering the adoption of this new technology.

Limitations

Limitations to this study were the research occurred at a single school of nursing and included only final semester nursing students. Students with less experience in nursing school and in health care settings could have different perspectives on 360-degree immersive video use.

As a new technology, it is unclear how student experience could change over time as students become accustomed to the new technology. It is entirely possible regular use of 360-degree immersive video could change student experience with the technology and result in different evaluation outcomes. Similarly, regular use of 360-degree immersive video could lower the possibility of experiencing dizziness.

While the equipment used in this study was new and technologically sufficient for immersive video, it is possible more expensive immersive video viewers that are currently available could result in improved user experience and decrease the possibility of viewers developing dizziness. Similarly, a professionally produced immersive video could have resulted in improved user experience by having better video production, audio quality, and image stability. The resources used in the development of this video, however, would likely be similar to or greater than those available in many schools of nursing. Finally, as mentioned above, it is possible the sample size in this study was not large enough to detect all potential effects, especially when identifying risks to patient safety.

Summary

The purpose of this study was to evaluate the use of 360-degree immersive video in nursing education and to compare this emerging technology to conventional video. The

first research question sought to learn if there was a difference on NLN survey scores between participants who viewed a 360-degree immersive video and participants who viewed a conventional video. While results showed generally high participant satisfaction with both 360-degree immersive video and conventional video, scores were higher on 3 of the 13 items on the questionnaire among participants who viewed a 360-degree immersive video than among participants who viewed a conventional video. This finding indicated higher satisfaction among participants who viewed the 360-degree immersive video than among participants who viewed the conventional video.

The second research question sought to learn if there was a difference in the number of risks to patient safety identified between participants who viewed the 360-degree immersive video and who viewed the conventional video. This study did not find a significant difference in identified risks to patient safety between the two groups. It is possible that repeated use of 360-degree immersive video could improve ability to recognize risks to patient safety as familiarity with the technology increases but that could not be ascertained from this study.

Finally, open-ended questions were asked to gain knowledge about participants' perceptions of 360-degree immersive video use in nursing education. These responses showed generally positive feedback regarding 360-degree immersive video and enthusiasm for its use in nursing education. Specific uses identified by participants included the depiction of emergency situations, skills performance, and simulation. This study did find some participants reported dizziness after viewing the 360-degree immersive video. Based on this finding, nurse educators should strongly consider

avoiding the use of 360-degree immersive video in required activities without providing an alternative to students who might experience dizziness while using the technology.

Additional research is needed to learn more about ways to improve user experience with immersive video by decreasing dizziness among viewers and to evaluate further the impact of immersive video on achievement of specific learning outcomes. This study demonstrated generally high participant satisfaction with 360-degree immersive video and future studies should consider evaluation criteria more directly connected to learning objectives and preparation for clinical nursing care.

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APPENDIX A

STUDENT SATISFACTION AND SELF-CONFIDENCE IN LEARNING INSTRUMENT

Student Satisfaction and Self-Confidence in Learning

Instructions: This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement 4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Satisfaction with Current Learning	**SD**	**D**	**UN**	**A**	**SA**
1. The teaching methods used in this simulation were helpful and effective.	○ 1	○ 2	○ 3	○ 4	○ 5
2. The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
3. I enjoyed how my instructor taught the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
4. The teaching materials used in this simulation were motivating and helped me to learn.	○ 1	○ 2	○ 3	○ 4	○ 5
5. The way my instructor(s) taught the simulation was suitable to the way I learn.	○ 1	○ 2	○ 3	○ 4	○ 5
Self-confidence in Learning	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	○ 1	○ 2	○ 3	○ 4	○ 5
7. I am confident that this simulation covered critical content necessary for the mastery of medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting	○ 1	○ 2	○ 3	○ 4	○ 5
9. My instructors used helpful resources to teach the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
10. It is my responsibility as the student to learn what I need to know from this simulation activity.	○ 1	○ 2	○ 3	○ 4	○ 5
11.I know how to get help when I do not understand the concepts covered in the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
12.I know how to use simulation activities to learn critical aspects of these skills.	○ 1	○ 2	○ 3	○ 4	○ 5
13.It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time..	○ 1	○ 2	○ 3	○ 4	○ 5

 Revised December 22, 2004

APPENDIX B

CONSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH

UNIVERSITY OF
NORTHERN COLORADO

CONSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH

Project Title: Student Satisfaction and Safety Awareness in 360-Immersive Video Simulation

Lead Investigator: John Nation, MSN, RN PhD Student in Nursing Education, University of Northern Colorado

Phone Number: 512-663-7423 E-mail: nati8132@bears.unco.edu

Research Advisor: Dr. Carlo Parker E-mail: carlo.parker@unco.edu.

The purpose of this study is to evaluate the effectiveness in nursing education of an emerging technology called 360-degree immersive, specifically as it relates to identifying risks to patient safety.

Participants will be randomly assigned to view either a 360-degree immersive video on a specialized immersive video viewer or to view a conventional video of the same scene. The video will depict a simulated scene in a hospital setting involving a patient and nurse interaction. After watching the video, participants will be asked to answer a brief series of written questions. No names or other identifying information will be collected on the surveys. It is estimated that participation in the study will take between 10-20 minutes in total. This study will take place in a classroom or conference room on an Austin Community College campus.

Signed consent forms and completed surveys will be kept in a locked cabinet in a locked office. Any electronic data will be stored on a password protected computer and/ or a password protected cloud-based electronic storage service. Participation is entirely voluntary. Your decision to participate in this study, or not to participate, will have no impact on your evaluation in this class or affect your course grade.

There is minimal risk to participants related to taking part in this study. While 360-degree immersive video is a commonly used technology, it is possible that a participant may develop dizziness. If any dizziness is experienced while viewing the immersive video, the participant is encouraged to remove the viewer. There are no other foreseeable risks associated with participation in the study greater than those potentially encountered in regular nursing instruction. Potential benefits to participants include gaining experience with an emerging technology and knowledge gained regarding identifying risks to patient safety.

Participation is voluntary. You may decide not to participate in this study and if you begin participation you may still decide to stop and withdraw at any time. Your decision will be respected and will not result in loss of benefits to which you are otherwise entitled. Having read the above and having had an opportunity to ask any questions, please sign below if you would like to participate in this research. A copy of this form will be given to you to retain for future reference. If you have any concerns about your selection or treatment as a research participant, please contact the Office of Research, Kepner Hall, University of Northern Colorado Greeley, CO 80639; 970-351-1910.

Subject's Signature	Subject's Printed Name	Date
Researcher's Signature	Researcher's Printed Name	Date

APPENDIX C

RECRUITMENT SCRIPT

Project: Student Satisfaction and Safety Awareness in 360-Immersive Video Simulation

Nursing Students,

Hello, my name is John Nation, and I am here today in my role as a PhD student in nursing at the University of Northern Colorado. I am conducting research on nursing simulation using a new technology called 360-degree immersive video, where the viewer is given the impression of being within a video scene. The purpose of this study is to learn more about potential uses for this technology in nursing education, specifically as it relates to identifying risks to patient safety.

Participants will be randomly assigned to view either a 360-degree immersive video on a specialized immersive video viewer or to view a conventional video of the same scene. The video will depict a simulated scene in a hospital setting involving a patient and nurse interaction. After watching the video, participants will be asked to answer a brief series of written questions. No names or other identifying information will be collected on the surveys. It is estimated that participation in the study will take between 10-20 minutes in total. This study will take place in a classroom or conference room on an Austin Community College campus.

Signed consent forms and completed surveys will be kept in a locked cabinet in a locked office. Any electronic data will be stored on a password protected computer and/ or a password protected cloud-based electronic storage service. Participation is entirely voluntary. Your decision to participate in this study, or not to participate, will have no impact on your evaluation in this class or affect your course grade. You can choose to withdraw from the study at any time.

There is minimal risk to participants related to taking part in this study. While 360-degree immersive video is a commonly used technology, it is possible that a participant may develop dizziness. If any dizziness is experienced while viewing the immersive video, the participant is encouraged to remove the viewer. There are no other foreseeable risks associated with participation in the study greater than those potentially encountered in regular nursing instruction. Potential benefits to participants include gaining experience with an emerging technology and knowledge gained regarding identifying risks to patient safety.

If you have any questions, I can be reached by email at nati8132@bears.unco.edu, and my research advisor Dr. Carlo Parker can be reached at carlo.parker@unco.edu.

Thank you for your time and consideration.

John Nation

APPENDIX D

INSTITUTIONAL REVIEW BOARD APPROVAL

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

DATE:	May 22, 2019
TO:	John Nation, MSN
FROM:	University of Northern Colorado (UNCO) IRB
PROJECT TITLE:	[1437231-1] Nursing Student Experience and Safety Awareness using 360-Degree Immersive Video Simulation
SUBMISSION TYPE:	New Project
ACTION:	APPROVAL/VERIFICATION OF EXEMPT STATUS
DECISION DATE:	May 22, 2019
EXPIRATION DATE:	May 22, 2023

Thank you for your submission of New Project materials for this project. The University of Northern Colorado (UNCO) IRB approves this project and verifies its status as EXEMPT according to federal IRB regulations.

John,

Thank you for a very well written application.

Best of luck with your research!

Nicole Morse

We will retain a copy of this correspondence within our records for a duration of 4 years.

If you have any questions, please contact Nicole Morse at 970-351-1910 or nicole.morse@unco.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Northern Colorado (UNCO) IRB's records.

APPENDIX E

RESEARCH REVIEW COMMITTEE APPROVAL

AUSTIN COMMUNITY COLLEGE DISTRICT

Office of Institutional Effectiveness and Accountability

5930 Middle Fiskville Road • Austin, Texas 78752-4390 • Phone 512/223-7036 • Email oieinfo@austincc.edu • Fax 512/223-7029

Austin Community College
Institutional Research Review Committee
Letter of Agreement

DATE: June 12, 2019

TO: John Nation
Austin Community College
3401 Webberville Rd
Austin, Texas 78702

FROM: Soon Merz Flynn

On behalf of the Institutional Research Review Committee of Austin Community College, I am pleased to inform you that the proposal you submitted, "Nursing Student Experience and Safety Awareness using 360-Degree Immersive Video Simulation" has been approved. Your proposal met the criteria for an expedited review, and it has been determined that your research proposal represents minimal risk to human subjects based on federal regulations that govern the protection of human subjects.

Specifically, 45 CFR 46.101(b) (2) identifies studies that are exempt from IRB review, including: Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation (see http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html#46.101).

If you wish to pursue this proposal, please sign and return this letter to the Office of Institutional Effectiveness and Accountability by June 20, 2019. All ACC-based research must be completed within one year of this agreement, unless otherwise stated.

Soon Merz Flynn 6/12/19

Soon Merz Flynn
Chair, ACC Research Review Committee
VP for Effectiveness and Accountability

Date

Researcher's Statement

I have read the **Research Review Process** and agree to abide by the guidelines specified there.

I understand that my Research Proposal has been approved contingent upon the modifications listed above.

I understand that approval of this project does not imply Austin Community College's endorsement of either the project or it results.

I understand that Austin Community College is not responsible for any debts that I may incur as part of this project nor will it provide consumable resources.

I will provide a copy of the results of this study to the Institutional Research Review Committee of Austin Community College.

John Nation Researcher Date

APPENDIX F

DESCRIPTIVE STATISTICS OF PARTICIPANT RESPONSES ON NATIONAL LEAGUE FOR NURSING STUDENT SATISFACTION AND SELF-CONFIDENCE IN LEARNING INSTRUMENT

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Item 1	85	3	2	5	4.20	.923
Item 2	85	3	2	5	4.01	.994
Item 3	85	2	3	5	4.41	.729
Item 4	85	4	1	5	4.19	.906
Item 5	85	4	1	5	4.16	.911
Item 6	85	4	1	5	4.14	.966
Item 7	85	4	1	5	4.14	.978
Item 8	85	4	1	5	4.25	.885
Item 9	85	3	2	5	4.36	.754
Item 10	85	4	1	5	4.31	.831
Item 11	85	3	2	5	4.54	.628
Item 12	85	3	2	5	4.44	.680
Item 13	85	4	1	5	3.56	1.117
Valid N (listwise)	85					

APPENDIX G

DESCRIPTIVE STATISTICS OF RESPONSES TO IDENTIFIED RISKS TO PATIENT SAFETY

Descriptive Statistics

	N	Range	Minimum	Maximum	*M*	*SD*
Safety Risks	91	11.00	.00	11.00	5.3077	2.37904
Valid N (listwise)	91					

APPENDIX H

TESTS FOR NORMALITY ON NATIONAL LEAGUE FOR NURSING STUDENT SATISFACTION AND SELF-CONFIDENCE IN LEARNING INSTRUMENT

Tests for Normality on NLN Student Satisfaction and Self-Confidence in Learning Survey Results

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Video Type	Statistic	df	Sig.	Statistic	df	Sig.
Item 1	Conventional Video	.256	42	.000	.810	42	.000
	Immersive Video	.332	43	.000	.743	43	.000
Item 2	Conventional Video	.216	42	.000	.859	42	.000
	Immersive Video	.290	43	.000	.785	43	.000
Item 3	Conventional Video	.258	42	.000	.790	42	.000
	Immersive Video	.423	43	.000	.625	43	.000
Item 4	Conventional Video	.263	42	.000	.835	42	.000
	Immersive Video	.338	43	.000	.722	43	.000
Item 5	Conventional Video	.247	42	.000	.817	42	.000
	Immersive Video	.277	43	.000	.777	43	.000
Item 6	Conventional Video	.244	42	.000	.820	42	.000
	Immersive Video	.274	43	.000	.766	43	.000
Item 7	Conventional Video	.242	42	.000	.819	42	.000
	Immersive Video	.294	43	.000	.770	43	.000
Item 8	Conventional Video	.247	42	.000	.801	42	.000
	Immersive Video	.283	43	.000	.727	43	.000
Item 9	Conventional Video	.248	42	.000	.816	42	.000
	Immersive Video	.385	43	.000	.684	43	.000
Item 10	Conventional Video	.265	42	.000	.743	42	.000
	Immersive Video	.309	43	.000	.766	43	.000
Item 11	Conventional Video	.378	42	.000	.677	42	.000
	Immersive Video	.361	43	.000	.689	43	.000
Item 12	Conventional Video	.330	42	.000	.734	42	.000
	Immersive Video	.322	43	.000	.738	43	.000
Item 13	Conventional Video	.172	42	.003	.898	42	.001
	Immersive Video	.184	43	.001	.881	43	.000

Tests of Normality

		Shapiro-Wilk[a]	
	Video Type	df	Sig.
Total Score	Conventional Video	42	.047
	Immersive Video	43	.000
Satisfaction Total Score	Conventional Video	42	.010
	Immersive Video	43	.000
Self-Confidence Total Score	Conventional Video	42	.009
	Immersive Video	43	.001

APPENDIX I

DESCRIPTIVE STATISTICS OF NATIONAL LEAGUE FOR NURSING STUDENT SATISFACTION AND SELF-CONFIDENCE IN LEARNING INSTRUMENT

Descriptives

	Video Type			Statistic	Std. Error
Item 1	Conventional Video	Mean		4.12	.137
		95% Confidence Interval for Mean	Lower Bound	3.84	
			Upper Bound	4.40	
		5% Trimmed Mean		4.19	
		Median		4.00	
		Variance		.790	
		Std. Deviation		.889	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-.898	.365
		Kurtosis		.292	.717
	Immersive Video	Mean		4.28	.146
		95% Confidence Interval for Mean	Lower Bound	3.98	
			Upper Bound	4.57	
		5% Trimmed Mean		4.37	
		Median		5.00	
		Variance		.920	
		Std. Deviation		.959	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-1.111	.361
		Kurtosis		.131	.709
Item 2	Conventional Video	Mean		3.88	.149
		95% Confidence Interval for Mean	Lower Bound	3.58	
			Upper Bound	4.18	
		5% Trimmed Mean		3.92	
		Median		4.00	
		Variance		.937	
		Std. Deviation		.968	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		2	
		Skewness		-.430	.365
		Kurtosis		-.771	.717
	Immersive Video	Mean		4.14	.155
		95% Confidence Interval for Mean	Lower Bound	3.83	
			Upper Bound	4.45	
		5% Trimmed Mean		4.21	
		Median		4.00	
		Variance		1.028	
		Std. Deviation		1.014	

		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		2	
		Skewness		-.867	.361
		Kurtosis		-.440	.709
Item 3	Conventional Video	Mean		4.24	.112
		95% Confidence Interval for Mean	Lower Bound	4.01	
			Upper Bound	4.46	
		5% Trimmed Mean		4.26	
		Median		4.00	
		Variance		.527	
		Std. Deviation		.726	
		Minimum		3	
		Maximum		5	
		Range		2	
		Interquartile Range		1	
		Skewness		-.402	.365
		Kurtosis		-.975	.717
	Immersive Video	Mean		4.58	.106
		95% Confidence Interval for Mean	Lower Bound	4.37	
			Upper Bound	4.80	
		5% Trimmed Mean		4.65	
		Median		5.00	
		Variance		.487	
		Std. Deviation		.698	
		Minimum		3	
		Maximum		5	
		Range		2	
		Interquartile Range		1	
		Skewness		-1.406	.361
		Kurtosis		.603	.709
Item 4	Conventional Video	Mean		4.05	.127
		95% Confidence Interval for Mean	Lower Bound	3.79	
			Upper Bound	4.30	
		5% Trimmed Mean		4.11	
		Median		4.00	
		Variance		.681	
		Std. Deviation		.825	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-.638	.365
		Kurtosis		.076	.717
	Immersive Video	Mean		4.33	.148
		95% Confidence Interval for Mean	Lower Bound	4.03	
			Upper Bound	4.62	
		5% Trimmed Mean		4.44	

		Median		5.00	
		Variance		.939	
		Std. Deviation		.969	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		1	
		Skewness		-1.537	.361
		Kurtosis		2.235	.709
Item 5	Conventional Video	Mean		4.17	.118
		95% Confidence Interval for Mean	Lower Bound	3.93	
			Upper Bound	4.40	
		5% Trimmed Mean		4.21	
		Median		4.00	
		Variance		.581	
		Std. Deviation		.762	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-.642	.365
		Kurtosis		.143	.717
	Immersive Video	Mean		4.16	.159
		95% Confidence Interval for Mean	Lower Bound	3.84	
			Upper Bound	4.48	
		5% Trimmed Mean		4.26	
		Median		4.00	
		Variance		1.092	
		Std. Deviation		1.045	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		1	
		Skewness		-1.260	.361
		Kurtosis		1.039	.709
Item 6	Conventional Video	Mean		4.10	.140
		95% Confidence Interval for Mean	Lower Bound	3.81	
			Upper Bound	4.38	
		5% Trimmed Mean		4.16	
		Median		4.00	
		Variance		.820	
		Std. Deviation		.906	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-.815	.365
		Kurtosis		.008	.717
	Immersive Video	Mean		4.19	.157

		95% Confidence Interval for Mean	Lower Bound	3.87	
			Upper Bound	4.50	
		5% Trimmed Mean		4.29	
		Median		4.00	
		Variance		1.060	
		Std. Deviation		1.029	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		1	
		Skewness		-1.353	.361
		Kurtosis		1.388	.709
Item 7	Conventional Video	Mean		4.14	.130
		95% Confidence Interval for Mean	Lower Bound	3.88	
			Upper Bound	4.41	
		5% Trimmed Mean		4.21	
		Median		4.00	
		Variance		.711	
		Std. Deviation		.843	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-.795	.365
		Kurtosis		.179	.717
	Immersive Video	Mean		4.14	.168
		95% Confidence Interval for Mean	Lower Bound	3.80	
			Upper Bound	4.48	
		5% Trimmed Mean		4.24	
		Median		5.00	
		Variance		1.218	
		Std. Deviation		1.104	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		1	
		Skewness		-1.180	.361
		Kurtosis		.502	.709
Item 8	Conventional Video	Mean		4.24	.117
		95% Confidence Interval for Mean	Lower Bound	4.00	
			Upper Bound	4.47	
		5% Trimmed Mean		4.29	
		Median		4.00	
		Variance		.576	
		Std. Deviation		.759	
		Minimum		2	
		Maximum		5	
		Range		3	

		Interquartile Range		1	
		Skewness		-.787	.365
		Kurtosis		.394	.717
	Immersive Video	Mean		4.26	.153
		95% Confidence Interval for Mean	Lower Bound	3.95	
			Upper Bound	4.56	
		5% Trimmed Mean		4.37	
		Median		5.00	
		Variance		1.004	
		Std. Deviation		1.002	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		1	
		Skewness		-1.590	.361
		Kurtosis		2.268	.709
Item 9	Conventional Video	Mean		4.19	.124
		95% Confidence Interval for Mean	Lower Bound	3.94	
			Upper Bound	4.44	
		5% Trimmed Mean		4.24	
		Median		4.00	
		Variance		.646	
		Std. Deviation		.804	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-.662	.365
		Kurtosis		-.226	.717
	Immersive Video	Mean		4.53	.102
		95% Confidence Interval for Mean	Lower Bound	4.33	
			Upper Bound	4.74	
		5% Trimmed Mean		4.59	
		Median		5.00	
		Variance		.445	
		Std. Deviation		.667	
		Minimum		3	
		Maximum		5	
		Range		2	
		Interquartile Range		1	
		Skewness		-1.142	.361
		Kurtosis		.161	.709
Item 10	Conventional Video	Mean		4.26	.137
		95% Confidence Interval for Mean	Lower Bound	3.99	
			Upper Bound	4.54	
		5% Trimmed Mean		4.37	
		Median		4.00	
		Variance		.783	
		Std. Deviation		.885	

		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		1	
		Skewness		-1.662	.365
		Kurtosis		3.794	.717
	Immersive Video	Mean		4.35	.119
		95% Confidence Interval for Mean	Lower Bound	4.11	
			Upper Bound	4.59	
		5% Trimmed Mean		4.41	
		Median		5.00	
		Variance		.614	
		Std. Deviation		.783	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-1.028	.361
		Kurtosis		.507	.709
Item 11	Conventional Video	Mean		4.57	.084
		95% Confidence Interval for Mean	Lower Bound	4.40	
			Upper Bound	4.74	
		5% Trimmed Mean		4.61	
		Median		5.00	
		Variance		.300	
		Std. Deviation		.547	
		Minimum		3	
		Maximum		5	
		Range		2	
		Interquartile Range		1	
		Skewness		-.765	.365
		Kurtosis		-.513	.717
	Immersive Video	Mean		4.51	.107
		95% Confidence Interval for Mean	Lower Bound	4.30	
			Upper Bound	4.73	
		5% Trimmed Mean		4.59	
		Median		5.00	
		Variance		.494	
		Std. Deviation		.703	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-1.554	.361
		Kurtosis		2.704	.709
Item 12	Conventional Video	Mean		4.45	.098
		95% Confidence Interval for Mean	Lower Bound	4.26	
			Upper Bound	4.65	
		5% Trimmed Mean		4.50	

		Median		5.00	
		Variance		.400	
		Std. Deviation		.633	
		Minimum		3	
		Maximum		5	
		Range		2	
		Interquartile Range		1	
		Skewness		-.724	.365
		Kurtosis		-.404	.717
	Immersive Video	Mean		4.42	.112
		95% Confidence Interval for Mean	Lower Bound	4.19	
			Upper Bound	4.64	
		5% Trimmed Mean		4.49	
		Median		5.00	
		Variance		.535	
		Std. Deviation		.731	
		Minimum		2	
		Maximum		5	
		Range		3	
		Interquartile Range		1	
		Skewness		-1.236	.361
		Kurtosis		1.524	.709
Item 13	Conventional Video	Mean		3.43	.174
		95% Confidence Interval for Mean	Lower Bound	3.08	
			Upper Bound	3.78	
		5% Trimmed Mean		3.45	
		Median		3.00	
		Variance		1.275	
		Std. Deviation		1.129	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		1	
		Skewness		-.081	.365
		Kurtosis		-.998	.717
	Immersive Video	Mean		3.70	.168
		95% Confidence Interval for Mean	Lower Bound	3.36	
			Upper Bound	4.04	
		5% Trimmed Mean		3.75	
		Median		4.00	
		Variance		1.216	
		Std. Deviation		1.103	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		2	
		Skewness		-.363	.361
		Kurtosis		-.718	.709

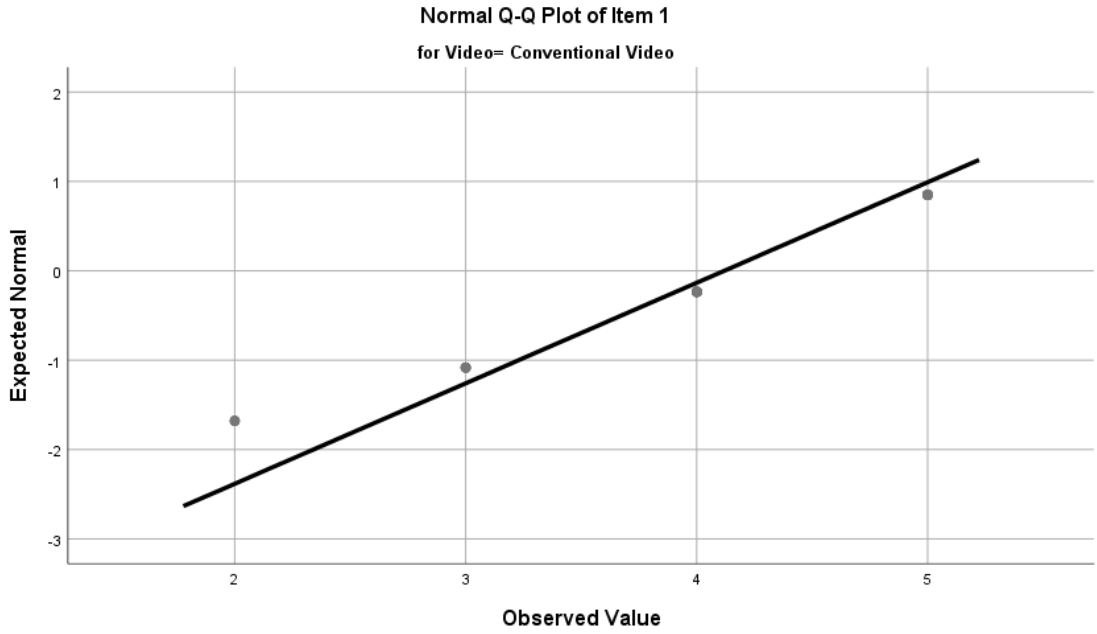
Descriptives

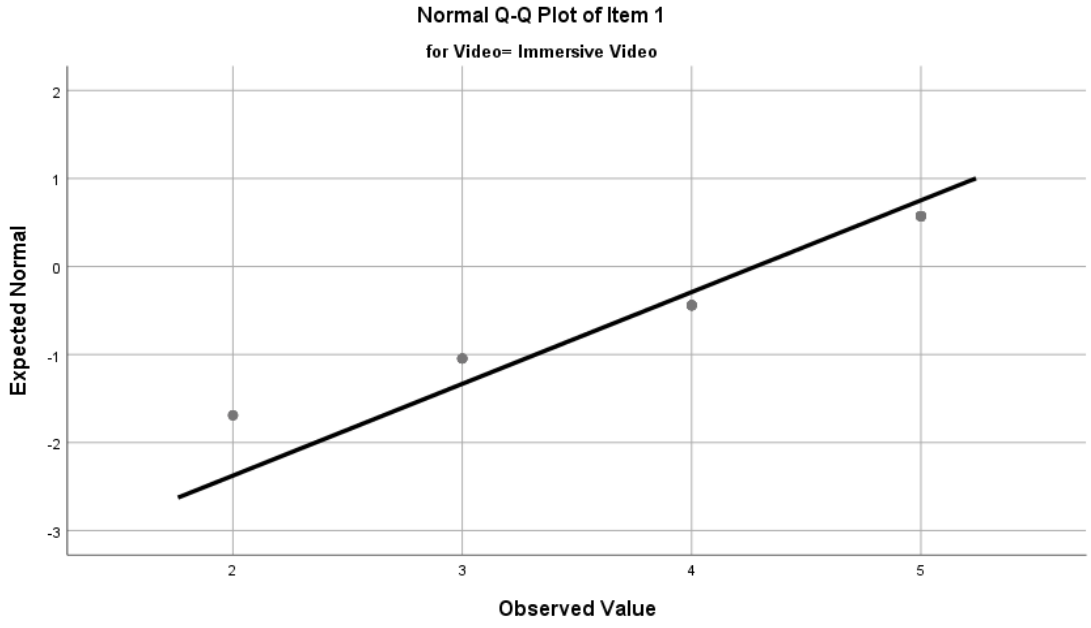
	Video Type			Statistic	Std. Error
Total	Conventional Video	Mean		53.83	1.238
		95% Confidence Interval for Mean	Lower Bound	51.33	
			Upper Bound	56.33	
		5% Trimmed Mean		54.06	
		Median		53.00	
		Variance		64.337	
		Std. Deviation		8.021	
		Minimum		36	
		Maximum		65	
		Range		29	
		Interquartile Range		14	
		Skewness		-.133	.365
		Kurtosis		-.880	.717
	Immersive Video	Mean		55.58	1.360
		95% Confidence Interval for Mean	Lower Bound	52.84	
			Upper Bound	58.33	
		5% Trimmed Mean		56.41	
		Median		58.00	
		Variance		79.535	
		Std. Deviation		8.918	
		Minimum		30	
		Maximum		65	
		Range		35	
		Interquartile Range		13	
		Skewness		-1.057	.361
		Kurtosis		.993	.709
Satisfaction	Conventional Video	Mean		20.45	.555
		95% Confidence Interval for Mean	Lower Bound	19.33	
			Upper Bound	21.57	
		5% Trimmed Mean		20.63	
		Median		20.50	
		Variance		12.937	
		Std. Deviation		3.597	
		Minimum		12	
		Maximum		25	
		Range		13	
		Interquartile Range		6	
		Skewness		-.322	.365
		Kurtosis		-.587	.717
	Immersive Video	Mean		21.49	.599
		95% Confidence Interval for Mean	Lower Bound	20.28	
			Upper Bound	22.70	
		5% Trimmed Mean		21.86	
		Median		23.00	
		Variance		15.446	

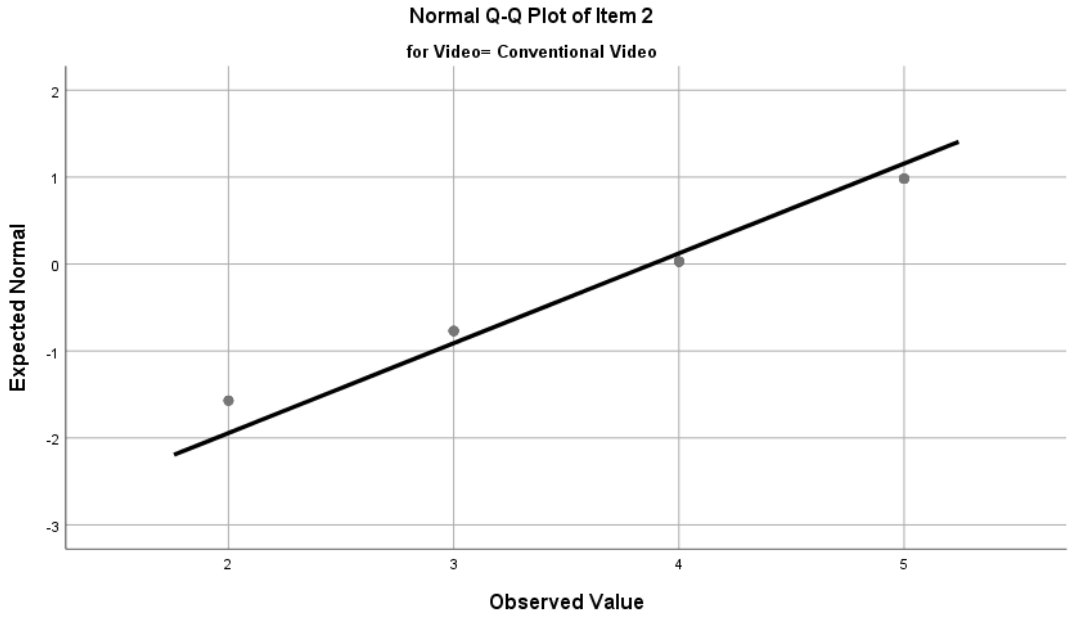
		Std. Deviation		3.930	
		Minimum		10	
		Maximum		25	
		Range		15	
		Interquartile Range		6	
		Skewness		-1.127	.361
		Kurtosis		.769	.709
Self-confidence	Conventional Video	Mean		33.38	.754
		95% Confidence Interval for Mean	Lower Bound	31.86	
			Upper Bound	34.90	
		5% Trimmed Mean		33.55	
		Median		32.00	
		Variance		23.851	
		Std. Deviation		4.884	
		Minimum		23	
		Maximum		40	
		Range		17	
		Interquartile Range		9	
		Skewness		-.040	.365
		Kurtosis		-.983	.717
	Immersive Video	Mean		34.07	.817
		95% Confidence Interval for Mean	Lower Bound	32.42	
			Upper Bound	35.72	
		5% Trimmed Mean		34.53	
		Median		35.00	
		Variance		28.733	
		Std. Deviation		5.360	
		Minimum		19	
		Maximum		40	
		Range		21	
		Interquartile Range		8	
		Skewness		-.921	.361
		Kurtosis		.655	.709

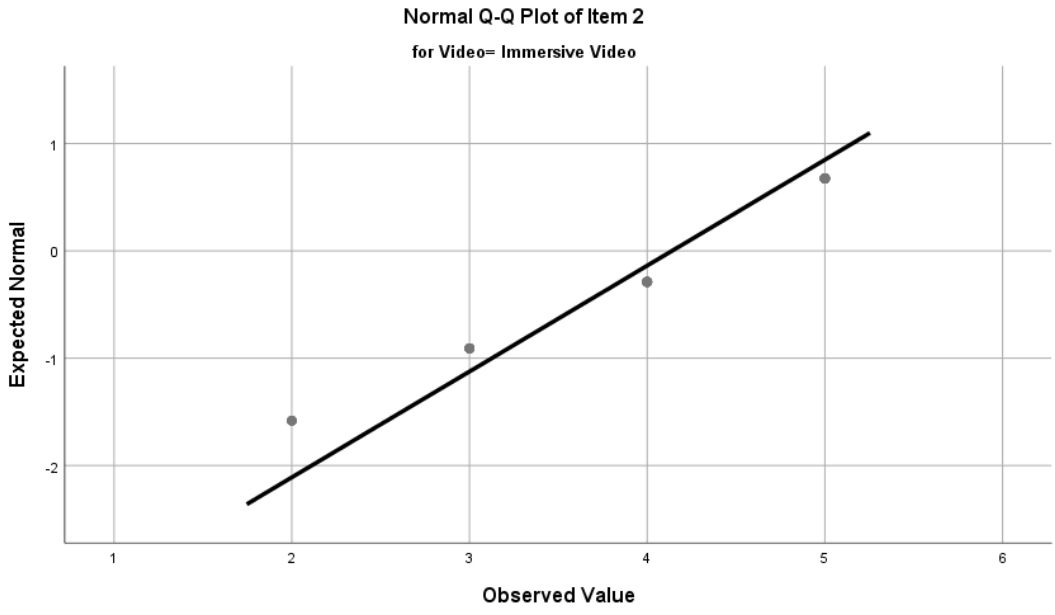
APPENDIX J

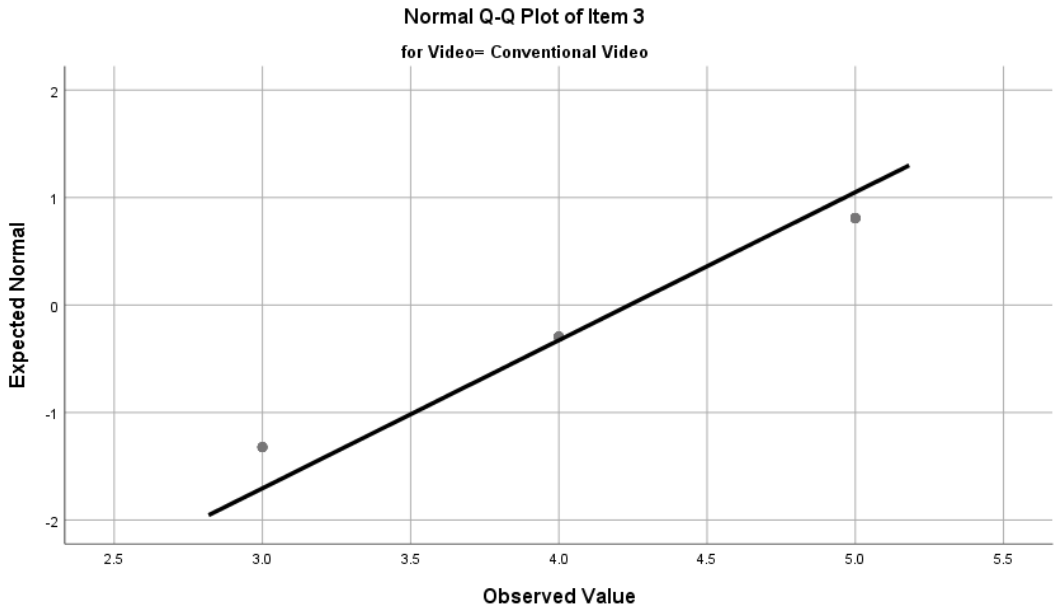
Q-Q PLOTS BY ITEM FOR NATIONAL LEAGUE FOR NURSING STUDENT SATISFACTION AND SELF-CONFIDENCE IN LEARNING INSTRUMENT

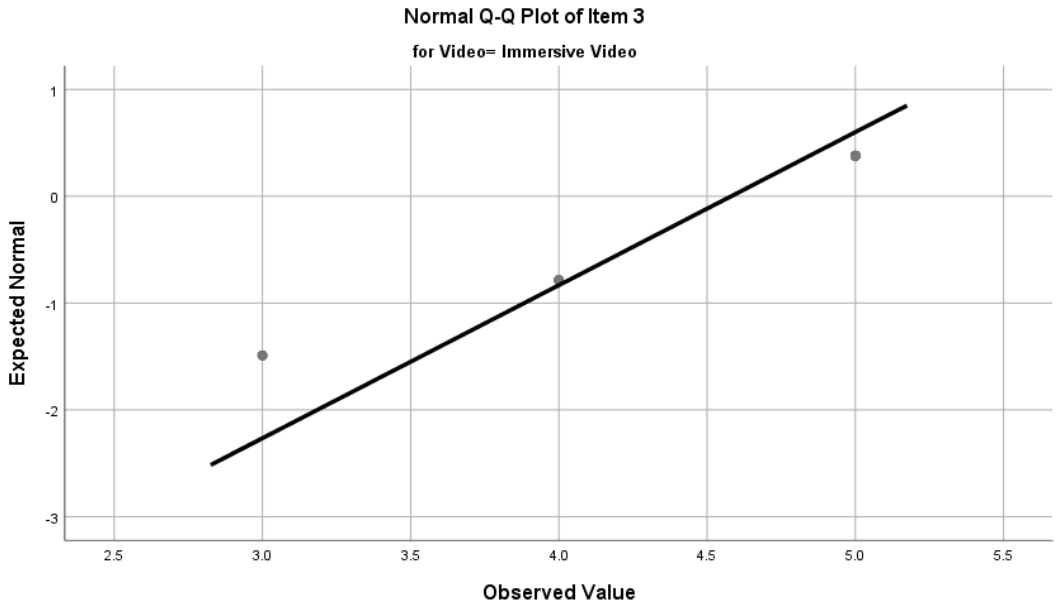

Normal Q-Q Plot of Item 1
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2
3
4
5

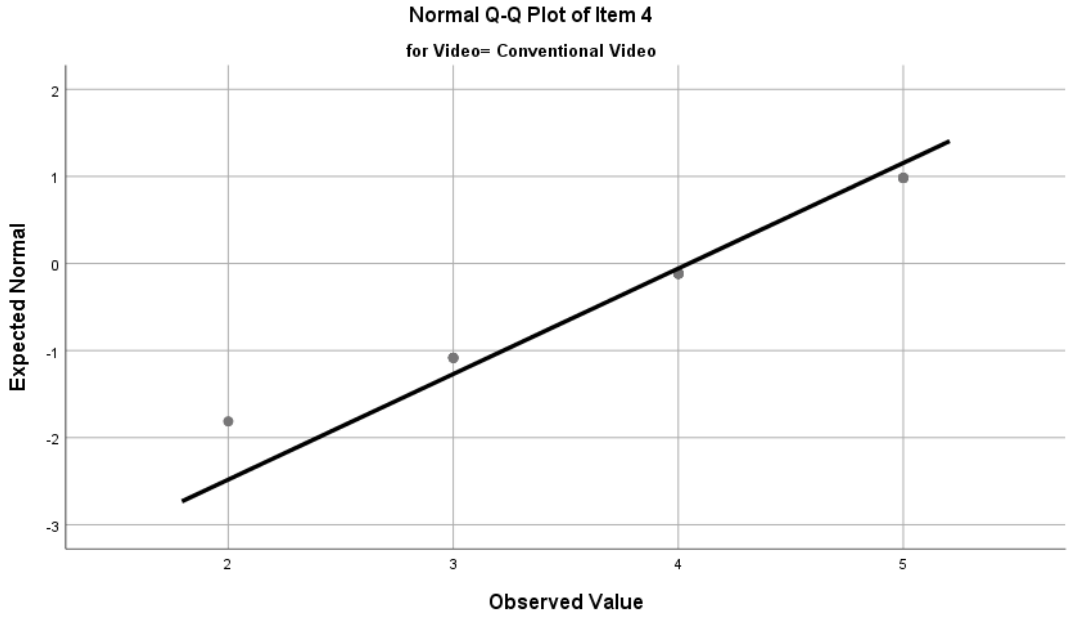

Normal Q-Q Plot of Item 1
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2
3
4
5

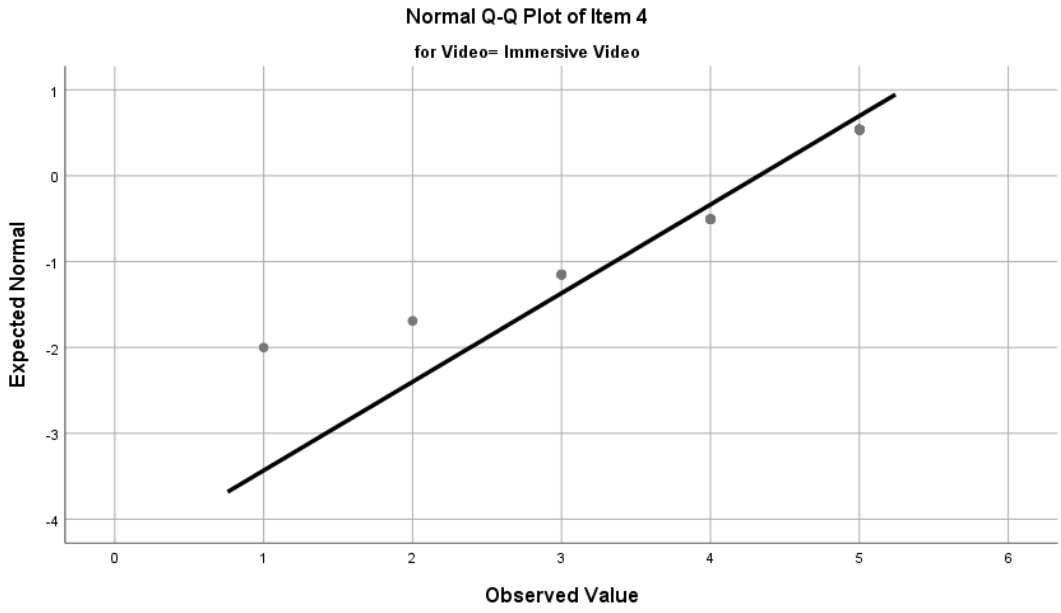

Normal Q-Q Plot of Item 2
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2
3
4
5

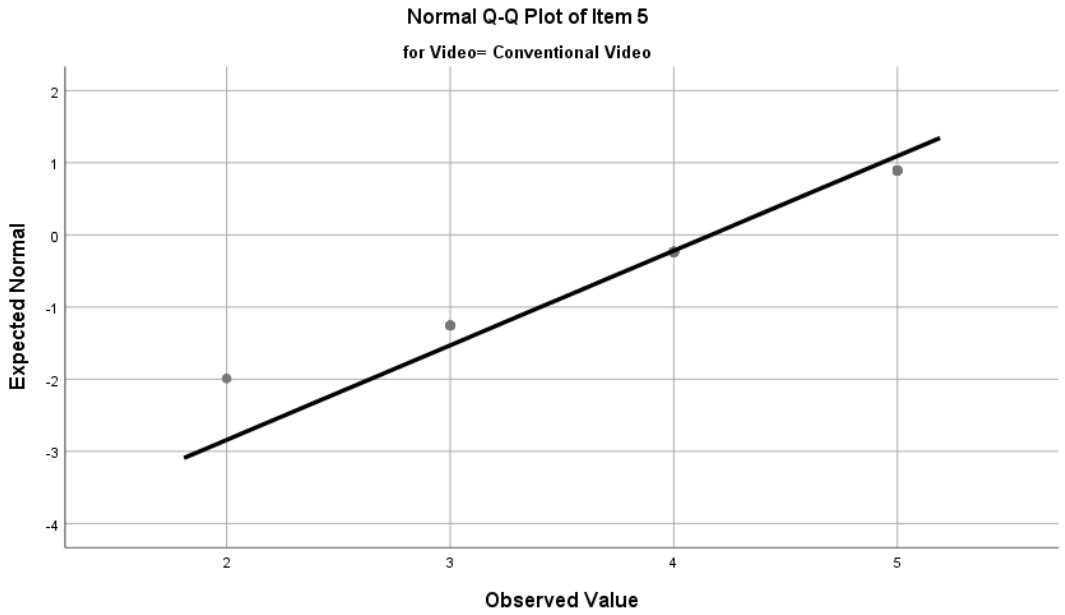

Normal Q-Q Plot of Item 2
for Video= Immersive Video
Expected Normal
Observed Value
1
0
-1
-2
1
2
3
4
5
6

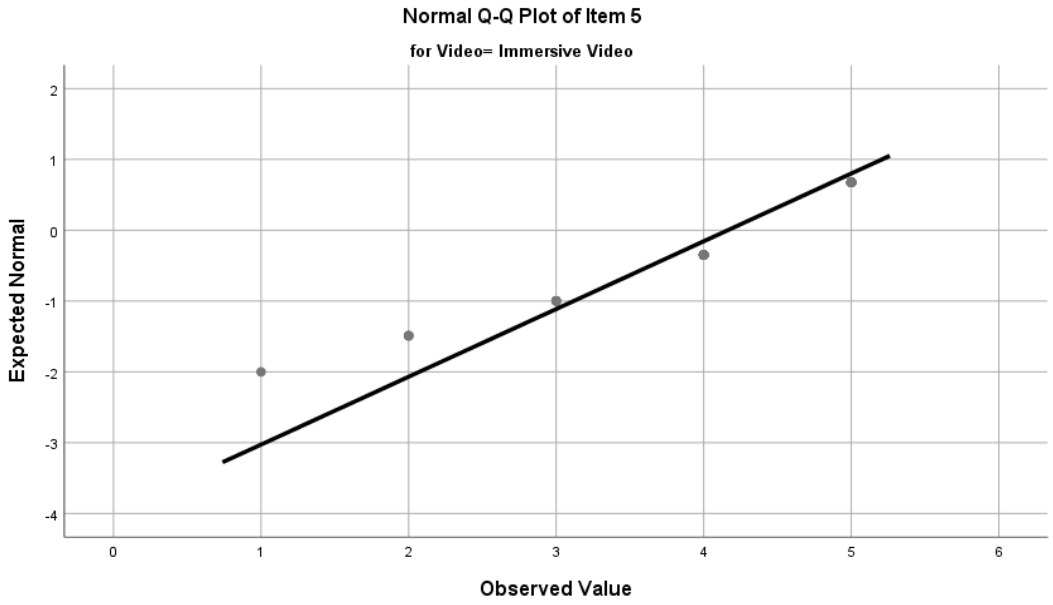

Normal Q-Q Plot of Item 3
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
2.5
3.0
3.5
4.0
4.5
5.0
5.5

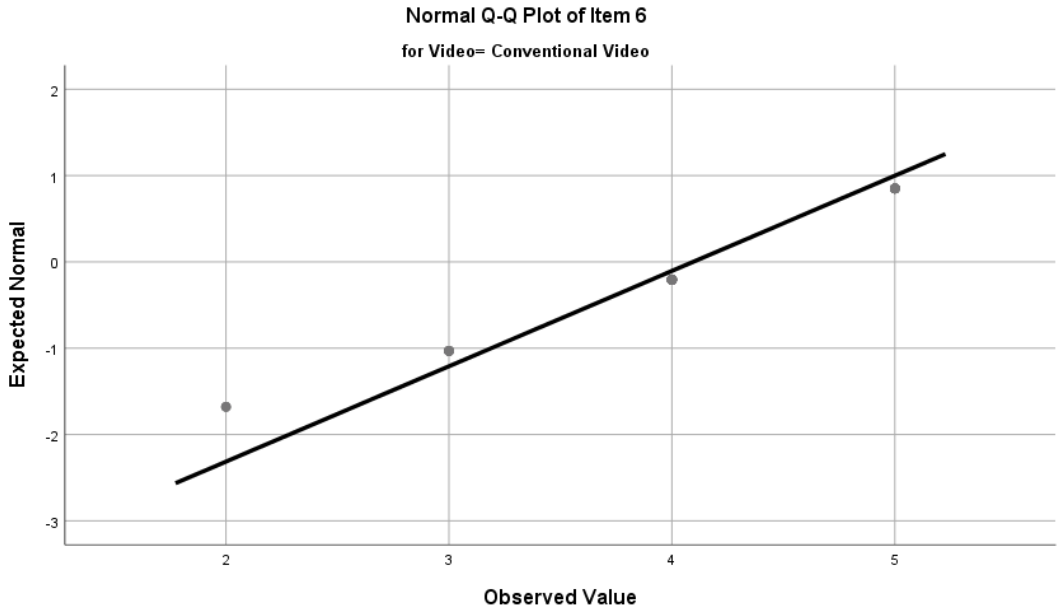

Normal Q-Q Plot of Item 3
for Video= Immersive Video
Expected Normal
Observed Value
1
0
-1
-2
-3
2.5
3.0
3.5
4.0
4.5
5.0
5.5

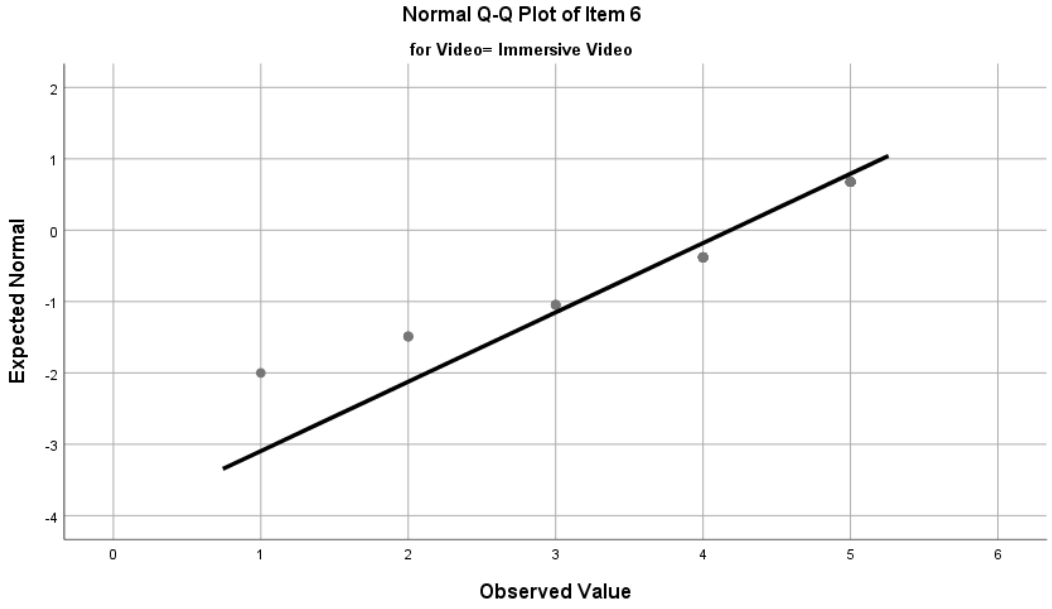

Normal Q-Q Plot of Item 4
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2
3
4
5

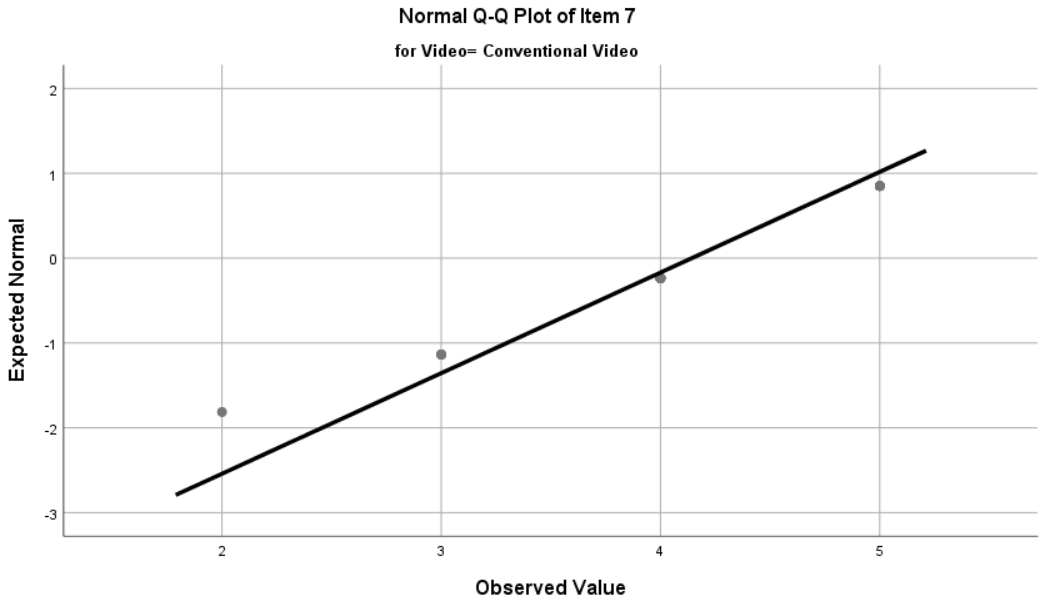

Normal Q-Q Plot of Item 4
for Video= Immersive Video
Expected Normal
Observed Value
1
0
-1
-2
-3
-4
0
1
2
3
4
5
6

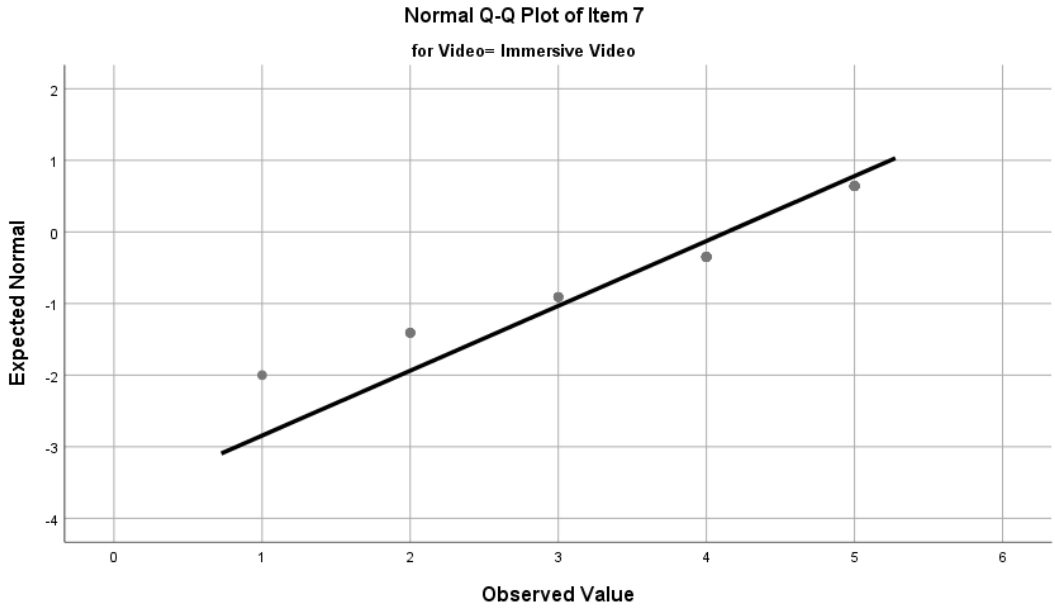

Normal Q-Q Plot of Item 5
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
2
3
4
5

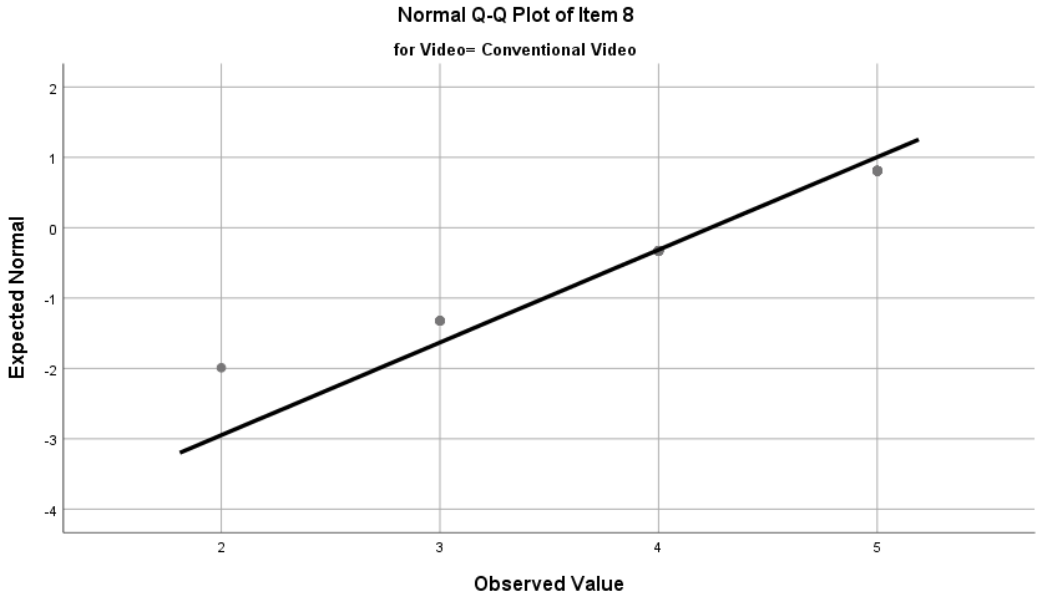

Normal Q-Q Plot of Item 5
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
0
1
2
3
4
5
6

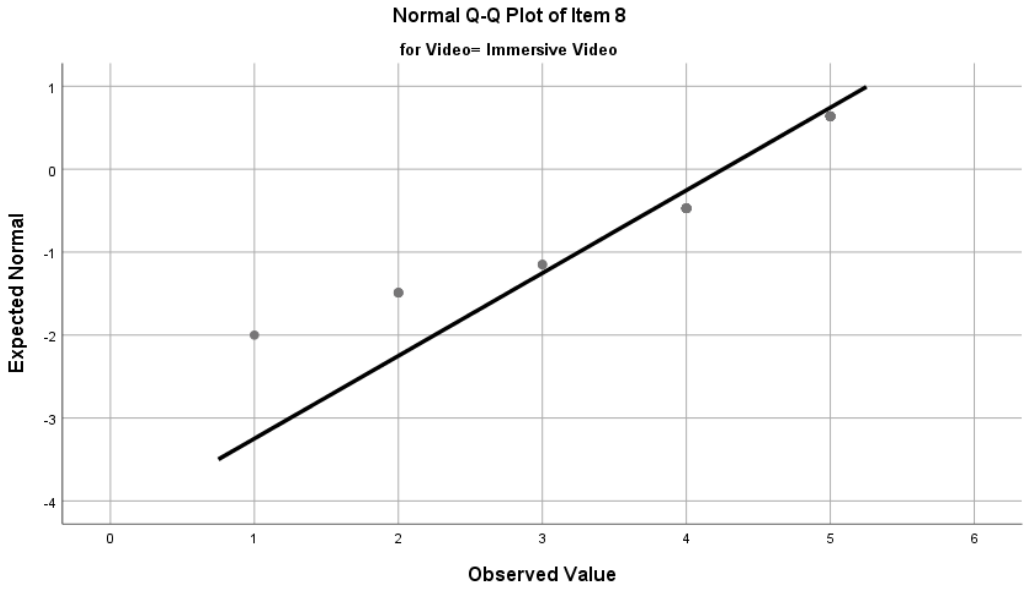

Normal Q-Q Plot of Item 6
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2
3
4
5

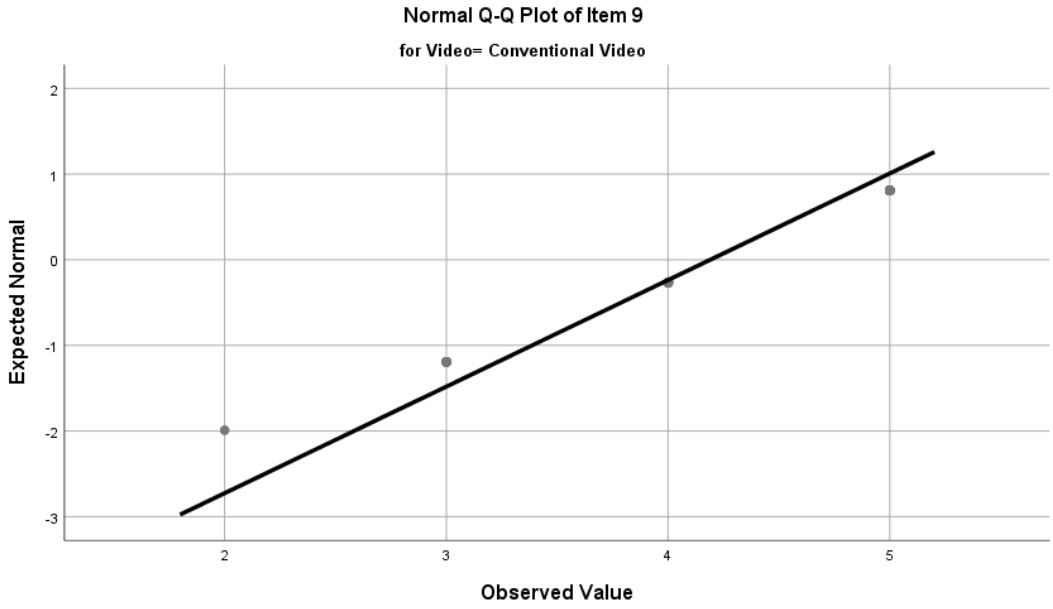

Normal Q-Q Plot of Item 6
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
0
1
2
3
4
5
6

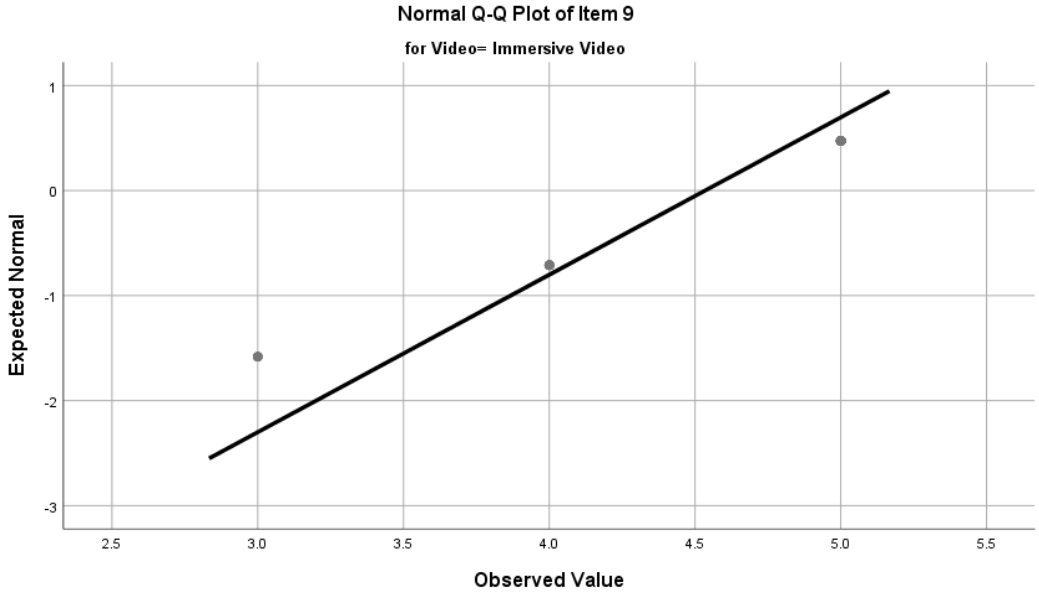

Normal Q-Q Plot of Item 7
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2
3
4
5

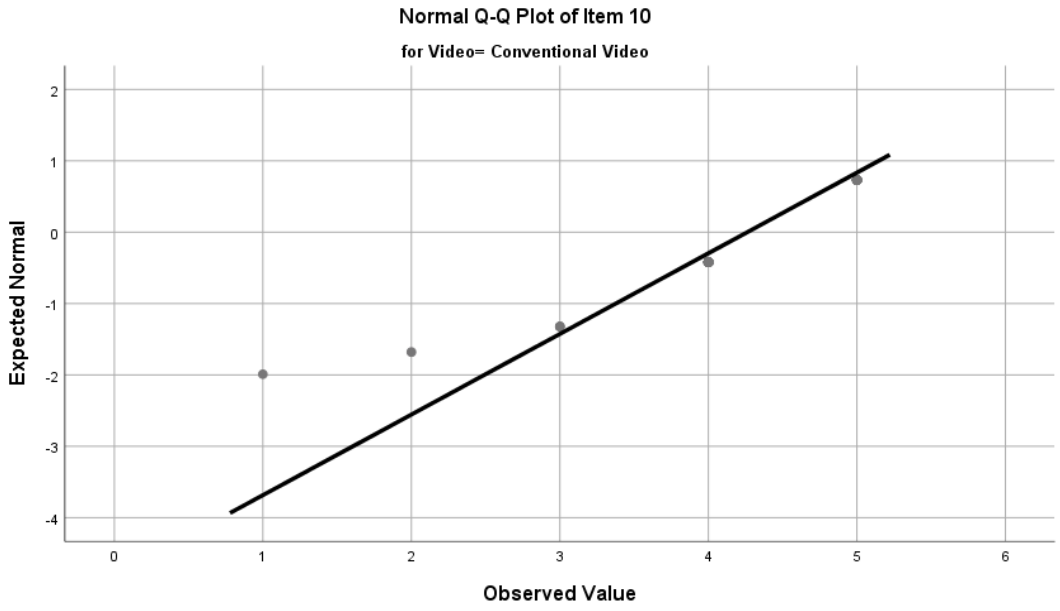

Normal Q-Q Plot of Item 7
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
0
1
2
3
4
5
6

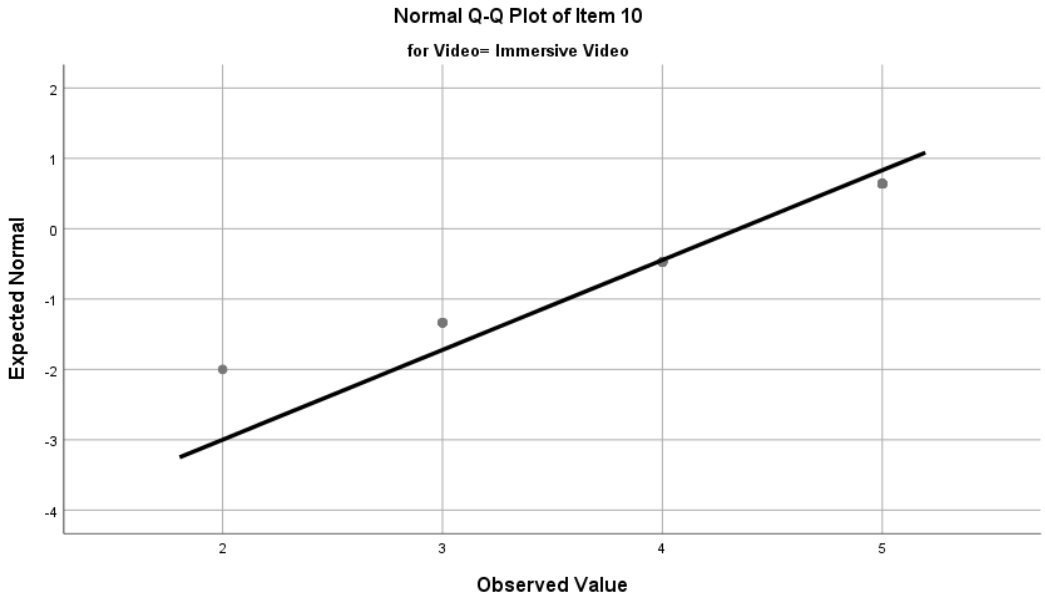

Normal Q-Q Plot of Item 8
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
2
3
4
5

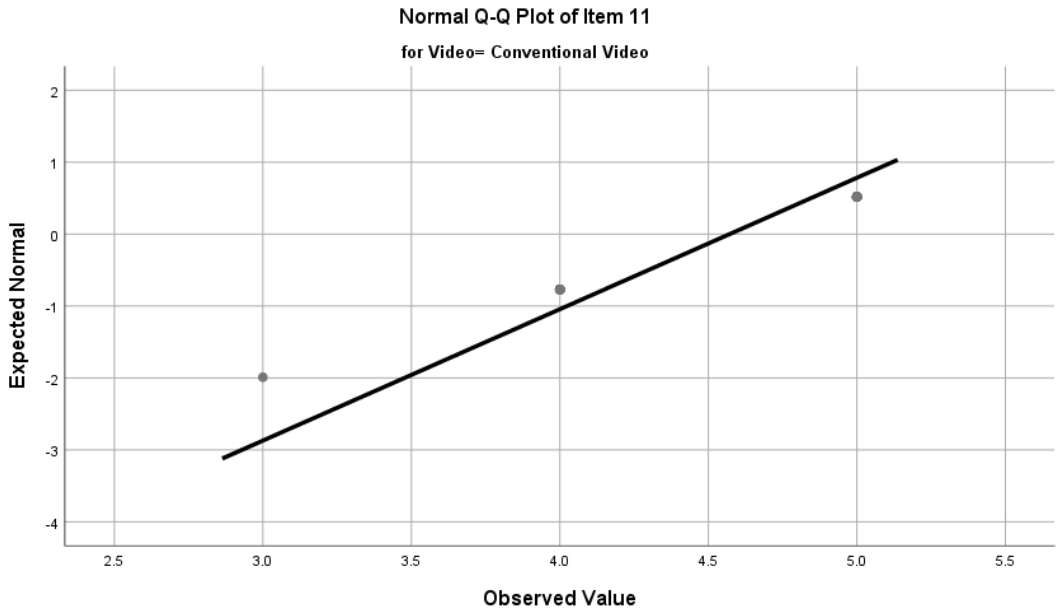

Normal Q-Q Plot of Item 8
for Video= Immersive Video
Expected Normal
Observed Value
1
0
-1
-2
-3
-4
0
1
2
3
4
5
6

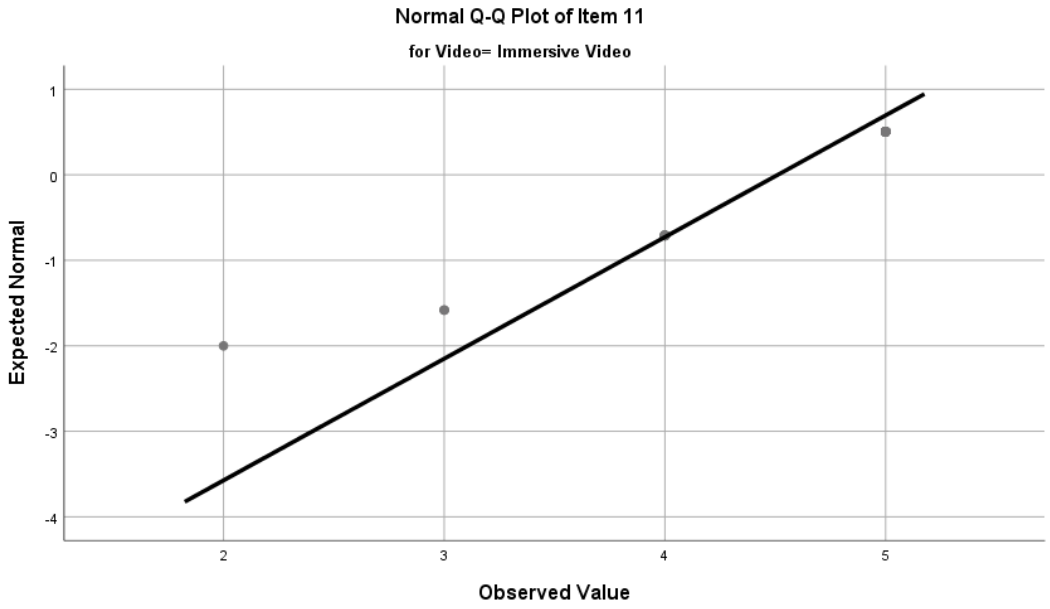

Normal Q-Q Plot of Item 9
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2
3
4
5

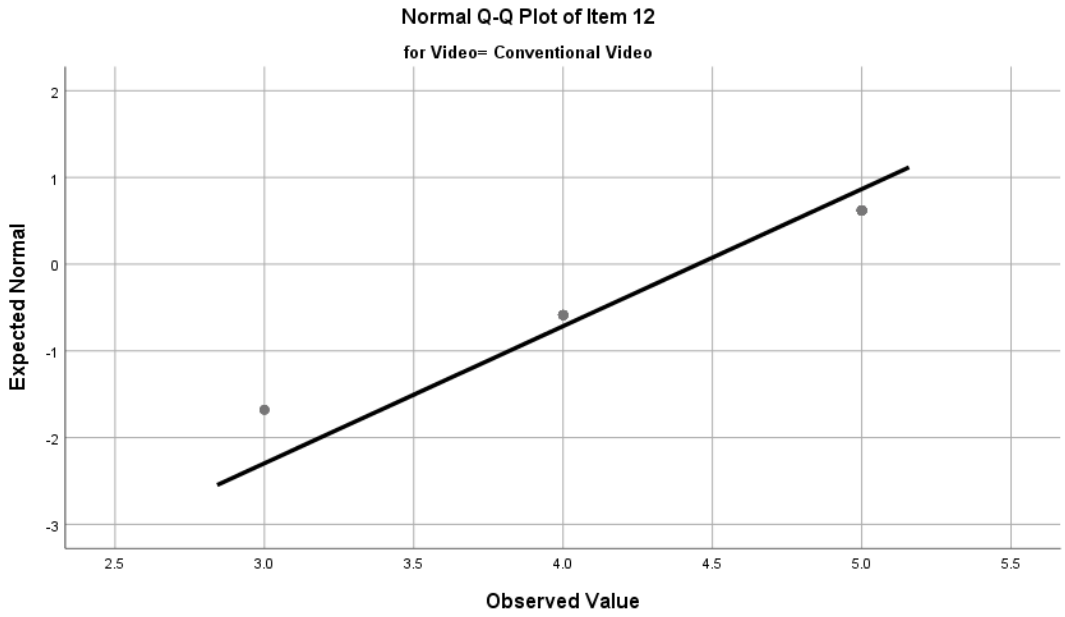

Normal Q-Q Plot of Item 9
for Video= Immersive Video
Expected Normal
Observed Value
1
0
-1
-2
-3
2.5
3.0
3.5
4.0
4.5
5.0
5.5

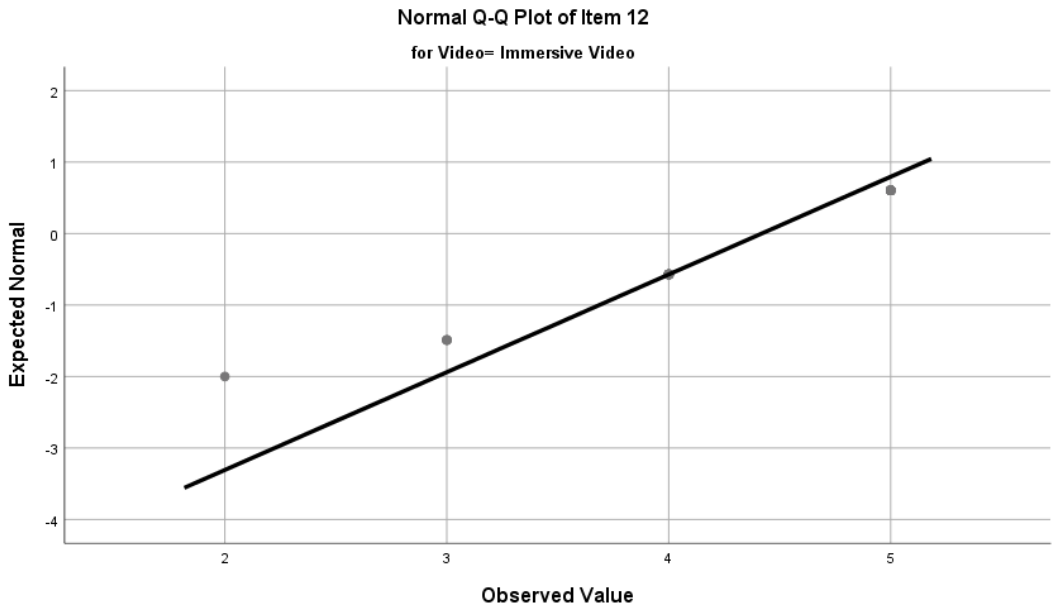

Normal Q-Q Plot of Item 10
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
0
1
2
3
4
5
6

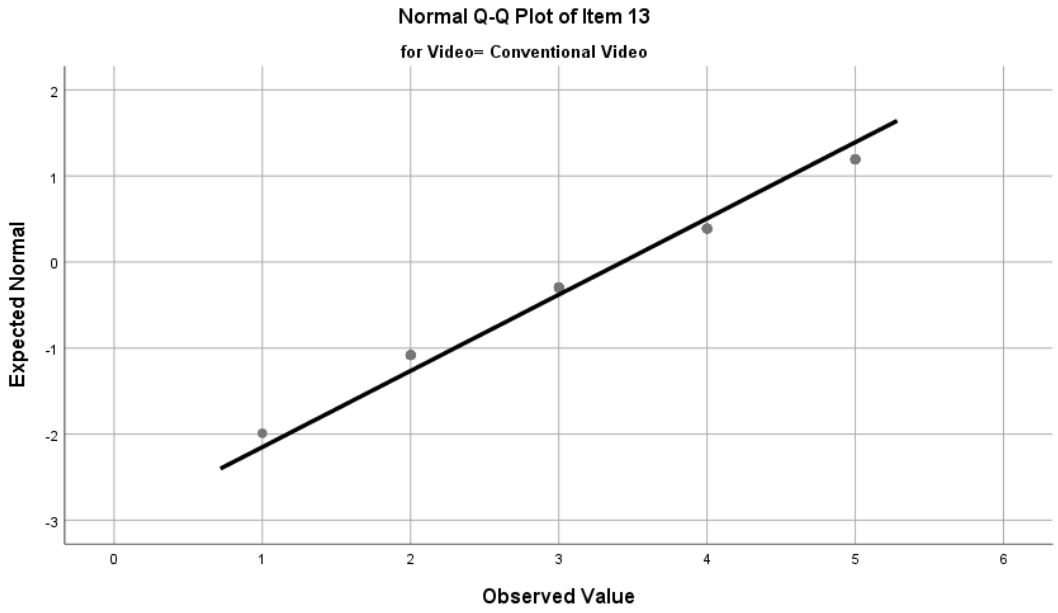

Normal Q-Q Plot of Item 10
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
2
3
4
5

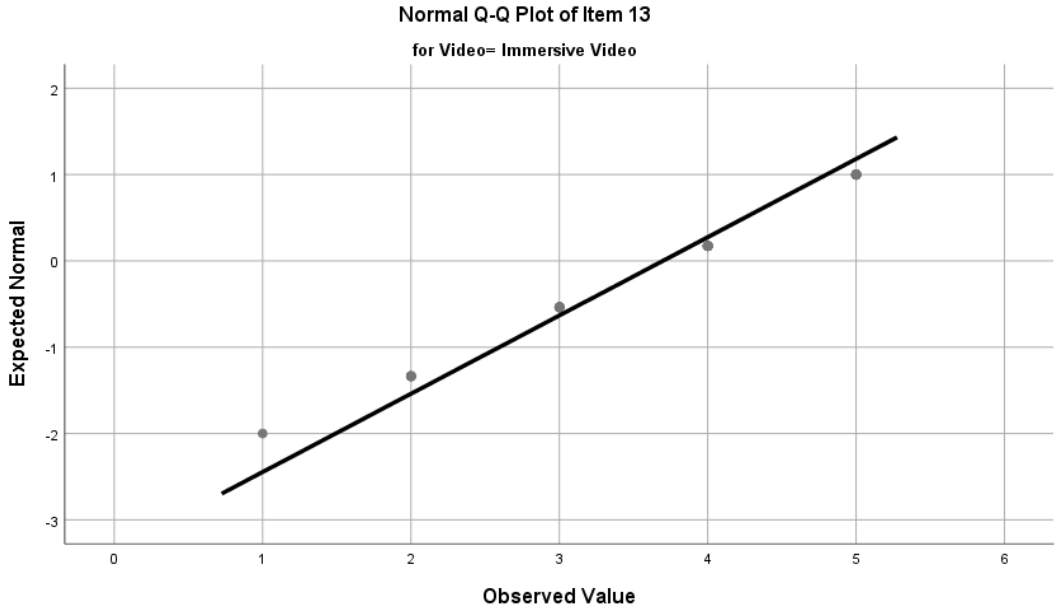

Normal Q-Q Plot of Item 11
for Video= Conventional Video
Expected Normal
2
1
0
-1
-2
-3
-4
2.5
3.0
3.5
4.0
4.5
5.0
5.5
Observed Value

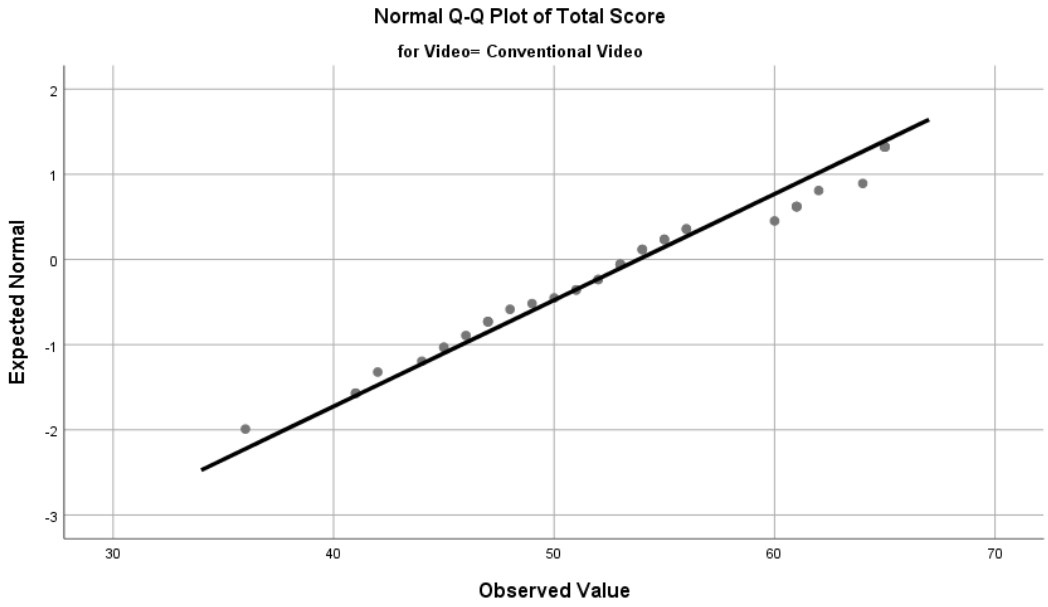

Normal Q-Q Plot of Item 11
for Video= Immersive Video
Expected Normal
1
0
-1
-2
-3
-4
2
3
4
5
Observed Value

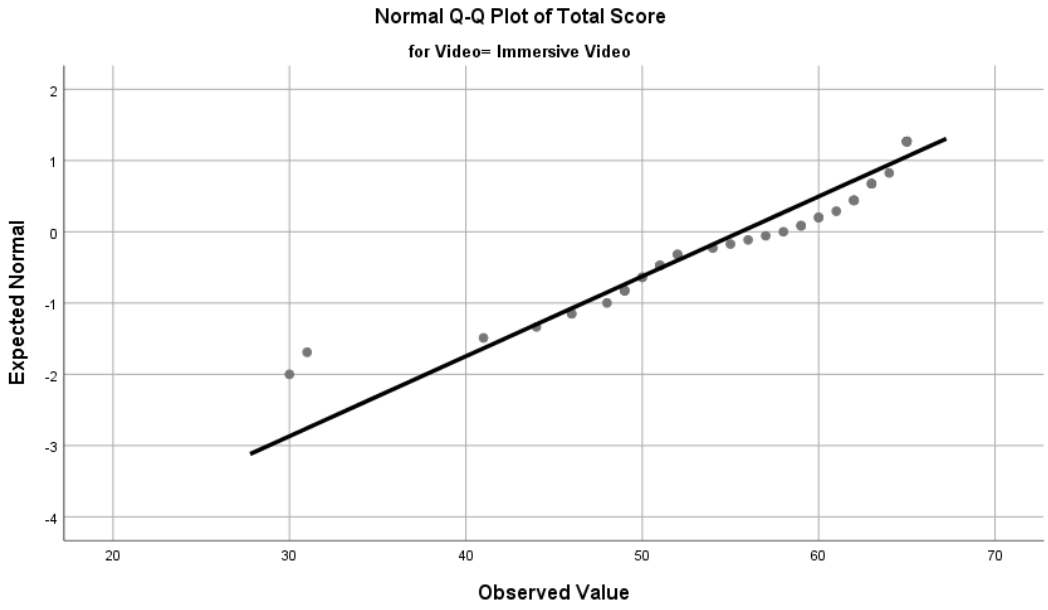

Normal Q-Q Plot of Item 12
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2.5
3.0
3.5
4.0
4.5
5.0
5.5

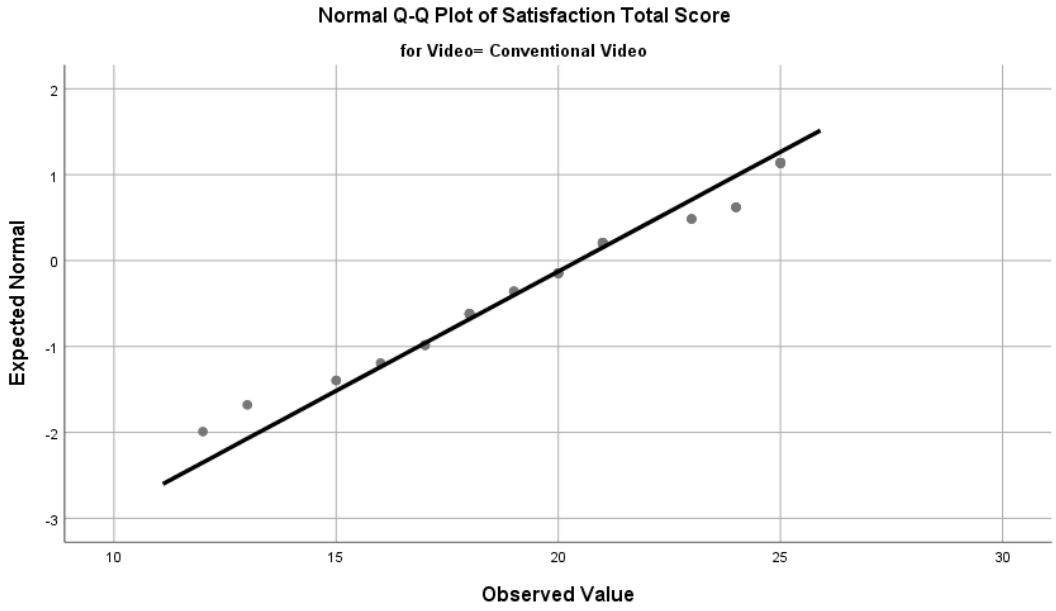

Normal Q-Q Plot of Item 12
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
2
3
4
5

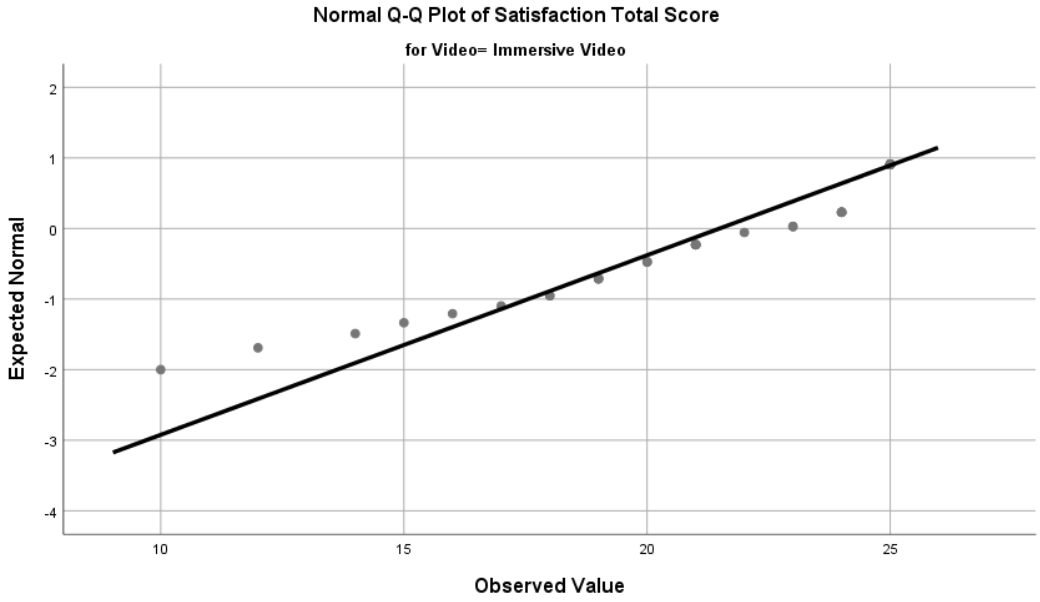

Normal Q-Q Plot of Item 13
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
0
1
2
3
4
5
6

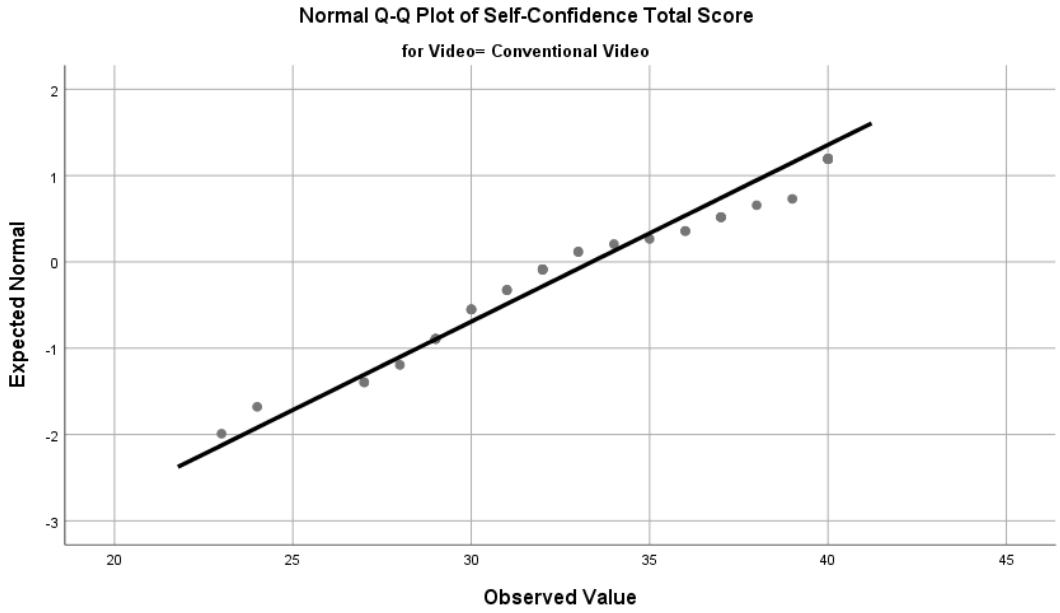

Normal Q-Q Plot of Item 13
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
0
1
2
3
4
5
6

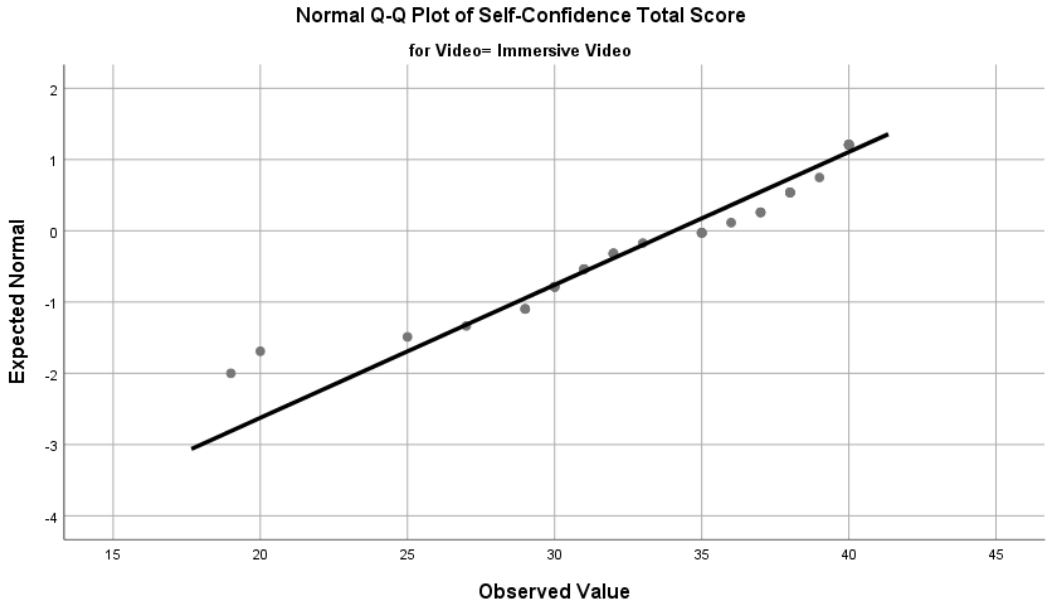

Normal Q-Q Plot of Total Score
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
30
40
50
60
70


Normal Q-Q Plot of Total Score
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
20
30
40
50
60
70


Normal Q-Q Plot of Satisfaction Total Score
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
10
15
20
25
30


Normal Q-Q Plot of Satisfaction Total Score
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
10
15
20
25


Normal Q-Q Plot of Self-Confidence Total Score
for Video= Conventional Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
20
25
30
35
40
45


Normal Q-Q Plot of Self-Confidence Total Score
for Video= Immersive Video
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
15
20
25
30
35
40
45

APPENDIX K

TESTS FOR NORMALITY OF IDENTIFIED PATIENT SAFETY RISKS

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Video Type	Statistic	Df	Sig.	Statistic	df	Sig.
Safety Risks	Conventional Video	.149	46	.012	.969	46	.262
	Immersive Video	.130	45	.056	.971	45	.322

APPENDIX L

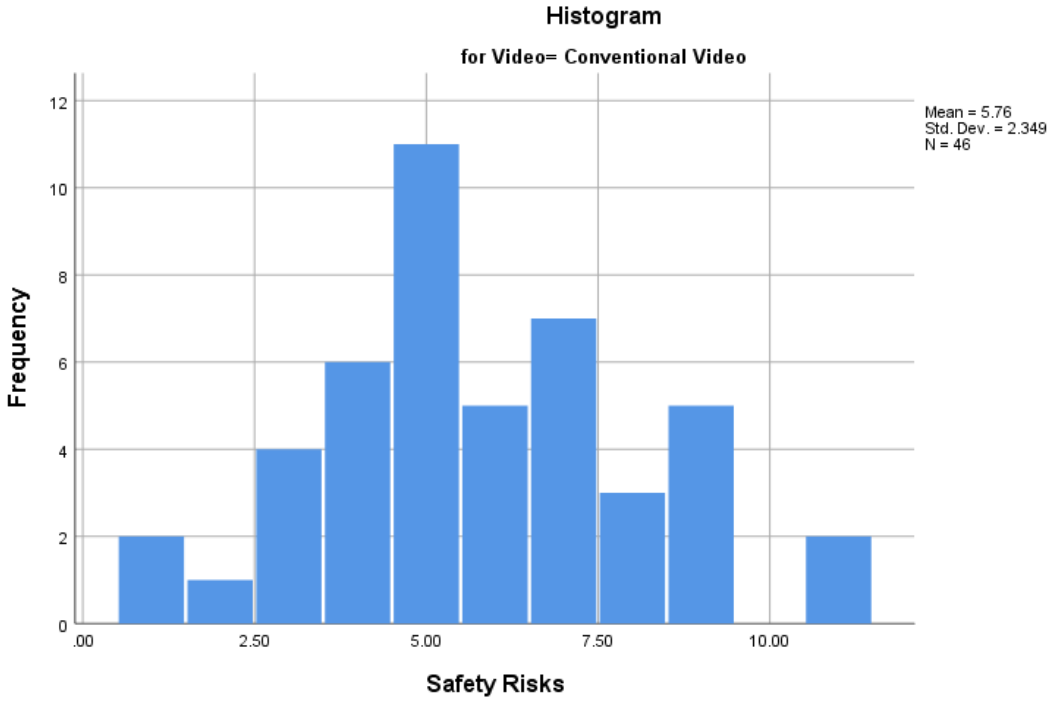
DESCRIPTIVE STATISTICS OF IDENTIFIED RISKS TO PATIENT SAFETY RESULTS

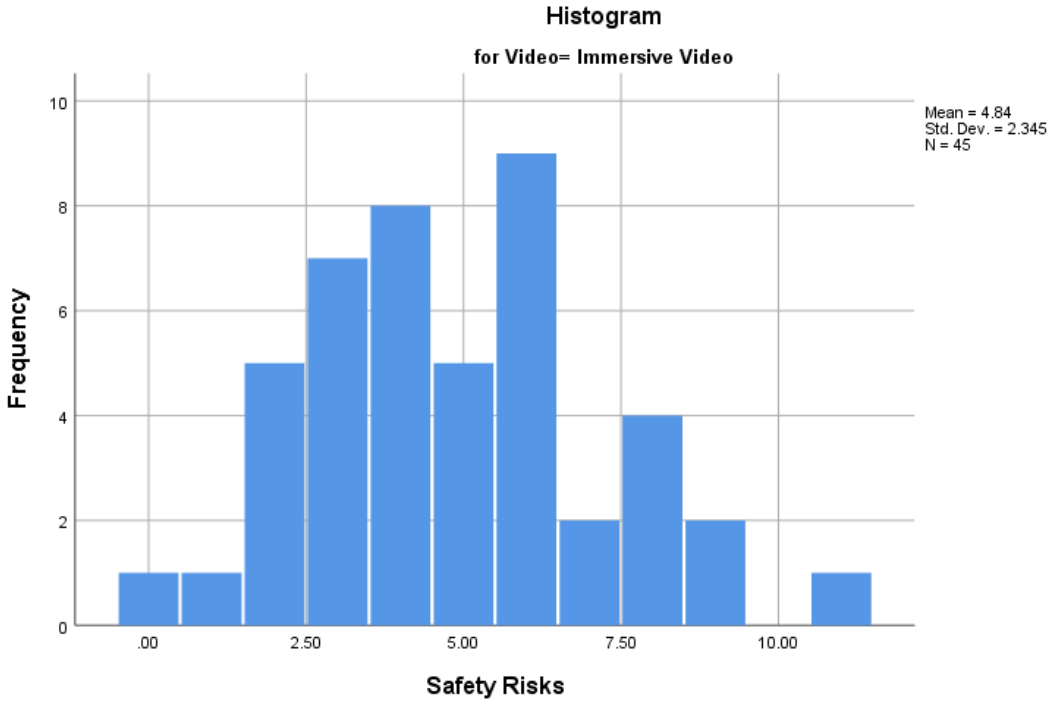
Descriptives

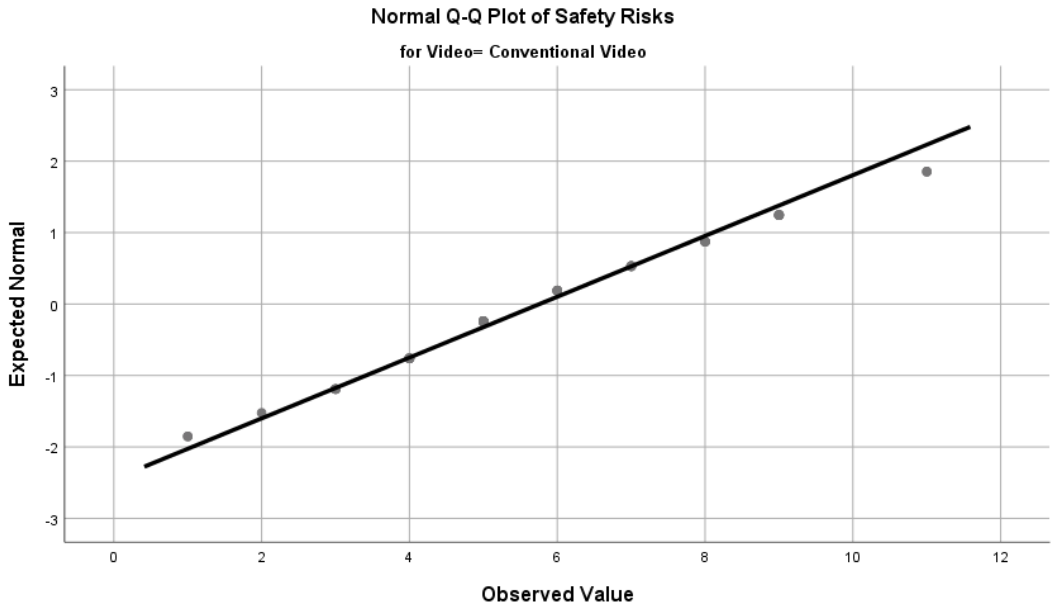
	Video Type			Statistic	Std. Error
Safety Risks	Conventional Video	Mean		5.7609	.34639
		95% Confidence Interval for Mean	Lower Bound	5.0632	
			Upper Bound	6.4585	
		5% Trimmed Mean		5.7415	
		Median		5.0000	
		Variance		5.519	
		Std. Deviation		2.34932	
		Minimum		1.00	
		Maximum		11.00	
		Range		10.00	
		Interquartile Range		3.00	
		Skewness		.204	.350
		Kurtosis		-.151	.688
	Immersive Video	Mean		4.8444	.34954
		95% Confidence Interval for Mean	Lower Bound	4.1400	
			Upper Bound	5.5489	
		5% Trimmed Mean		4.7963	
		Median		5.0000	
		Variance		5.498	
		Std. Deviation		2.34478	
		Minimum		.00	
		Maximum		11.00	
		Range		11.00	
		Interquartile Range		3.00	
		Skewness		.373	.354
		Kurtosis		-.054	.695

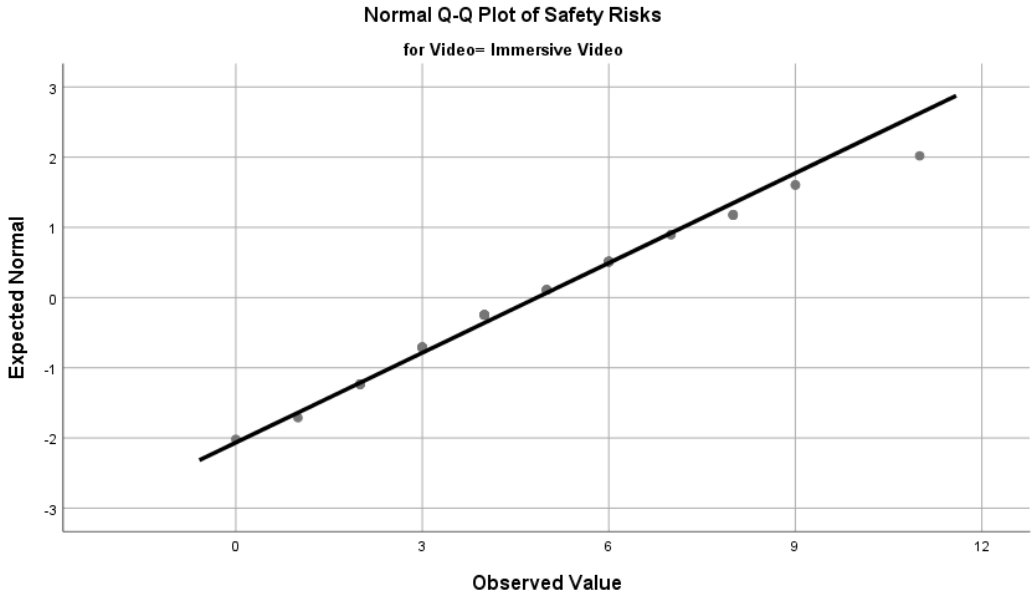
APPENDIX M

IDENTIFIED RISKS TO PATIENT SAFETY HISTOGRAMS AND Q-Q PLOTS


Histogram
for Video= Conventional Video
Mean = 5.76
Std. Dev. = 2.349
N = 46
Frequency
0
2
4
6
8
10
12
.00
2.50
5.00
7.50
10.00
Safety Risks

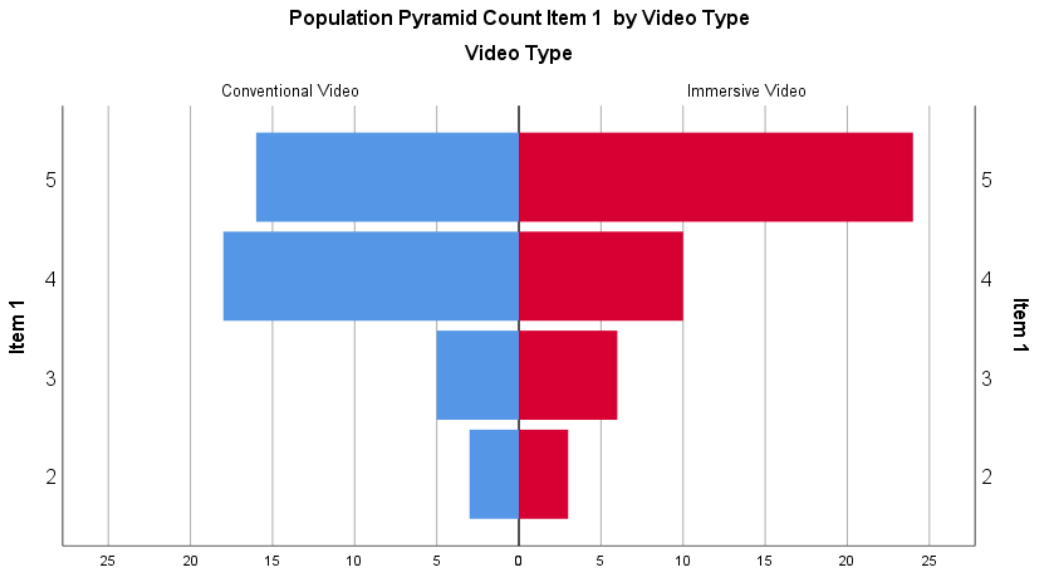

Histogram
for Video= Immersive Video
Mean = 4.84
Std. Dev. = 2.345
N = 45
Frequency
0
2
4
6
8
10
.00
2.50
5.00
7.50
10.00
Safety Risks

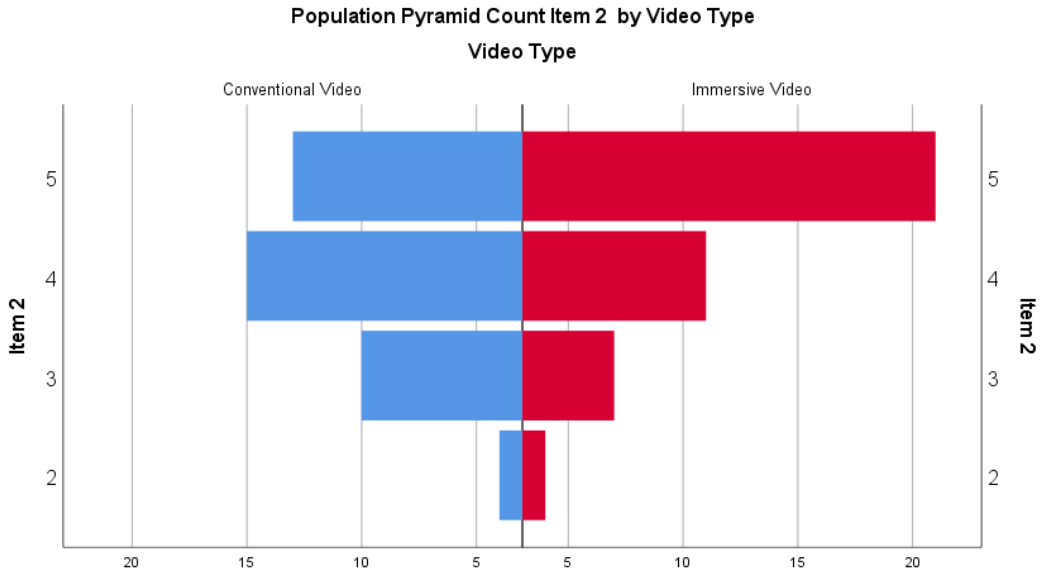

Normal Q-Q Plot of Safety Risks
for Video= Conventional Video
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
0
2
4
6
8
10
12

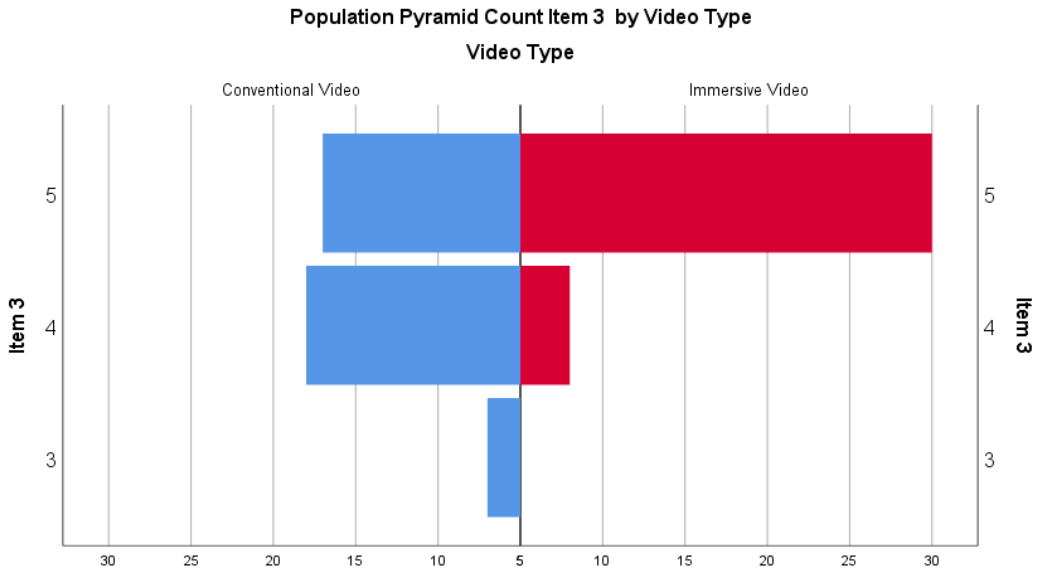

Normal Q-Q Plot of Safety Risks
for Video= Immersive Video
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
0
3
6
9
12

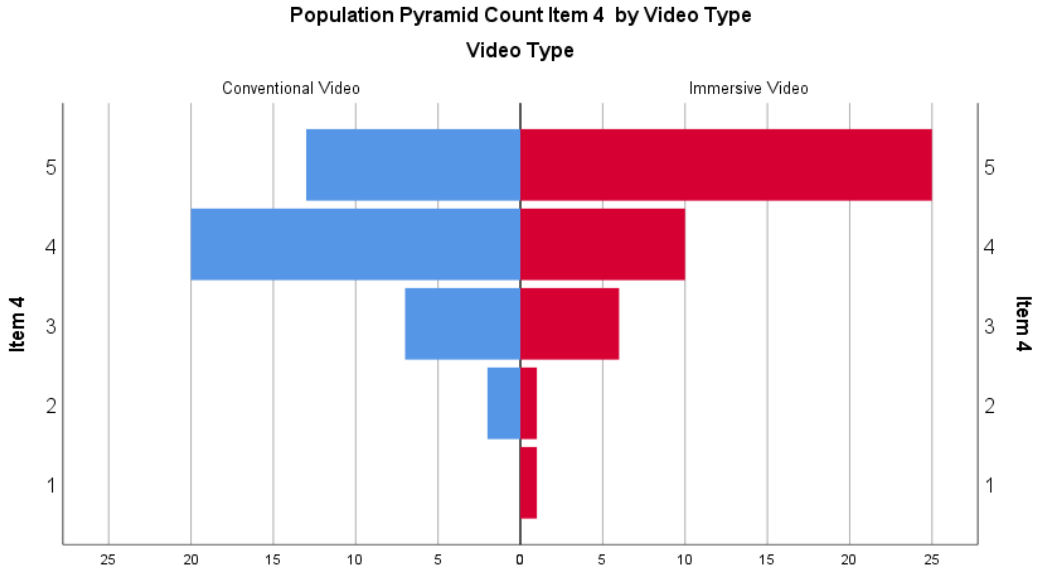
APPENDIX N

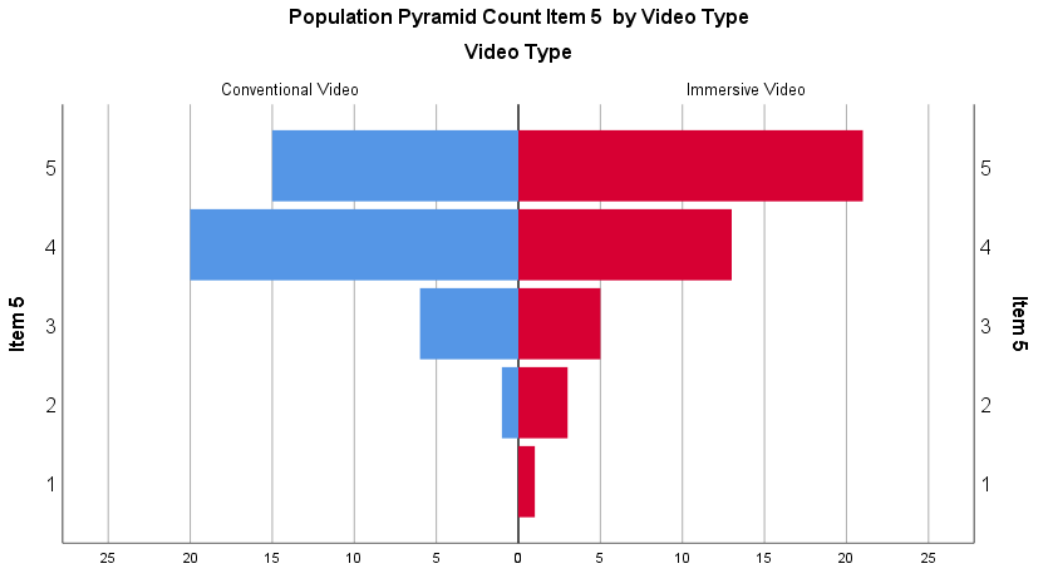
NATIONAL LEAGUE FOR NURSING STUDENT SATISFACTION AND SELF-CONFIDENCE IN LEARNING HISTOGRAMS

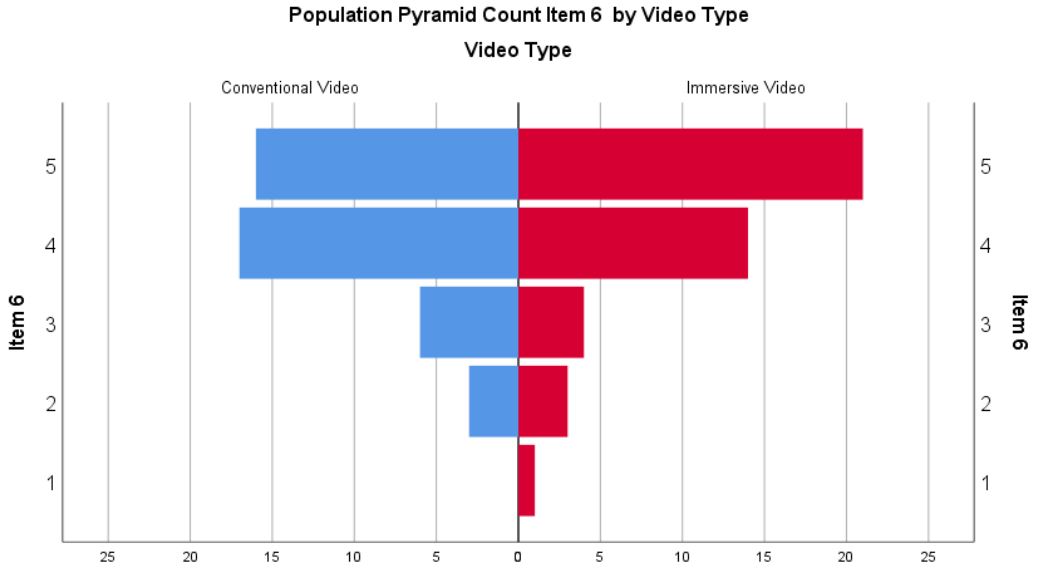

Population Pyramid Count Item 1 by Video Type
Video Type
Conventional Video
Immersive Video
Item 1
5
4
3
2
25
20
15
10
5
0
5
10
15
20
25

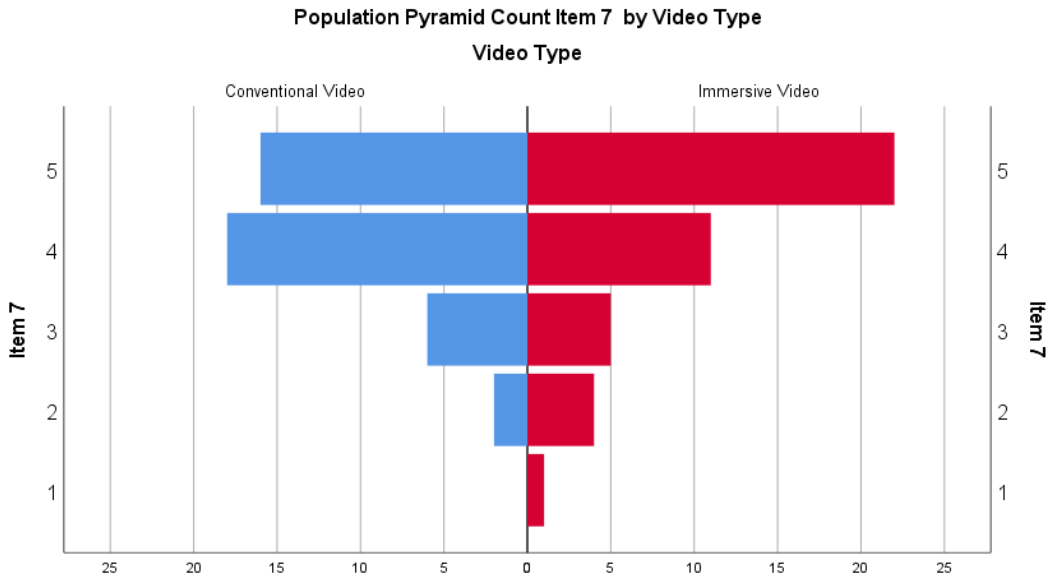

Population Pyramid Count Item 2 by Video Type
Video Type
Conventional Video
Immersive Video
Item 2
5
4
3
2
20
15
10
5
5
10
15
20

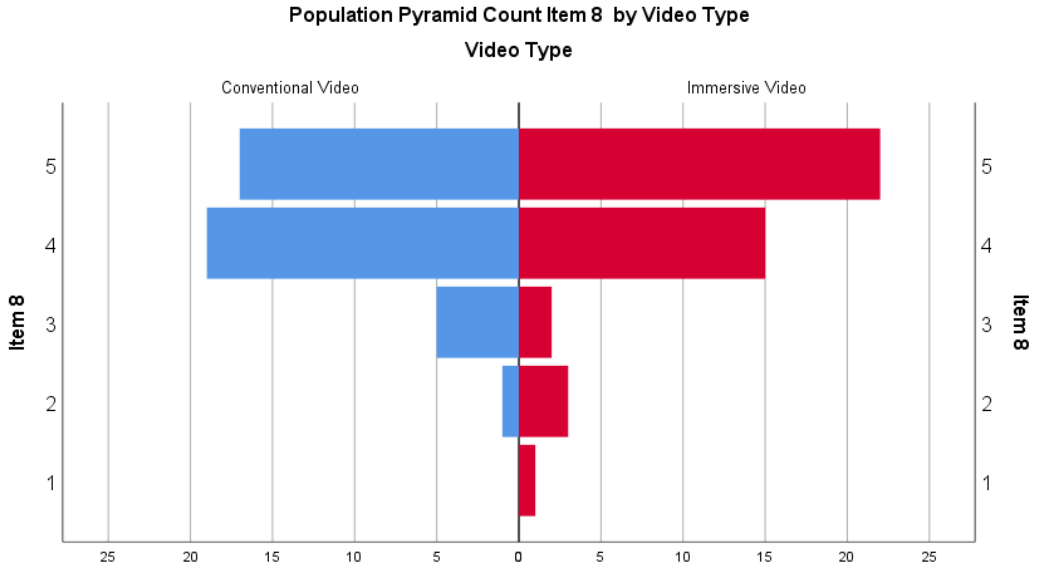

Population Pyramid Count Item 3 by Video Type
Video Type
Conventional Video
Immersive Video
Item 3
5
4
3
30
25
20
15
10
5

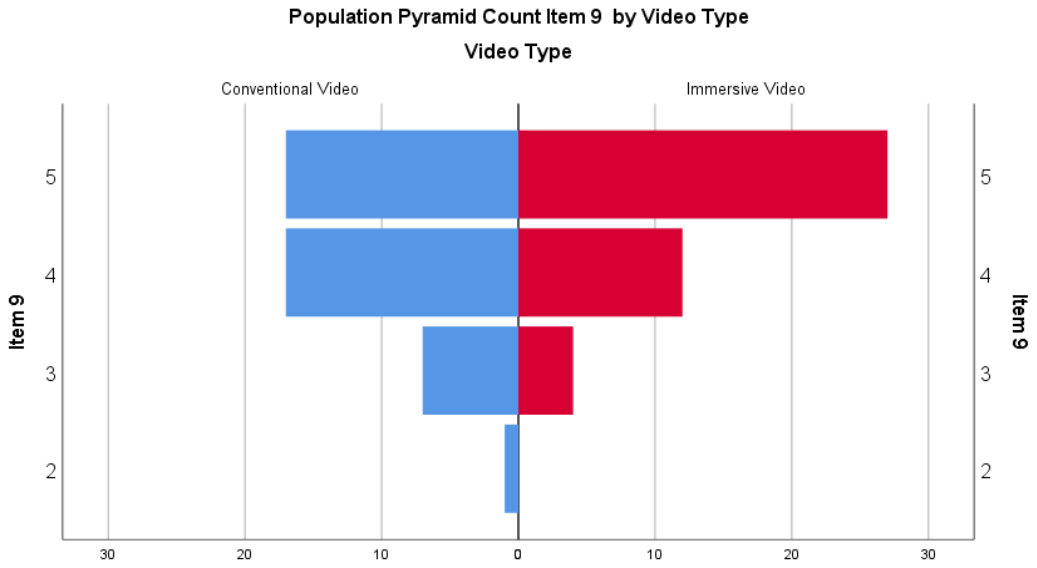

Population Pyramid Count Item 4 by Video Type
Video Type
Conventional Video
Immersive Video
Item 4
5
4
3
2
1
25
20
15
10
5
0

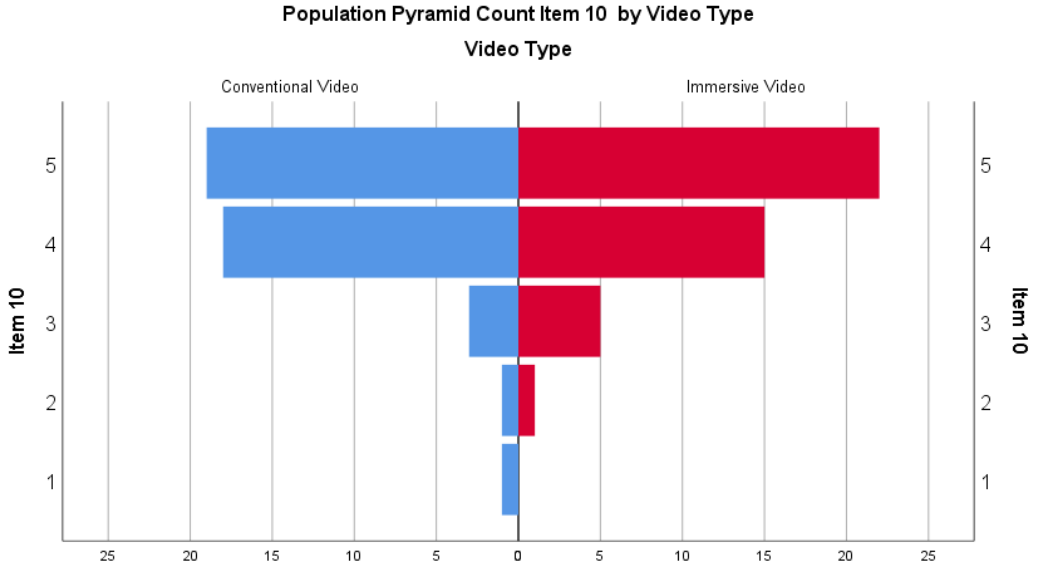

Population Pyramid Count Item 5 by Video Type
Video Type
Conventional Video
Immersive Video
Item 5
5
4
3
2
1
25
20
15
10
5
0

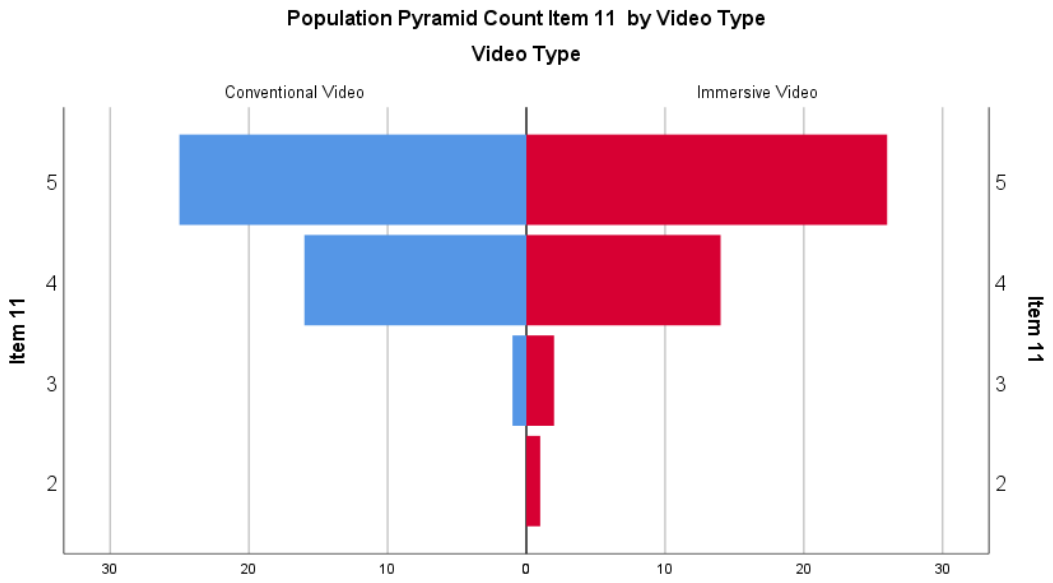

Population Pyramid Count Item 6 by Video Type
Video Type
Conventional Video
Immersive Video
Item 6
5
4
3
2
1
25
20
15
10
5
0

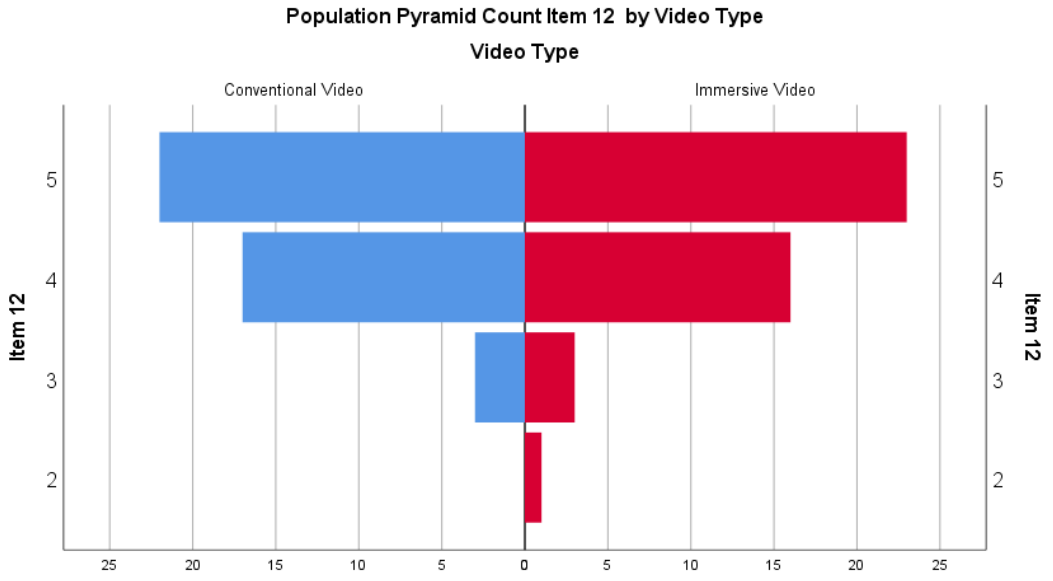

Population Pyramid Count Item 7 by Video Type
Video Type
Conventional Video
Immersive Video
Item 7
5
4
3
2
1
25
20
15
10
5
0
5
10
15
20
25

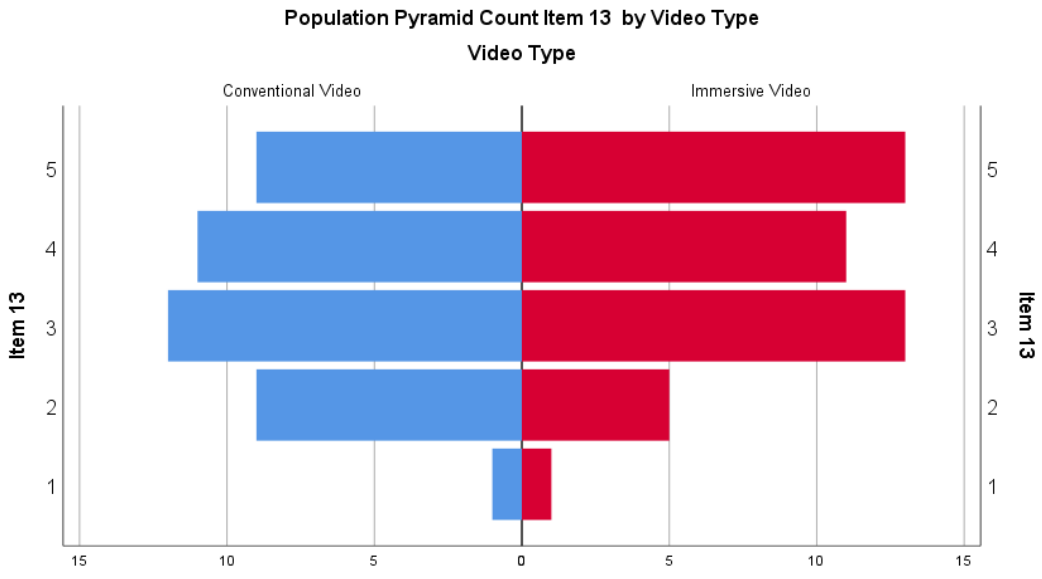

Population Pyramid Count Item 8 by Video Type
Video Type
Conventional Video
Immersive Video
Item 8
5
4
3
2
1
25
20
15
10
5
0
5
10
15
20
25

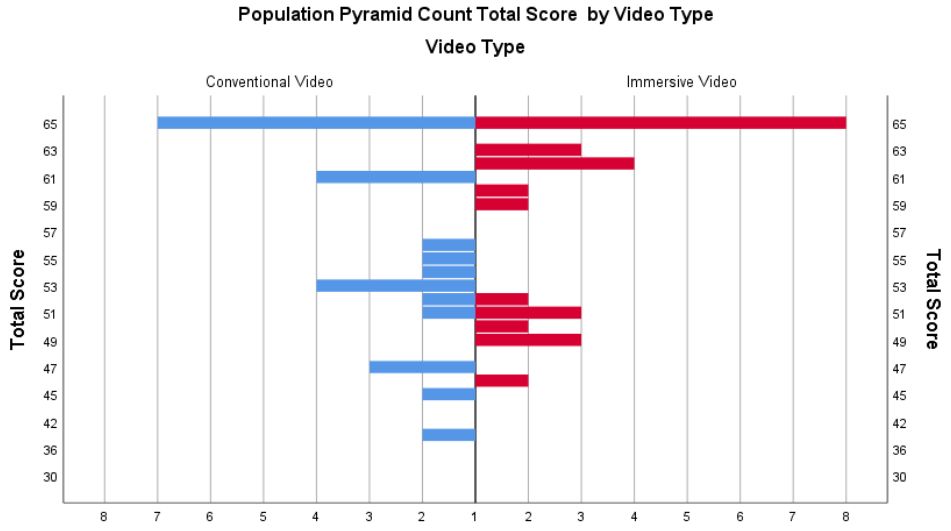

Population Pyramid Count Item 9 by Video Type
Video Type
Conventional Video
Immersive Video
Item 9
5
4
3
2
30
20
10
0
10
20
30

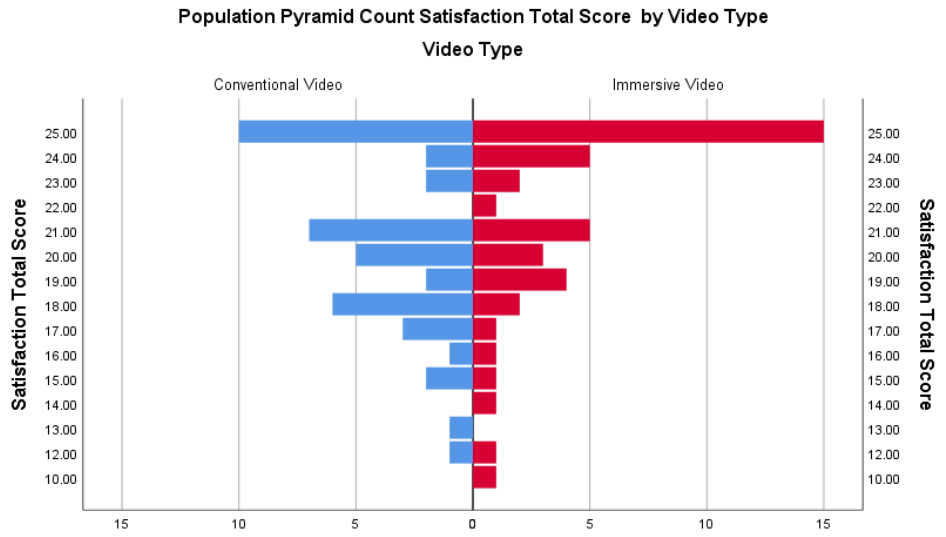

Population Pyramid Count Item 10 by Video Type
Video Type
Conventional Video
Immersive Video
Item 10
5
4
3
2
1
25
20
15
10
5
0
5
10
15
20
25

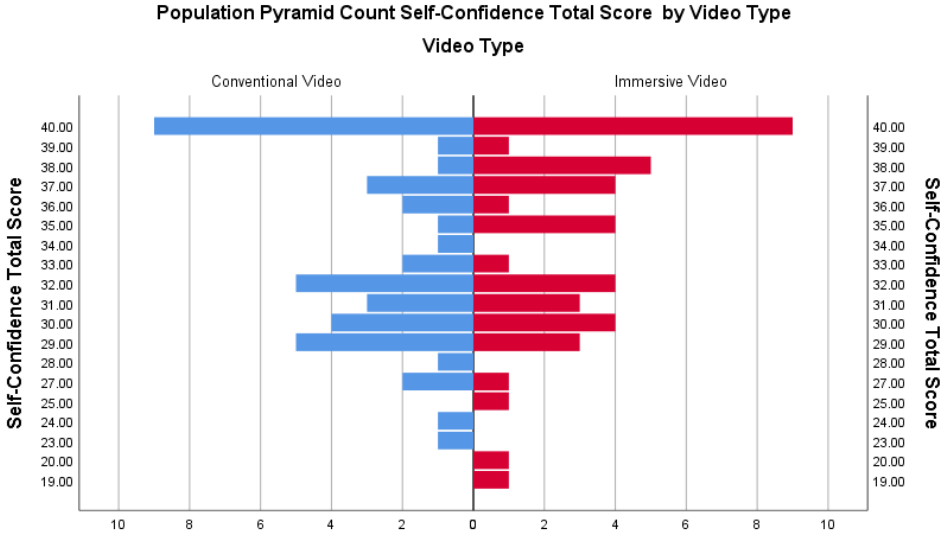

Population Pyramid Count Item 11 by Video Type
Video Type
Conventional Video
Immersive Video
Item 11
5
4
3
2
30
20
10
0
10
20
30


Population Pyramid Count Item 12 by Video Type
Video Type
Conventional Video
Immersive Video
Item 12
5
4
3
2
25
20
15
10
5
0
5
10
15
20
25


Population Pyramid Count Item 13 by Video Type
Video Type
Conventional Video
Immersive Video
Item 13
5
4
3
2
1
15
10
5
0
5
10
15


Population Pyramid Count Total Score by Video Type
Video Type
Conventional Video
Immersive Video
Total Score
65
63
61
59
57
55
53
51
49
47
45
42
36
30
8
7
6
5
4
3
2
1
2
3
4
5
6
7
8


Population Pyramid Count Satisfaction Total Score by Video Type
Video Type
Conventional Video
Immersive Video
Satisfaction Total Score
25.00
24.00
23.00
22.00
21.00
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
10.00
15
10
5
0
5
10
15


Population Pyramid Count Self-Confidence Total Score by Video Type
Video Type
Conventional Video
Immersive Video
Self-Confidence Total Score
40.00
39.00
38.00
37.00
36.00
35.00
34.00
33.00
32.00
31.00
30.00
29.00
28.00
27.00
25.00
24.00
23.00
20.00
19.00
10
8
6
4
2
0
2
4
6
8
10

APPENDIX O

MANN-WHITNEY U TEST NATIONAL LEAGUE FOR NURSING STUDENT SATISFACTION AND SELF-CONFIDENCE IN LEARNING RESULTS

Ranks

	Video Type	N	Mean Rank	Sum of Ranks
Item 1	Conventional Video	42	40.13	1685.50
	Immersive Video	43	45.80	1969.50
	Total	85		
Item 2	Conventional Video	42	39.43	1656.00
	Immersive Video	43	46.49	1999.00
	Total	85		
Item 3	Conventional Video	42	37.11	1558.50
	Immersive Video	43	48.76	2096.50
	Total	85		
Item 4	Conventional Video	42	38.04	1597.50
	Immersive Video	43	47.85	2057.50
	Total	85		
Item 5	Conventional Video	42	41.48	1742.00
	Immersive Video	43	44.49	1913.00
	Total	85		
Item 6	Conventional Video	42	40.99	1721.50
	Immersive Video	43	44.97	1933.50
	Total	85		
Item 7	Conventional Video	42	41.55	1745.00
	Immersive Video	43	44.42	1910.00
	Total	85		
Item 8	Conventional Video	42	41.21	1731.00
	Immersive Video	43	44.74	1924.00
	Total	85		
Item 9	Conventional Video	42	37.82	1588.50
	Immersive Video	43	48.06	2066.50
	Total	85		
Item 10	Conventional Video	42	42.02	1765.00
	Immersive Video	43	43.95	1890.00
	Total	85		
Item 11	Conventional Video	42	43.21	1815.00
	Immersive Video	43	42.79	1840.00
	Total	85		
Item 12	Conventional Video	42	43.04	1807.50
	Immersive Video	43	42.97	1847.50
	Total	85		
Item 13	Conventional Video	42	40.07	1683.00
	Immersive Video	43	45.86	1972.00
	Total	85		

Test Statistics[a]

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
Mann-Whitney U	782.500	753.000	655.500	694.500	839.000	818.500
Wilcoxon W	1685.500	1656.000	1558.500	1597.500	1742.000	1721.500
Z	-1.144	-1.391	-2.433	-1.973	-.605	-.798
Asymp. Sig. (2-tailed)	.253	.164	.015	.049	.545	.425

Test Statistics[a]

	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12
Mann-Whitney U	842.000	828.000	685.500	862.000	894.000	901.500
Wilcoxon W	1745.000	1731.000	1588.500	1765.000	1840.000	1847.500
Z	-.575	-.720	-2.112	-.396	-.092	-.015
Asymp. Sig. (2-tailed)	.565	.472	.035	.692	.927	.988

Test Statistics[a]

	Item 13
Mann-Whitney U	780.000
Wilcoxon W	1683.000
Z	-1.118
Asymp. Sig. (2-tailed)	.264

Ranks

	Video Type	N	Mean Rank	Sum of Ranks
Total	Conventional Video	42	39.98	1679.00
	Immersive Video	43	45.95	1976.00
	Total	85		
Satisfaction	Conventional Video	42	38.96	1636.50
	Immersive Video	43	46.94	2018.50
	Total	85		
Self-confidence	Conventional Video	42	40.75	1711.50
	Immersive Video	43	45.20	1943.50
	Total	85		

Test Statistics[a]

	Total Score	Satisfaction Total Score	Self-Confidence Total Score
Mann-Whitney U	776.000	733.500	808.500
Wilcoxon W	1679.000	1636.500	1711.500
Z	-1.120	-1.514	-.836
Asymp. Sig. (2-tailed)	.263	.130	.403

APPENDIX P

INDEPENDENT T-TEST ON IDENTIFIED NUMBER OF SAFETY RISKS RESULTS

Group Statistics

	Video Type	*N*	*M*	*SD*	Std. Error Mean
Number of Safety Risks	Conventional Video	46	5.7609	2.34932	.34639
	Immersive Video	45	4.8444	2.34478	.34954

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means
		F	Sig.	t
Number of Safety Risks	Equal variances assumed	.002	.968	1.862
	Equal variances not assumed			1.862

Independent Samples Test

		t-test for Equality of Means		
		df	Sig. (2-tailed)	Mean Difference
Number of Safety Risks	Equal variances assumed	89	.066	.91643
	Equal variances not assumed	88.963	.066	.91643