Student Perceptions and Considerations for Medical Educational Modeling in Radiologic Technology Education

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Abstract

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Student Perceptions and Considerations for Medical Educational Modeling in Radiologic Technology Education

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Medical educational modeling (MEM) is a widely used pedagogical practice in the education and training of healthcare professions. MEM is the use of peers within the same cohort as simulated patients for examinations involving physical contact between the pre-healthcare provider student and patient in order to demonstrate and hone skills that will be necessary for professional practice. While this pedagogical practice has been studied in other fields, its use within the imaging sciences discipline has not been readily reviewed. The purpose of this study was to examine student perceptions and comfort levels of MEM within their professional program training. Results indicate that participants in the study had an overall positive perception and comfort level among the various roles associated with MEM in the imaging sciences discipline. Discussion and implications for practice detailed within the study may provide greater understanding and sensitivity to the design of pedagogical practice in the training and education of future imaging science professionals.

Dedication

This dissertation is dedicated to the people in my life who never gave up on me. For my husband, Brian, thank you for being my other half through this journey. For my friends and colleagues, I thank you for the support as I took on this endeavor I would have never dreamed of when I set sail in this big world. Finally, to my children, Cheyenne, Rylee, and Gavin, even after completing this dissertation, you will still remain my greatest accomplishment of all.

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Chapter 1: The Problem of Practice

Learning by doing is a common mantra throughout many health science disciplines. Healthcare is ultimately about caring for the needs of the patients and usually requires a significant amount of patient contact. The training of future healthcare providers presents a unique situation whereby students need to practice and demonstrate skills necessary to promote positive patient outcomes. However, the question remains on whom these students should practice and demonstrate these skills.

Background and Significance

Multiple researchers cite numerous ways students may demonstrate these skills including teaching mannequins, volunteers who act as patients (and are usually compensated), or through the use of peers within the same cohort (Das et al., 1998; Hendry, 2013; Wearn et al., 2013). The practice of using peers to demonstrate clinical skills for healthcare practice is referred to in the literature as peer physical examination (PPE) (Chen et al., 2011; Chinnah, et al., 2011; Consorti, et al., 2013; Hendry, 2013; Vaughan & Grace, 2016). Burgggraf et al. (2018) refers to PPE in terms of modeling for fellow classmates (medical educational modeling or MEM). These skills can include menial tasks such as taking a temperature or clinical history, more complex tasks involving touch and manipulation of various parts of body anatomy of one peer by another, or potentially invasive procedures involving puncturing of the skin. MEM is a more encompassing term capturing both the physical contact of examination as well as other aspects of a patient encounter that may happen such as dialogue. Seminal works found in the investigation of student perceptions of this pedagogical practice focused mainly on physician training and were outside of the United States (Braunack-Mayer, 2001; Das, et al., 1998; O'Neill, et al., 1998; Rees, et al., 2005; Wearn & Bhoopatkar, 2006; Wearn, et al., 2008; Wearn & Vnuk, 2005).

While there have been many benefits identified, several areas of concern have surfaced, warranting further investigation. Demographic factors such as gender, age, religious beliefs, and body image may play a part in a student's willingness to participate in PPE (Chang & Power, 2000; Chen, et al., 2011; Rees, 2007; Rees, et al., 2005; Reid, et al., 2012; Vaughan & Grace, 2016; Wearn, et al., 2013). Additionally, student perceptions and concerns about their ability to voluntarily consent to participate in the pedagogical practice has also been brought to light (Braunack-Mayer, 2001; Hendryl, 2012; Wearn & Bhoopatkar, 2006).

Statement of the Problem

This research study built upon the seminal works focused on nursing and physician training with PPE to add imaging sciences educational training to the ongoing discussion of the pedagogical practice of MEM. Research has demonstrated that not all students within medical education or nursing education are comfortable with the long-standing pedagogical practice of MEM. No research currently exists that examines imaging science students' comfort level with, or perception of, MEM as a pedagogical practice within their educational curriculum. The guiding questions for this study were whether students are truly comfortable with this teaching pedagogy and how they perceive this practice in their educational training.

Purpose

The purpose of this quantitative research study was to examine the perception and comfort levels of radiologic technology students participating in MEM as part of their educational programs in Joint Review Committee on Education in Radiologic Technology

(JRCERT) accredited bachelor-level radiography programs in the United States. Through a single, cross-sectional survey design using quantitative methods, the study sought to fill in gaps in the literature related to radiologic technology students' perceptions about MEM and the students' comfort levels with this practice across multiple demographic factors.

Examination of student roles in MEM (e.g., whether the student participates as a simulated patient or takes on the role of the technologist practicing on a peer), teacher involvement in the practice, and how students perceive this practice in terms of benefits and drawbacks could potentially enlighten educators across multiple disciplines on the utilization of peers within the same cohort for education modeling. Student comfort levels with MEM may potentially shift the thought process of continuing to teach in this manner simply because it has always been done this way. The information from this study is needed to critically evaluate the practice and potentially transform educational approaches to teaching essential skills requiring physical touch in the future.

Research Questions

This study examined the perception and comfort levels of radiologic technology students participating in MEM as part of their educational programs in JRCERT accredited bachelor-level radiography programs in the United States. This study sought to answer the following research questions:

1. What are radiologic technology students' perceptions of the MEM experience as a pedagogical practice?
2. What are radiologic technology students' comfort levels with MEM?

3. What demographic factors influence radiologic technology students' comfort levels of MEM?
4. What demographic factors influence radiologic technology students' perceptions of MEM?
5. Is there a difference between roles a radiologic technology student participates in the MEM experience and comfort level with MEM?
6. Is there a relationship between roles a radiologic technology student participates in MEM experience and perceptions of MEM?

Hypothesis

The researcher believed that due to the nature of the profession of radiologic technology, students enrolled in radiologic technology bachelor-level programs are comfortable with the practice of MEM. The researcher supported the notion that students understand that radiologic technology is a hands-on profession so it would then be relevant and would follow that there will be physical touching taking place during educational training. The researcher believed that there would be no difference among the means between any scores across any of the demographic factors or roles a student undertakes in MEM.

Definition of Terms

Specific terms used in this study are defined as follows:

Body Image. How one sees one's body and associated thoughts and feelings (Rees, 2007).

Medical Educational Modeling (MEM). Similar to peer physical examination; the pedagogical practice of utilizing students within a cohort as simulated patients for the purposes of skill acquisition and demonstrations in both the cognitive and psychomotor domains by fellow cohort members (Burggraf, et al., 2018).

Peer Physical Examination (PPE). The practice of using classmates or members of a cohort of students as simulated patients for fellow students to practice physical skills associated with examinations (Chen et al., 2011; Chinnah, et al., 2011; Consorti, et al., 2013; Hendry, 2013; Vaughan & Grace, 2016).

Standardized patient. A volunteer or paid person who has been trained to perform and respond as a patient would for the purpose of training healthcare professionals (Clark, et al., King, et al., 2019).

Assumptions

As participants for this study were indirectly invited to participate in this study through their program chair, it was assumed that they have had some exposure MEM through their programs. It was also assumed that participants would respond to the survey with the same thoughts and perceptions that they have experienced in an actual laboratory setting when utilizing MEM with peers. Finally, it was assumed that participants would be honest with the various demographic information reported in the study and that the survey data provides the true measure of participant comfort and perceptions of MEM when utilized in a radiologic technology education program.

Limitations

Limitations of this study included survey access, sampling, and response rate. The researcher did not have access to the approximately 3,000 JRCERT-accredited Bachelor's degree programs' radiologic technology student email addresses to directly recruit individual participants and had to rely on program chairs to forward recruitment communication from the researcher to their respective students. This may have significantly limited the number of available participants' access to the survey due to potential failure of program chairs to forward the researcher's request and included survey link for survey participation. The researcher had chosen to use purposive sampling which is a form of nonrandom sampling presenting the limitation of the inability to potentially generalize the results beyond the group of participants at the specific time of survey completion. While bachelor's degree radiologic technology students were the intended population for the survey, other imaging modalities within imaging sciences, such as diagnostic medical sonography or magnetic resonance imaging, may also be part of a bachelor's degree program with similar characteristics to radiologic technology students. Additionally, due to the nature of online surveys, response rate was expected to be low further limiting the study's generalizability across the entire population.

Delimitations

Delimitations for this study included limiting the study to bachelor's degree radiologic technology program students, only those students enrolled in JRCERT-accredited programs, and only those radiologic technology programs that utilized MEM as a pedagogical practice. The researcher was concerned only with bachelor's degree radiologic technology students. There were 608 JRCERT-accredited radiography programs in the United States at the time of the study with only 50 accredited at the baccalaureate level (Joint Review Committee on Education in Radiologic Technology, 2019). While JRCERT is the most widely used accrediting body for radiologic technology educational programs, there are additional accreditation mechanisms for schools besides the JRCERT, so not all radiologic technology bachelor's degree students may have been included in this study. Additionally, not all JRCERT-accredited bachelor-level radiologic technology programs utilize MEM within their curriculum. As this research study's focus was on the pedagogical practice of MEM, those schools which do not use this pedagogy were excluded by way of the program chair not forwarding the survey link onto students.

Summary

This research study challenged the longstanding utilization of MEM in healthcare education, and more specifically in radiologic technology, by casting a shadow on the tradition and giving current and future radiologic technology educators a moment to pause and consider the practice from the student perspective. In the current era of reflective teaching and gathering student responses to educational course delivery, it stands to reason that educators should be examining longstanding practices to ensure these practices still meet the needs of today's students. Being able to reflect on this specific teaching method of MEM would allow educators a chance to adapt and modify teaching practices to the unique students in their classrooms and laboratories. Additionally, educators may be able to identify potential issues with MEM in advance of student clashes based upon demographic factors.

Chapter 2: A Review of Relevant Literature

Like other allied health professions, the field of imaging sciences is very patient focused. The imaging science discipline allows for the review of anatomy and physiologic properties of patients through images obtained in a variety of modalities. Radiologic technologists are the healthcare providers charged with acquiring radiographic images prescribed by licensed individuals for diagnoses and treatment of pathologies.

The skills needed to become a competent practitioner focused on delivering effective patient care in an imaging science field are usually taught over the course of two to four years at an undergraduate level. Many of these skills involve direct contact with patients and require hours of practice for a student to feel comfortable in the clinical setting. The question arises as to who or what the students should be practicing these skills on and can lead many to question the pedagogical practice of creating experiential and transformational learning experiences to lead into the clinical setting. This literature review sought to examine student perceptions, comfort levels, and issues related to the pedagogical practice of MEM commonly referred to as peer physical examination (PPE), including demographic factors of influence on these experiences. Key focus areas of the literature include the curriculum and theoretical framework guiding the study, an overview of MEM as a pedagogical practice, benefits and areas of concern identified in the literature, and the influential demographic factors for MEM.

Curriculum Framework

Like many healthcare programs, the curriculum for imaging sciences is divided between classroom, laboratory, and clinical coursework. The classroom portion of the curriculum is where much of the cognitive knowledge is taught followed by practice time in the laboratory environment for skills acquisition (Callaway, 2020). A large portion of the curriculum will be focused on clinical skills either by practicing on fellow students in the lab or in the actual clinical environment with real patients (Callaway, 2020). These clinical skills involve positioning patients for imaging procedures, conducting procedure examination histories, and executing procedural skills for image acquisition. The amount of laboratory time focused on clinical skills practice will vary between programs and the modality of imaging sciences being taught. Some modalities, such as sonography, necessitate an even greater amount of clinical skills laboratory practice time for appropriate techniques of image acquisition to meet accreditation standards. Hours for the sonography imaging modality may increase significantly compared to other modalities due to the technologist-dependent nature of the field and individual student ability to hone necessary skills (Sorrentino, 2019).

Imaging science practitioners must have a thorough understanding of human anatomy to produce quality diagnostic images for interpretation by radiologists. Many of the imaging sciences disciplines utilize various structures of the human body for positioning patients and centering imaging equipment to produce these diagnostic images. Since the human body is not translucent, most of the landmarks utilized must be palpated by the radiologic technologist during the imaging exam to ensure appropriate alignment with the imaging equipment. This palpation is done through the touch of the performing radiologic technologist against the patient's anatomy of interest to locate appropriate topographic landmarks. The skill of locating these landmarks is most often acquired in the laboratory setting, as a student, through the use of other humans as simulated patients. While many schools for medical education have access to mannequins or patient simulators, the use of these devices is not often employed for the imaging sciences.

The use of mannequins within the imaging sciences is not practical for many reasons. The rigid structure of most patient simulators makes it difficult to appropriately palpate topographic landmarks necessary for image centering. Likewise, since many mannequins are designed for patient care procedures of gross anatomy, attention to the creation of the palpable bony landmarks has not been integrated into the development of even high-fidelity patient simulators. Many professions, including imaging sciences, can practice skills on the patient simulators for blood pressure acquisition, cardiopulmonary resuscitation, intravenous access, catheterization, or intubation. However, the simulators lack the ability to simulate the contact feel of normal patient anatomy and oftentimes only represent a very specific patient population. Through the use of MEM in the classroom setting, imaging sciences students can feel normal topographic bony landmarks on an actual human body and experience differences in anatomical structure that will be experienced in the clinical setting. This low-fidelity form of practice allows students to simulate procedures and increase competent skill demonstration prior to patient encounters. The practice of MEM in a laboratory setting greatly benefits patients and clinical affiliates when students enter this phase of their education. Patients can feel more comfortable as students have already honed some of the professional skills needed to competently perform examinations. Clinical affiliates will have students who are adequately prepared to represent their affiliates well in patient care and procedures.

Theoretical Framework for the Study

As a faculty member within a radiologic and imaging sciences program, the researcher experiences students engaging in multiple forms of learning. Popkess and Frey (2016) state concern for the varied learning styles of healthcare students as the population and education classroom continues to become even more diverse. Healthcare education is also unique from many other disciplines due to the nature of healthcare delivery with the need for the transference of knowledge into practical skills utilized with patients. This cycle of learning and application of knowledge in a practical environment aligns with Kolb's Experiential Learning Theory.

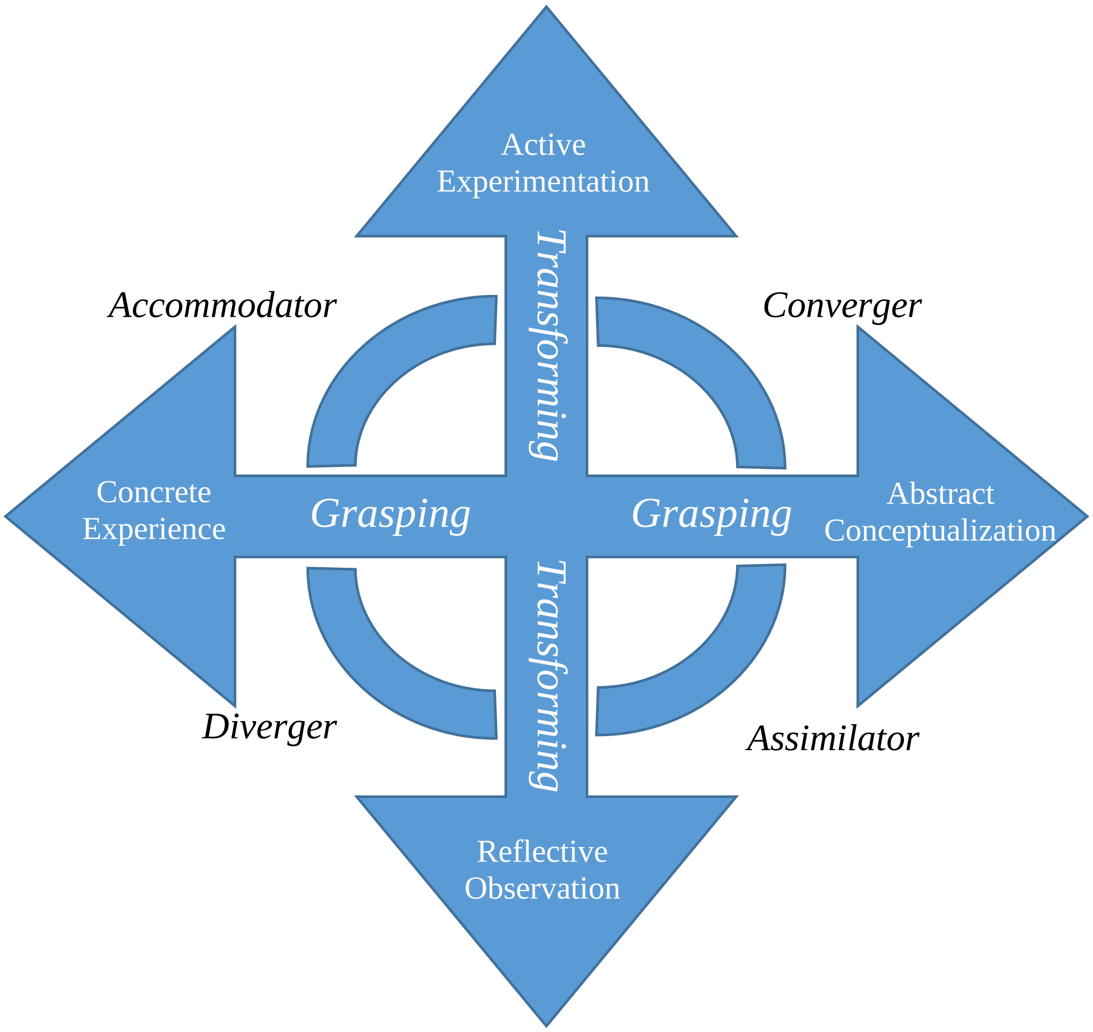
Kolb's Experiential Learning Theory

Kolb's Experiential Learning Theory (ELT) builds upon works of educational philosophers John Dewey, Kurt Lewin, and Jean Piaget related to the influence of real experience in the learning process (Kolb, 1984). Kolb's ELT situates learning amongst two intersecting continuums which create a learning cycle unique for each learner (Kolb, 1984). The first continuum is based upon the initial understanding of new content and stretches from what Kolb (1984) termed concrete experience (CE) at one end of the spectrum to abstract conceptualization (AC) at the other end. The second continuum bisects this first continuum and represents a transformation of the initial learning from active experimentation (AE) to reflective observation (RO) (Kolb, 1984).

These domains of learning (CE, AC, AE, and RO) are viewed as opposite ends of their respective continuums, but learners cycle through each of these in a continuous process of acquiring new knowledge (Kolb, 1984). Learners can typically be identified by a learning mode which will be comprised of two neighboring domains (see Figure 1).

Figure 1

Kolb's Experiential Learning Theory Domains and Learning Modes



Note. This figure was adapted from Kolb (1984) "Structural Dimensions Underlying the Process of Experiential Learning and the Resulting Basic Knowledge Forms" (p. 42).

On the CE side of the continuum lie the divergers and accommodators. Divergers are comprised of CE and RO domains while accommodators rely on the CE and AE domains predominantly for learning. At the other end of the grasping continuum toward AC, convergers will tend to pull from the AE and AC domains and assimilators use RO and AC to make sense of the world. Students may rotate continuously through each of these learning modes as they make sense of new knowledge and attempt to apply it for further knowledge gains (Popkess & Frey, 2016).

To make the leap from lecture to real-world application, many authors situate their pedagogical practice around Kolb's ELT (Cox et al., 2013; Kitchie, 2014; Tapler, 2014; Williams & Spurlock, 2019). Kitchie (2014) recommends educators begin instruction tailored to the diverger learners before adjusting instruction for the various other styles. This is premised on the fact that learners must have a foundation of knowledge to build upon before moving forward in the learning process and tend to need the concreteness of instruction and examples to construct new knowledge. The skills laboratory provides an environment ripe for the diverse learner needs presenting to a healthcare program and can situate the acquisition of knowledge and skillsets into a meaningful experience (Tapler, 2014). Understanding how each person learns is critical for inclusive pedagogical practice and allowing learners to maximize their educational experience

Imaging Science Education

As imaging science students enter a traditional radiographic procedures course, a didactic lecture is usually presented first followed by active laboratory practice or clinical setting placement for skills acquisition (Callaway, 2020). Didactic lectures and active skills practice are critical for acquiring the necessary level of competence for entry into the profession (Spence, 2019). Imaging science students learn through multiple learning modes (Cox et al., 2013; Fowler, 2002). Acquisition of skills is often obtained through multiple formats including clinical simulation, role play, and experiential learning.

Clinical Simulation. Clinical simulation is the practice of creating an educational environment where the purpose is to create a realistic, life-like experience that resembles the actual clinical environment as closely as possible in order to provide healthcare education. This educational setting may include the imitation of real patients, clinical tasks necessary for performance as a healthcare provider, or imitation of various clinical settings such as trauma scenarios, bedside encounters, and interprofessional encounters (Issenberg & Scalese, 2008). These settings could then be used to teach problem-solving, critical thinking, or teamwork skills necessary for clinical practice.

Role Play. Role play is a form of experiential learning based on the formation of scenarios for the purpose of practicing skill sets associated with the delivery of healthcare such as communication, teamwork, and patient care (Pilnick, et al, 2018). Through role play students may exhibit and practice professional behaviors and interactions for preparation for encounters in a healthcare setting. In role play, students may take on the role of either the healthcare professional providing care or the patient (Pilnick, et al., 2018).

Experiential Learning. The researcher routinely assesses students' learning modes to tailor instructional strategies to best meet the needs of students. As the primary instructor for each of her program's four radiographic procedures courses, the researcher witnesses first-hand student engagement in active experiential learning in the laboratory environment where students practice MEM. Fowler (2002) and Cox et al. (2013) support Kolb's ELT as a pedagogical practice for imaging sciences. Hendry (2013) also supports Kolb's ELT as a method for clinical skill acquisition in allied health programs.

Experiential Learning in Imaging Sciences. Experiential learning theory allows the instructor to adapt curriculum, encourages students to own their learning, and engages students in real-world application (Zijdemans-Boudreau et al., 2013). Students engaging in MEM can develop skills and acquire new knowledge from the active experience, feedback, and observation integrated into this pedagogical practice (Kong et al, 2015). Specific to the imaging sciences, Kolb's ELT can be observed in the curriculum cycle. Imaging science students are trained in the cognitive domain through didactic lecture (grasping knowledge through CE and AC) in the classroom setting and must learn to transfer this knowledge (through AE and RO) into the psychomotor domain (Dutton & Ryan, 2019, Chapter 3). This transfer of knowledge into skills may occur in multiple settings including a simulation laboratory or clinical setting.

Since much of the anatomy of interest is not visible to the human eye, radiologic technologists utilize various bony landmarks throughout the body to determine alignment of equipment for image acquisition (Lampignano & Kendrick, 2018, Chapter 1; Long et al., 2019, Chapter 2). Imaging science education must take on a very 'hands-on' approach as students learn skills of appropriate touch for emotional support, emphasis, and palpation of bony landmarks necessary for the alignment of equipment to produce radiographic images (Wilson, 2007). Students learn over 200 different radiographic positions for the human body as required by the American Registry of Radiologic Technologists (ARRT) through small group interactions oftentimes with peer medical education models serving as simulated patients in a laboratory environment (American Registry of Radiologic Technologists, 2017; Callaway, 2020). Students engage in conversation and support as they transfer didactic lecture knowledge into active experience using MEM followed by reflection and feedback with peers and laboratory instructors. As Kolb's ELT is focused on experience brought into the educational environment and the active engagement in the ongoing educational experience, Kolb's ELT provides a theoretical framework for understanding student experience in this study focused on MEM as a pedagogical practice.

Medical Education Modeling. Many health profession students must learn clinical skills to become competent practitioners upon graduation (Tapler, 2014). These skills can be learned in multiple ways including practice with mannequins in a simulated skills environment, using standardized patients who are volunteers usually paid to participate as simulated patients in a learning environment, on real patients in real time, or through practice on peers within the students' cohort (Das et al., 1998; Hendry, 2013, Taylor & Shulruf, 2016; Wearn et al., 2013). The use of peers as simulated patients is known as medical education modeling (MEM) or peer physical examination (PPE) (Chen et al., 2011; Chinnah et al., 2011; Consorti et al., 2013; Hendry, 2013; Power & Center, 2005; Vaughan & Grace, 2016). Vaughan and Grace (2016) further define PPE to involve students in pairs or small groups of peers in order to become competent in the clinical skills necessary for practice. Wearn et al. (2013) discussed the importance of touch in the healthcare field in that appropriate levels of PPE practice can promote the transition of theoretical learning to actual practice in the clinical setting with real patients.

The practice of using PPE is longstanding and pervasive in healthcare training programs (Grace et al, 2019, Koehler & Mcmenamin, 2014; Wearn et al., 2017). Over time, the culture of society has shifted away from using real patients in the clinical setting as practice subjects for a variety of reasons. Several authors make mention of decreases in hospital stays and increased awareness of patient rights leading to fewer available patients for students in the health disciplines having opportunities to learn clinical skills (Grace et al., 2007; Koehler & Mcmenamin, 2014; O'Neill, 1998; Outram & Nair, 2008; Rees, et al., 2009b; Wearn & Vnuk, 2005). Wearn and Vnuk (2005), Braunack-Mayer (2001), Chen et al. (2011), and Vaughan and Grace (2016) state that PPE employed in the laboratory or classroom setting prior to clinical rotations can even decrease potential harm to patients from novice learners.

Researchers began investigating the ramifications of PPE almost 40 years ago (Metcalf et al., 1982). O'Neill et al. (1998) produced one of the first formal studies examining PPE as a pedagogical practice for learning clinical exam skills. Much of the currently published research focuses on the medical education of future physicians (Braunack-Mayer, 2001; Chen et al., 2011; Chang & Power, 2000; Chinnah et al., 2011; Das et al., 1998; Martineau et al., 2013; O'Neill et al., 1998; Rees et al., 2005; Reid et al., 2012; Vnuk et al., 2017; Wearn & Bhoopatkar, 2006; Wearn et al., 2013; Wearn et al, 2008; Wearn & Vnuk, 2005). The research has been principally conducted outside of the United States with very few studies focused on similar schools or curriculum plans to what is present in the United States.

Medical Educational Modeling as Pedagogical Practice

Several themes emerge in the review of the current literature concerning PPE. Researchers regularly argue for the potential benefits of PPE and have collected data on demographic factors that may influence student perceptions of PPE. Likewise, many researchers have gleaned a variety of responses from students regarding potential drawbacks and areas of concern that may need to be addressed with this teaching method.

Survey Instruments

Two prominent survey instruments utilized in quantitative research in this realm are the Examining Fellow Students (EFS) questionnaire (O'Neill et al., 1998) and the Peer Physical Examination Questionnaire (PPEQ) (Consorti et al., 2013). According to Consorti et al. (2013), the EFS questionnaire presents a dichotomous pairing of willing or not willing to participate against a range of demographic factors while the PPEQ presents a more global perspective of degrees of willingness against the demographic factors by incorporating a Likert scale to measure students' agreement with survey items. Additional survey instruments in the study of PPE include the expansion of these instruments such as the self-administered questionnaire by Burggraf et al., (2018) and Taylor and Schulruf's (2016) survey.

Burggraf et al. (2018) expanded beyond the dichotomous presentation of the EFS questionnaire to include a 10-point Likert scale for willingness to participate in PPE for various areas of the body with same gender peer, opposite gender peer or as a model for a tutor in front of one's class of peers. Other enhancements to this survey included additional anthropometric data to include BMI calculations based on reported height and weight, the importance of and motivation level for participating in PPE, preferred group composition, and strength of religiousness. Open-ended questions were also included to allow students the opportunity to comment on positives, negatives, and opportunities for improvement related to PPE. These additional demographic factors allowed for further expansion of understanding potential factors in student perceptions of PPE.

Taylor and Schulruf (2016) created a similar survey to the EFS survey with a focus on gender. Their survey differed by specifically examining student outlook (e.g., liberal or conservative) as a factor for the actual participation in PPE, comfort level related to PPE, and perceived improvement in skills when using PPE. Additionally, an option was provided to assess whether students even had an opportunity to examine fellow students for the various body regions included on the survey.

Using quantitative and qualitative analysis, researchers have been able to identify some factors that may contribute to student perceptions of, comfort level with, and willingness to participate in PPE. These factors include gender, roles (whether the student participates in the role of examiner or examinee in PPE), exam types, religious affiliation and strength, exposure to PPE, group composition, body image, and age (Barnette et al., 2000; Burggraf et al., 2018; Chen et al., 2011; Chinnah et al., 2011; Consorti at al., 2013; O'Neill et al., 1998; Taylor & Schulruf, 2016). Various methods have been used to examine influential factors in the performance of PPE.

Gender and Roles

Studies in medical education related to gender and PPE have focused on determining students' willingness to participate as an examinee or to examine peers of similar or opposite gender. Several studies have found a significant difference related to role in PPE and gender (Chang & Power, 2000; Chen et al., 2011; Power & Center, 2005; Rees et al., 2005; Reid et al., 2012; Vaughan & Grace, 2016; Wearn et al., 2013). Specifically, females had a significantly higher level of discomfort being examined by peers and particularly peers of the opposite gender (Consorti et al., 2013, Rees, 2007, Reid et al., 2012). Males, in some studies, did not express unwillingness to be examined regardless of gender (Chen et al., 2011; Reid et al., 2012; Wearn et al., 2013). Power and Center (2005) even found that younger males, along with older females, were the most uncomfortable with PPE.

Culture and Religion, and Outlook

Along with gender and specific roles, culture, religion, and student outlook may also play a part in student experiences with PPE (Burggraf et al, 2018; Chen et al., 2011; Das et al., 1998; Hattingh & Labuschagne, 2019; Hendry, 2013; Rees et al., 2009a; Rees et al., 2009b; Taylor & Shulruf, 2016; Wearn, et al., 2013). Students will present to a higher education classroom with previous and current lived experiences. These experiences and personal histories will shape their thoughts about topics including physical contact with other people.

Grace et al. (2019) state that many students in Western culture automatically assume that PPE will be part of the curriculum. Arguably, this assumption may be too broad. Western cultures are becoming increasingly diverse, and consideration for the diverse cultures, religions, and outlook cannot be overlooked. Certain Asian cultures have been found to be less willing to participate in PPE (Chen et al, 2011; Wearn et al, 2013) while aspects of Arab culture and the Islamic faith can significantly limit what is perceived as allowable by social norms (Das et al., 1998; Rees et al., 2009a).

Student outlook and degree of religiousness can impact this perception as well. Rees et al. (2009b) caution against stereotyping all students of a similar faith stating that religious laws may be interpreted differently by individuals and some will view educational exposure to PPE as allowable. Hendry (2013) and Outram and Nair (2008) added to this finding that faculty should consider students' values and belief systems when considering PPE. Consideration should also be given to the natural bias of assuming students with more conservative outlooks have relegated preferences toward PPE and roles undertaken in this practice. Taylor and Shulruf (2016) found that students with more conservative outlooks who might be assumed to be less willing to participate in PPE actually had more opportunities than those with more liberal outlooks. This finding brings to light a need to examine students' actual exposure to PPE as an influential factor in perceptions and comfort levels.

Exposure to PPE

Multiple studies have investigated students at various levels in their educational journeys to examine how perceptions may change over time (Chen et al., 2011; Chinnah et al., 2011; Das et al., 1998; O'Neill et al., 1998; Power & Center, 2005; Rees et al., 2009b; Tolsgaard et al., 2014; Wearn et al., 2013). From the literature, it appears that students become more comfortable and have more positive perceptions with more exposure to PPE (Wearn et al., 2013). This may be due to actual experience in the clinical environment as students progress in their educational program, allowing for the benefit of PPE to be realized in an actual context of providing care to real patients. Chen et al. (2011) found that some students preferred to be in the role of examiner rather than being examined as they progressed.

The goal of healthcare education is to have students become increasingly more independent. Over time, some studies found a reversal of student perceptions where students became less willing to examine other students (Rees et al., 2009b; Tolsgaard et al., 2014), but Rees et al. (2009b) found that students increased their willingness to be examined if needed by a peer. Power and Center (2005) found no significant difference in perceptions of PPE as students progressed through academic programs of study with their cohort.

Age

Students entering a cohort will undoubtedly be varied in terms of age. Several studies have capitalized on this fact to understand if age is an influential factor in perceptions and comfort levels with PPE (Chinnah et al., 2011; Power & Center, 2005; Rees, 2007; Rees et al., 2009a; Rees et al., 2009b; Wearn et al., 2013). Several studies could not determine age alone to be a significant predictor of effect on perceptions or comfort level with PPE (Chinnah et al., 2011; Rees et al., 2009b)

Typically, older students tend to be more accepting of PPE as a pedagogical practice (Power & Center, 2005; Wearn et al., 2013). When combined with other factors such as gender or exam types, however, differences between ages become significant. Rees (2007) noted that older females are uncomfortable with PPE. Power and Center (2005) agreed with this finding and noted that when age is combined with gender, young males have indicated being less willing to engage in PPE. Rees et al. (2009a) found that younger students particularly are more uncomfortable with sensitive area exams such as genital, rectal, or breast. Group composition of those engaging in PPE appears to be of significant importance in practice.

Group Composition

Group composition for peer groups has been brought forth numerous times as a focus area when examining PPE (Barnette et al., 2000; Burgraff et al., 2018; Chen et al., 2011; Hendry, 2013; Metcalf et al., 1982; Wearn et al., 2008). Students can sometimes have mixed feelings regarding PPE when their partners for PPE are dictated to them by faculty. This can also potentially highlight issues with boundaries and consent from the student's perspective.

Several studies have found a preference among students for same-gender groups when PPE is the primary pedagogy (Rees, et al, 2009b; Taylor & Shulruf, 2016). Metcalf et al. (1982) found that students who had experienced mixed gender groupings had decreased anxieties about opposite gender peers performing PPE on them. This led to Metcalf et al. (1982) hypothesizing that fear of the unknown may play a part in students' anxieties of PPE. Ultimately, students should be allowed to choose the composition of the group they engage with for PPE, especially in terms of gender composition of group (Burgraff, et al., 2018; Power & Center, 2005).

Body Image

Further research into the influence of gender on PPE has been conducted to investigate the 'why' behind discomfort with PPE; especially for female students. Rees (2007) examined the Objectified Body Consciousness (OBC) Theory to explain potential influences of female discomfort with PPE. Rees (2007) used previous research studies related to PPE in the context of the OBC Theory to emphasize that female perceptions of their own body play an integral part in their desire to participate in PPE due to fear of embarrassment, harassment, and general unfavorable comparisons of their body against their peers. She further outlines that traditional university female students are more conscious of their incongruity between their body and the 'perfect body' compared to their male peers' approaches to body image and that older female students take it a step further by attempting to compare themselves with their younger female peers (Rees, 2007).

Alongside the findings from Rees (2007), a more recent qualitative study has emerged examining the influence of male gender on perceptions of PPE. Previous research highlighted that males were more willing to participate in PPE (Reid et al., 2012, Wearn et al., 2013), but Vnuk et al. (2017) found that males oftentimes felt coerced to be examined either due to faculty assumptions about gender roles or a need to shield female peers from being examined. Male students in the study expressed concern over their inequitable learning experiences from having to always be the one to be examined and female students expressed that they missed out on learning what the patient perspective is during physical examinations by not participating in the role of examinee (Vnuk et al., 2017). Power and Center (2005) recommend that even when PPE is conducted with limited exam types with the exclusion of sensitive areas, students should be allowed to decline specific areas of examinations without having to explain why.

Exam Types

Studies regarding PPE involving various areas of the body are an important factor in examining the perception and comfort levels of PPE. Student perceptions of PPE with sensitive areas of the body have been discussed in the literature (Burgraff, et al., 2018; Power & Center, 2005; Rees, et al., 2009a; Rees, et al, 2009b). The concept of limited PPE was brought forth by Power and Center (2005) to denote a PPE pedagogy that specifically excludes sensitive areas such as genitals, rectum, or breast. When sensitive areas of the body are excluded from the construct of PPE, reported willingness to examine and be examined increased in numerous studies (Consorti, et al., 2013; Rees et al., 2009b; Reid et al., 2012)

When studies included healthcare fields that typically involve higher levels of hands-on patient care and contact, many of the significant findings related to PPE based on various demographic constraints disappeared. Consorti et al. (2013) cited that the disappearance of the significance may have been due to preconceived ideas by the students of the actual practice of the discipline to include physical contact. When students are more familiar with the discipline and what may be entailed to competently practice as a member of that discipline, the perception of PPE may seem more relevant in training compared to other disciplines such as medical education training for physicians (Consorti et al., 2013).

Benefits of Peer Physical Examination

The use of PPE in the training of future healthcare providers offers numerous benefits. There is a tremendous cost saving due to not having to pay standardized patients or spend time locating volunteers (Chen et al., 2011; Hendry, 2013; Power & Center, 2005; Spence, 2019; Wearn & Bhoopatkar, 2006; Wearn, & Vnuk, 2005) and being able to learn “normal” anatomy prior to encountering abnormalities in clinical experience (Chen et al., 2011; Hattingh & Labuschagne, 2019; O’Neill et al., 1998; Rees et al., 2005; Vnuk et al., 2017; Wearn & Bhoopatkar, 2006). Koehler and McMenamin (2014) note that fellow students are a good alternative to actual clinical patients, especially when students are inexperienced.

Additional benefits include shielding patients from incompetent individuals who are learning the discipline (Braunack-Mayer, 2001; Chen et al., 2011; Hattingh & Labuschagne, 2019; Vaughan & Grace, 2016; Wearn & Vnuk, 2005). The use of PPE in training allows students to appreciate the patient perspective when participating as the examinee in PPE (Braunack-Mayer, 2001; Chen et al., 2011; Chinnah et al., 2011; Grace et al., 2007; Hattingh & Labuschagne, 2019; Hendry, 2013; Hilton & Barrett, 2009; Metcalf et al., 1982; Power & Center, 2005; Pols et al., 2003; O’Neill et al., 1998; Outram & Nair, 2008; Wearn & Vnuk, 2005). Martineau et al. (2013) argue that the act of observing peer physical examination is also beneficial and attributed to higher learning gains by the students utilizing PPE.

Concerns for Peer Physical Examination

Recent literature suggests that there may also be some drawbacks to PPE. Areas highlighted include possible coercion in the informed consent process for PPE (Braunack-Mayer, 2001; Delany & Frawley, 2012; Marley, 2009; Wearn & Bhoopatkar, 2006) and students not wanting to participate in PPE due to cultural or religious affiliation (Das et al., 1998; Hattingh & Labuschagne, 2019; Rees et al., 2009b; Wearn et al., 2013). Additionally, embarrassment by faculty or peers in the PPE process due to relationships outside of the classroom or from comment by those examining or being examined were also noted (O'Neill et al., 1998; Rees et al., 2009a; Vnuk et al., 2017; Wearn et al., 2008). Another concern brought forth in the literature is the potential of discovering an anomaly and failing to report the findings (Hilton & Barrett, 2009; McLachlan et al., 2010; Outram & Nair, 2008; Pols et al., 2003; Wearn et al., 2017).

Consent Concerns

The obtainment of true informed consent of the students participating in PPE was addressed numerous times in the literature (Barnette et al, 2000; Braunack-Mayer, 2001; Chen et al., 2011; Delany & Frawley, 2012; Hendry, 2013; Wearn & Bhoopatkar, 2006). Some students may feel coerced into volunteering based on gender (Vnuk et al., 2017). There also exists an inherent imbalance in power between the faculty role and student position for consideration in obtaining informed consent from students prior to initiating PPE (Delany & Frawley, 2012, Marley, 2009). Informed consent for PPE should include risks and benefits related to the pedagogical practice of PPE.

As detailed previously, benefits for the use of PPE in healthcare education can be numerous. There are, however, several risks associated with PPE. Grace et al. (2007) state numerous risks associated with PPE including discomfort in potential disrobing, being touched by other people, having to provide personal information in the PPE process, and even potential injury due to receiving unnecessary treatments. Within the current technology age, Grace et al. (2019) also points out a potential risk and consent concern surrounding the use of mobile devices for image and video recording within the laboratory setting highlighting the need for policies specific to PPE.

Careful consideration of the continued practice of PPE in the context of weighing the risk and benefit factors must be employed if educational institutions desire to employ PPE as a necessary pedagogy. Faculty must be ever vigilant to protect the well-being of students participating in PPE through appropriate policy construction and enforcement. As Grace, et al. (2019) and Hattingh and Labuschagne (2019) point out, MEM is a longstanding practice of continuing to teach using the methods that have always been used to teach clinical skills even though society’s norms have shifted over time. This brings to light an inherent weakness by virtue of simply justifying the means because of the result without critical reflection on the process.

Policy Concerns

Several authors point to specific issues that need to be addressed in policy to alleviate some concerns. Outram and Nair (2008) specifically outlined the best practice standards related to PPE, including consideration for written policy and procedure for PPE surrounding the voluntary nature of PPE, excluding intimate exam categories of breasts, genitals, and rectum from routine PPE practice, and giving appropriate weight to religious and cultural norms depending on student cohort demographic composition. Barnette et al. (2000) and Power and Center (2005) also noted the need for addressing appropriate laboratory dress and student ability to choose group or partner dynamic composition for PPE.

Allowance for students to decide and select their preferred group composition for PPE is an important area for potential policy development (Barnette et al, 2000; McLachlan, et al., 2010; O'Neill, 1998; Power & Center, 2005; Wearn & Vnuk, 2005). Some of the rationales for student-selected groups revolve around relationships within a cohort of students versus that of the normal doctor/healthcare professional and patient relations where actual physical examination would take place for a medical need (Barnette et al., 2005; Rees et al., 2009a; Vnuk, et al., 2017). Both Barnette et al. (2005) and Rees et al. (2009a) highlight this topic specifically pointing out that as a patient, one might only encounter his healthcare provider once a year or maybe once in a lifetime. Comparatively, a peer within a cohort will have to see and possibly interact with a fellow peer whom he had engaged in the PPE process with potentially daily until he completes his educational studies. Having conducted PPE on a peer could potentially place a strain on the relationship between peers in a cohort (Power & Center, 2005; Wearn et al, 2008).

Lack of Research in Allied Health Professions

Many studies have attempted to shed light on the concerns of PPE. Predominantly, the medical education field for physician training has provided numerous research studies gauging student perceptions to this practice. Factors such as students' demographics compared to willingness to participate have formed a foundational pedagogical consideration for the utility of PPE. Although many of these studies add to the literature in terms of delineating factors for consideration, much of the work has focused directly on the implications for medical education curriculum.

Few studies (Consorti et al., 2013; Grace et al., 2019; Hattingh & Labuschagne, 2019; Vaughan & Grace, 2016; Wearn et al., 2013) have compared the findings from the medical education realm to other disciplines in an attempt to reliably attribute similar findings for the various professions involved in healthcare. Both Consorti et al. (2013) and Vaughan and Grace

(2016) examined the field of osteopathy while Wearn et al. (2013) focused on nursing and Grace et al. (2019) examined nursing alongside other fields such as chiropractic, occupational therapy, osteopathy, paramedicine, and physiotherapy related to the practice of PPE. These fields do require more patient contact compared to the medical education field. Osteopathy student responses were still found to be comfortable with the practice of PPE with less differences in significance related to various demographic factors (Consorti et al., 2013; Vaughan & Grace, 2016). Wearn et al. (2013) found that the majority of participants in their study of the female-dominated nursing discipline were comfortable with PPE and this comfort level increased with experience and exposure to PPE.

Medical Education Modeling in Imaging Sciences

The researcher's discipline is focused on the imaging sciences. Like the field of osteopathy and nursing, a great extent of the practice in imaging sciences is related to direct patient contact in the clinical setting. To graduate competent individuals, educators in the imaging sciences oftentimes teach clinical skills in a laboratory environment prior to students' practicing on actual patients.

Concerns in Medical Educational Modeling for Imaging Sciences

The practice of MEM is a predominant pedagogical practice in many healthcare programs across the nation (Grace et al., 2019). Within the imaging science discipline, the physical touching of patients is a necessary component to ensure diagnostic image acquisition. The imaging science discipline may present some of the same concerns identified in the literature for other professions when MEM is implemented into the curriculum.

Gender of the Profession. One large area of concern for the imaging sciences in the practice of MEM is gender. The profession of imaging sciences is heavily female-dominated. In 2013, a census report by the ARRT indicated 72% of the 323,492 registered technologists in the United States are female (American Registry of Radiologic Technologists, 2013). With the concerns noted by previous research related to gender and the practice of PPE (Chang & Power, 2000; Rees et al., 2005; Reid et al., 2012; Vaughan & Grace, 2016; Wearn et al., 2013), imaging sciences programs have an even greater potential to have issues related to the practice of PPE.

Accreditation. Many imaging sciences programs are accredited by the Joint Review Committee on Education in Radiologic Technology (JRCERT). The JRCERT has several standards related to examination competency for students in imaging sciences programs (Joint Review Committee on Education in Radiologic Technology, 2014). Although the JRCERT does not stipulate that students must perform examinations in the didactic or laboratory environment prior to practice on actual patients, the ongoing theme in many programs is that students will develop these skills prior to entering the clinical environment. The accepted practice of MEM is viewed by many as a natural extension of the traditional didactic lecture of imaging sciences courses focused on the skills of patient image acquisition but lacks evidence in accreditation standards of support for this practice.

Legal Cases. The practice of MEM had not ever been called into question in the imaging sciences discipline until recently. During the 2015 academic year, two students from a sonography program sued the school claiming they were forced to participate in PPE for transvaginal ultrasounds in 2013 (Milward v. Shaheen, 2015). Concerns in the court case highlight not only the invasive nature of such a procedure but also the students' discomfort level with the procedure being performed by peers and by peers of opposite gender (Milward v. Shaheen, 2015). Another concern brought forth was faculty comments made during laboratory time while these imaging exams were taking place and the faculty roles in the supervision of this practice (Milward v. Shaheen, 2015).

The ultrasound school case points to the issue that MEM may not be the best pedagogical method of clinical skills acquisition for all students in all environments. There are definite concerns that must be addressed prior to student engagement in MEM. Research calls for a detailed informed consent procedure to be in place prior to engagement in MEM (Braunack-Mayer, 2001; Delany & Frawley, 2012; Wearn & Bhoopatkar, 2006). Likewise, many authors note that discussion of MEM prior to program entry and sometimes even as frequently as prior to each session should take place to highlight appropriate professional behaviors and expectations for MEM sessions in the laboratory or classroom setting (Braunack-Mayer, 2001; Outram & Nair, 2008; Wearn & Bhoopatkar, 2006; Wearn & Vnuk, 2005).

Conclusion

The literature suggests that PPE is accepted by many students in various health professions but is mainly focused on those students enrolled in medical education. Many benefits are promoted in the literature including the development and refinement of pertinent clinical skills prior to encounters with actual patients and the development of the patient perspective. There are concerns brought forward in the research related to students' ability to consent, gender, age, culture or religion, and roles in the MEM process. Females are sometimes uncomfortable with examining peers or being examined by peers which would warrant investigation into the highly female-dominated profession of imaging sciences. At the present time, there is a lack of research specific to the imaging sciences discipline related to the student perceptions of the pervasive practice of MEM. Additional questions of inquiry include examination of student demographic information in relation to MEM practice and duration of exposure to MEM. Some research suggests comfort levels with MEM may be dependent upon student exposure to MEM and student perceptions of the discipline prior to entering the program of study. Based on the current literature on MEM and the lack of literature specific to the imaging sciences discipline related to MEM, there is a clear need to investigate student perceptions related to MEM within the imaging sciences. By evaluating student perceptions of the pervasive historical practice of MEM in the imaging sciences, faculty can be better informed in their pedagogical practice for educating and developing future practitioners in a conducive experiential learning environment.

Chapter 3: Methodology

Learning by doing is a common mantra throughout many health sciences disciplines. Healthcare is ultimately about caring for the needs of patients and requires a significant amount of patient contact in many fields. The training of future healthcare providers presents a unique situation whereby students need to practice and demonstrate the skills necessary to promote positive patient outcomes, but the question remains whom should these students practice on and demonstrate these skills?

Multiple researchers cite numerous ways students may demonstrate these skills including the use of teaching mannequins, volunteers who act as patients (and are usually compensated), or peers within the same cohort (Das et al., 1998; Hendry, 2013; Wearn et al., 2013). The practice of using peers to demonstrate clinical skills for healthcare practice is referred to in the literature as peer physical examination (PPE) or medical educational modeling (MEM) (Chen et al., 2011; Chinnah, et al., 2011; Consorti, et al., 2013; Hendry, 2013; Vaughan & Grace, 2016; Wearn & Vnuk, 2005). These skills may include menial tasks such as taking a temperature or clinical history, more complex tasks involving touch and manipulation of various parts of body anatomy, or potentially invasive procedures involving puncturing of the skin. Seminal works in this investigation of student perceptions of this pedagogical practice focused mainly on physician training and were outside of the United States (Braunack-Mayer, 2001; Das, et al., 1998; O'Neill, et al., 1998; Rees, et al., 2005; Wearn & Bhoopatkar, 2006, Wearn, et al., 2008; Wearn & Vnuk, 2005).

While there have been many benefits identified, several areas of concern have surfaced, warranting further investigation. Demographic factors such as gender, age, religious beliefs, and body image may play a part in a student's willingness to participate in MEM (Chang & Power, 2000; Chen, et al., 2011; Rees, 2007; Rees, et al., 2005; Reid, et al., 2012; Vaughan & Grace, 2016; Wearn, et al., 2013). Additionally, student perceptions and concerns about their ability to voluntarily consent to participate in the pedagogical practice have also been brought to light (Braunack-Mayer, 2001; Hendryl, 2012; Wearn & Bhoopatkar, 2006).

This chapter will explain the research methods that were utilized to answer the research questions for the study related to students' comfort level with MEM, perceptions of MEM, influential factors for these comfort levels and perceptions, and the relationships between differences in comfort levels and perception with the various roles as part of MEM. This chapter will also detail the research procedures employed to conduct this research study. This chapter also details the research instrument pilot tested for this study, specific testing for the validity and reliability of this instrument, and methods for data collection and analysis that were employed for the pilot study and the full research study.

Purpose

The purpose of this quantitative research study was to examine the perception and comfort levels of radiologic technology students participating in MEM as part of their educational programs in Joint Review Committee on Education in Radiologic Technology (JRCERT) accredited bachelor-level radiography programs in the United States. This study sought to answer the following research questions:

1. What are radiologic technology students' perceptions of the MEM experience as a pedagogical practice?
2. What are radiologic technology students' comfort levels with MEM?

3. What demographic factors influence radiologic technology students' comfort levels of MEM?
4. What demographic factors influence radiologic technology students' perceptions of MEM?
5. Is there a difference between roles a radiologic technology student participates in the MEM experience and comfort level with MEM?
6. Is there a relationship between roles a radiologic technology student participates in MEM experience and perceptions of MEM?

Through a single, cross-sectional survey approach, this study sought to fill in gaps in the literature related to radiologic technology students' perceptions about MEM and the students' comfort and perception levels with this practice across multiple demographic factors. Examination of student roles in MEM (e.g., whether the student participates as a simulated patient or takes on the role of the technologist practicing on a peer), teacher involvement in the practice, and how students perceive this practice in terms of benefits and drawbacks could potentially enlighten educators across multiple disciplines on the utilization of peers within the same cohort for education modeling. Student comfort levels with MEM may potentially shift the thought process of continuing to teach in this manner simply because it has always been done this way. The information from this study is needed to critically evaluate the practice and potentially transform educational approaches to teaching essential skills requiring physical touch in the future.

The Quantitative Paradigm

The researcher espouses a postpositivist worldview based upon the thought that no absolute truth exists and that the researcher must remain as an objective observer while collecting data through instruments completed by participants (Creswell, 2014). This research study was deductive in nature, intending to determine if a relationship exists between various demographic factors and students' reported scale responses of perception and comfort level with MEM. Ary et al. (2019) contend collecting numeric data for the purpose of answering questions aligns with quantitative research. The use of a quantitative research method was therefore appropriate.

The Research Design

While the topic for this research study may be of interest for multiple healthcare disciplines that employ MEM, this study specifically focused on imaging sciences. To further narrow the focus, the researcher conducted a quantitative research method using a cross-sectional survey research design to examine only diagnostic radiologic technology students rather than students from every imaging modality within imaging sciences, such as diagnostic medical sonography or magnetic resonance imaging. As the survey was only conducted at a singular point in time and was being used to describe the beliefs and perceptions of participants at the time of the survey, a cross-sectional survey design using quantitative methods was appropriate (Cresswell, 2014; Lavrakas, 2008; Nardi, 2018). In order to collect data from a variety of resources, an online survey was utilized to provide the most efficient mechanism of data collection across a large geographic area (Sue & Ritter, 2012). As no literature was found examining bachelor-level radiologic technology students' perceptions and comfort levels with MEM, the researcher conducted a pilot study to evaluate the created survey instrument.

Survey Design

The survey designed for this study was based upon two established surveys used previously to investigate PPE in physician training: the Peer Physical Examination Questionnaire (PPEQ) and the Examining Fellow Students Questionnaire (EFS) (Consorti, et al., 2013; O'Neill, et al., 1998). Permission was obtained for the use of these survey instruments in this study (see Appendix A). Additionally, the researcher adapted and combined elements from two additional surveys to capture additional perspectives and demographic information as it relates to PPE: the self-created survey by Burggraf, et al., (2018) and the Student's Peer Physical Examination Experience Questionnaire (SPPEEQ) by Taylor and Shulruf (2016). Together, these combined surveys were adapted to language consistent with radiologic technology and were formatted to flow within the newly formed Student Perceptions of Medical Educational Modeling (SPMEM) survey. This survey was designed to provide a more holistic view of student perceptions and comfort levels related to MEM in radiologic technology (see Appendix B).

SPMEM Survey Instrument. The SPMEM survey contains four main parts. The largest section at the beginning of the survey focuses on participant responses selecting a scale response from 1-10 of "not at all willing to participate" to "very willing to participate" respectively for 10 different areas of the body for examination similar to O'Neill et al. (1998) EFS Questionnaire but using a scale rather than the dichotomous response for the various body parts. The other difference between these original question formats from the source survey and the developed survey is the addition of qualitative descriptors for the different body regions like Taylor and Shulruf's (2016) survey. Additional questions were added regarding being the medical educational model for an instructor and the role of strictly observing MEM taking place based upon Burggraf et al.’s (2018) work on roles undertaken as part of MEM.

There are 7 focused questions specifically relating to roles a student may undergo during peer educational modeling (simulated patient or technologist), as well as teacher participation and a strictly observation role. Each question changes perspective on whether the student is participating in a role with a same gender peer or teacher or a different gender peer or teacher with observation being a single question on comfort level for each of the exams being performed.

The second section is a perception scale of 0-4 from “strongly disagree” to “strongly agree” respectively, across 8 questions on the participants’ perception of the benefit and appropriateness of medical educational modeling. This section was adapted from Consorti, et al. (2013) PPEQ Questionnaire to fit the imaging science profession. Additionally, participants were asked the number of times they have volunteered to be the model for a teacher and the number of times they have volunteered to be the model within a group of students, along with their preferred composition of student groups for peer educational modeling to possibly contextualize responses on the perception and comfort scale selections.

The third section focuses on demographic content including information on age, gender, race, religious affiliation, body mass index (BMI), and general outlook in terms of conservative versus liberal. These demographic factors were selected based upon information collected through an extensive literature review on the topic of PPE. The participant’s overall enrolled program length and completed length as well as clinical exposure was also collected based upon studies indicating that students who have more exposure to MEM or PPE and the clinical environment are less apprehensive and more accepting of the pedagogical practice due to the perceived benefit (Reid et al., 2012; Wearn et al., 2013). The demographic section of the survey was purposely placed later in the survey design based upon recommendation from Nardi (2018) to place more interesting questions at the start of online surveys to attract respondents and potentially ensure more accurate and complete responses on the critical questions of the study. Demographic responses placed near the end of the survey help alleviate response fatigue as these responses are simple (Nardi, 2018).

The final section of the survey includes an area for participants to provide descriptive feedback on the practice of MEM. This section asked participants to respond only to items for which they have strong feelings and includes a focus on benefits, drawbacks, and suggestions for improvement. There is space provided to allow an opportunity for feedback on the general practice of peer educational modeling, when participating as the simulated patient or technologist, and when participating as the model for the teacher in front of peers. A lack of response in this section will not eliminate the participant's entire survey from inclusion in data analysis since this section was aimed at obtaining descriptive statistics on strongly held beliefs about MEM as a pedagogical practice.

Pilot Study

As there is no current literature on the topic of MEM specific to radiologic technology and a single survey instrument does not currently exist to answer all of the intended research questions, a pilot study was conducted to establish the validity and reliability of a new survey instrument with the intended population. Specifically, the purpose of the pilot study was to evaluate a new survey tool aimed at examining the perception and comfort levels of radiologic technology students participating in MEM as part of their educational program in a JRCERT-accredited Bachelor of Science in Radiography program in the United States.

Population and Sample. The intended population for the pilot study was students enrolled in a single JRCERT-accredited bachelor's degree program for radiologic technology at a university in the Midwest. This population was specifically chosen as the members can be easily excluded from the final research study for this dissertation to eliminate a potential source of bias (Nardi, 2018). The pilot study population was mostly representative of the general demographics of the full population for the entire study and thus provided a good sample population to examine validity and reliability of the survey instrument (Rea & Parker, 2014). This group comprised of approximately 35 students including a mix of genders, race, age, and other demographic factors under examination.

Research Procedures. The pilot survey was administered as an online survey through Qualtrics online survey platform following Institutional Review Board (IRB) approval from the University of Southern Indiana. The researcher recruited participants for this pilot study through an electronic mail request to the program chair of a JRCERT-accredited bachelor's degree program to distribute the survey link (see Appendix C). Voluntary consent was implied when participants proceeded to the online survey through the link. Additionally, the first page of the survey highlighted the informed consent protocol as established and approved by the researcher's IRB (see Appendix D). Data collection for the pilot study took place immediately following survey distribution and continued for two weeks to obtain a sufficient response rate. The researcher hoped to attain a response rate of approximately 30 students (83.33%) following survey distribution which falls within the suggested guidelines of 20 to 40 participants for pilot study sample size as set forth by Rea and Parker (2014). The researcher sent a follow-up per IRB protocol to the program chair on day 5 of the live survey timeframe. Ultimately, the pilot study yielded 30 responses; however, 6 responses contained missing data and had to be removed, resulting in a total of 24 complete surveys for analysis out of a possible 35. While this response rate of 69% was under the projected 83.33% response rate, the number of participants still fell within a reputable sample size (Rea and Parker, 2014). Results of the pilot study were communicated with the researcher's dissertation committee chair and are detailed below.

Statistical Tests Conducted. The SPMEM survey instrument is a new survey tool made from the combination of multiple surveys already published in literature. For the pilot study, establishing construct validity and reliability of the survey instrument was the primary focus. While the SPMEM survey was designed from previously validated survey instruments, combining the elements of the various surveys, adapting verbiage on the survey, and using the survey instrument on a population not previously studied necessitated a pilot study to measure the survey's validity and reliability. Validating a survey instrument is critical to ensuring the survey instrument is measuring what it was designed to measure and that the results are meaningful (Mohamad, et al., 2015; Nardi, 2018).

Validity. Validity of a survey instrument can be achieved through multiple methods. Face, content, construct, and criterion validity are all ways to achieve validation of the survey tool (Nardi, 2018). Additionally, Nardi (2018) suggests establishing survey item reliability to ensure consistent data.

To examine the face and content validity of the SPMEM survey, the researcher had previously delivered the survey electronically to radiologic technology educators, who are also familiar with research design, to review the survey in its entirety. Having experts in the field who are also familiar with research practices review the survey instrument is recommended for establishing face and content validity (Mohamad et al., 2015; Nardi, 2018; & Radhakrishna, 2007). Responses in question phrasing were adapted based upon feedback provided for both section one and section two of the survey. Additionally, specific instructions were adapted to better inform survey participants of acronyms used throughout the survey.

Following the collection of data, the researcher measured construct validity of survey items across the two main constructs of comfort and perceptions of MEM as well as survey readability (Radhakrishna, 2007). To test the constructs, the researcher downloaded pilot study results from the field test responses stored within the Qualtrics online survey platform into the Statistical Package for Social Sciences (SPSS), version 24. The SPSS system was used to conduct a Pearson *r* Correlation among the constructs of perception and comfort. This test measures the correlation between each item of a construct with the total score of a construct. If individual items are strongly correlated to the total score of the construct, the items are deemed valid (Krauss, 1997). Results for section one of the survey measuring the construct of comfort indicate validity for all survey items at the $p < .05$ level with statistical significance for most items at the $p < .01$ level (see Table 1). Similarly, results measuring the validity for the construct of student perceptions indicate statistical significance across all related survey items in section two (see Table 2).

Table 1

Pilot Study Correlation of Comfort Constructs for Student Willingness to Participate in Medical Educational Modeling for Various Body Areas in Different Roles

Body Area	As patient with same gender peer	As patient with different gender peer	As technologist with same gender peer	As technologist with different gender peer	As model for same gender teacher	As model for different gender teacher	As an observer
Head and Neck	.939**	.882**	.899**	.796**	.889**	.924**	.999**
Hand	.939**	.882**	.870**	.810**	.887**	.921**	.999**
Arm and Shoulder	.939**	.882**	.899**	.762**	.887**	.921**	.999**
Upper Body	.871**	.862**	.870**	.804**	.832**	.770**	.949**
Abdomen	.951**	.956**	.848**	.907**	.937**	.872**	.983**
Back	.939**	.882**	.870**	.816**	.889**	.924**	.999**
Pelvis	.690**	.696**	.491*	.605**	.551**	.710**	.999**
Lower Leg and Foot	.939**	.882**	.964**	.837**	.889**	.924**	.999**
Knee	.939**	.882**	.834**	.837**	.889**	.895**	.999**
Hip Joint	.886**	.919**	.931**	.692**	.716**	.753**	.999**

Note. $n = 24$; $*p < .05$, $**p < .01$

Table 2

Pilot Study Correlation of Student Perception of Medical Educational Modeling Construct

Perception Item	Pearson Correlation *r*
It is inappropriate to perform MEM on persons that will be my future colleagues (reverse coded)	.753**
To perform MEM is an appropriate practice for the education of a radiologic technologist	.456*
To undergo MEM is an appropriate practice for the education of a radiologic technologist	.848**
In performing MEM, I (will) get useful feedback from my colleagues about my skill	.872**
It is a sign of professionalism as a student to accept to perform and undergo MEM	.553**
I believe It is important for me to participate in MEM	.852**
I am motivated to participate in MEM	.828**
Performing MEM improved my skills for clinical practice	.885**

Note. $n = 24$; $*p < .05$, $**p < .01$

***Reliability*.** Radhakrishna (2007) recommends establishing reliability following validity testing. To measure the reliability of the survey instrument, the researcher evaluated internal consistency by obtaining a Cronbach Alpha on each scale for the survey (see Table 3). This is a common reliability test for items of scale response statements (Taherdost, 2016). By conducting this test, the researcher was able to review item by item the potential reliability that could be achieved if an item were to be removed. The results demonstrate a Cronbach Alpha of .859 or greater on all measured items across the comfort and perception scales. Taherdost (2016) and Mohamad et al. (2015) support an internal consistency coefficient of 0.6 or higher for pilot testing in the social sciences. As each item achieved an internal consistency higher than 0.6, no survey items will need to be removed for the full study.

Table 3

Pilot Study Internal Consistency for Student Comfort and Perception of Medical Educational Modeling Survey Scales

Scale	α
Comfort	
Student Willingness to Participate in Medical Educational Modeling:	
As a patient with same gender peer	.907
As a patient with different gender peer	.907
As a technologist with same gender peer	.918
As a technologist with different gender peer	.886
As a model for same gender teacher	.887
As a model for different gender teacher	.927
As an observer	.997
Perception	
Perception of Medical Educational Modeling items	.859

Note. n = 24, α = Cronbach's Alpha

The researcher also employed a series of questions at the end of the survey to collect qualitative feedback about the survey experience for analyzing readability, delivery, and potential modifications for future survey administration (Nardi, 2018). A total of 20 survey participants completed this section. Survey respondents reported a mean completion time of approximately 12 minutes for the entire survey. When questioned on the ease of navigation for the survey, 62.5% (n = 15) responded “Extremely easy” while the remaining 37.5% responded as either “Somewhat easy” or “Neither easy or difficult” (n = 4 and n = 1, respectively). No specific qualitative comments were provided as suggestions for survey modifications.

Establishing validity and reliability and obtaining feedback from a pilot study of a survey instrument is critical to ensuring the accuracy of data collection for analysis. While pilot testing the survey instrument was tedious and time consuming, it was a necessary step for research in order to make adjustments to the survey instrument or refine other aspects of the research methods before proceeding to the full study (Ary et al., 2019). Based upon the statistical analysis performed during the pilot study, the survey instrument was deemed valid and reliable for the full study. Minor typographical corrections were made to a few survey questions and the survey analysis was removed from the survey instrument that was used for the full study.

Limitations and Delimitation. While the ultimate goal of the pilot study was to be able to evaluate the SPMEM survey instrument in terms of validity and reliability, the realistic outcome is that the data collected was from a single JRCERT accredited program. The researcher operated with a convenience sample, so a significant limitation due to the non-probability sampling method is that this data was truly only representative of the case for the sample of participants who responded to the survey. While this group comprised a heterogeneous composition related to most demographic factors, all students utilized from this pilot study are from similar geographic backgrounds so true diversity in this regard cannot be assumed. A delimitation of the pilot study was that the geographic area was limited to a single Midwest region university. As the pilot study was used to measure the validity and reliability of the survey instrument, this delimitation did not significantly impact results.

Full Study

Population and Sample. The intended population for the full study was students enrolled in JRCERT accredited bachelor's degree radiologic technology programs across the United States. At the time of the study, there were 50 programs meeting these criteria in the country with an average of 60 students per program yielding an approximate population of 3,000 (Joint Review Committee on Education in Radiologic Technology, 2020). While limiting the population to a smaller, more manageable size would be beneficial, this research study sought to be inclusive of a diverse population that would be found across the varying geographic areas of the United States. Due to the researcher's background, the researcher used purposive sampling to specifically target bachelor-level radiologic technology students from JRCERT-accredited programs to better understand their comfort levels and perceptions of MEM.

Research Procedures. The researcher utilized similar research procedures for the full study as utilized in the pilot study. The researcher utilized publicly available contact information for program chairs from across the United States published on the accredited program search portal from the JRCERT website (Joint Review Committee on Education in Radiologic Technology, 2020). The researcher submitted an electronic mail request to each of the 50 program chairs to distribute the survey link from Qualtrics online survey platform (see Appendix C) following successful dissertation proposal defense and IRB approval. The researcher administered the survey for 2 weeks for the full study. Follow-up electronic mail messages were submitted to the program chairs on day 5 and 12 of the survey collection timeframe.

For an online survey, response rates may be lower than 30% (Ary et al., 2019). The researcher expected an approximately 5% response rate on the full study yielding approximately 150 completed surveys returned. While this response rate may be considered low, Ary et al. (2019) contends that lower response rates should not automatically be assumed as biased. The researcher checked responses using a wave analysis between early and late respondents to the survey using a split between week one and week two of the data collection timeframe (Cresswell, 2014). Ary et al. (2019) and Rea and Parker (2014) state that late respondents have been shown to produce similar responses to nonrespondents; therefore, if no major differences exist between early and late respondents in terms of survey item responses, it can be assumed that the results of data analysis are representative of the whole population. Data analysis began at the close of the survey.

Plans for Data Analysis. The researcher believes that due to the nature of the profession of imaging sciences, students enrolled in radiologic technology bachelor-level programs are comfortable with the practice of MEM. The researcher supports the notion that students understand that radiologic technology is a hands-on profession so it would then be relevant and would follow that there will be physical touching taking place during educational training. The researcher believed that there would be no difference among the means between any scores across any of the demographic factors or roles a student undertakes in MEM.

Prior to analyzing the data received, the researcher evaluated all returned surveys for completeness. Incomplete surveys with missing data points can negatively impact statistical analysis. Surveys with missing data points within section one or two were eliminated from the study. By eliminating incomplete surveys from the analysis, the researcher can ensure more accurate results (Saris & Gallhofer, 2014).

Statistical Tests for Full Study. The researcher planned to conduct the full study using the adjusted survey instrument as an online survey within Qualtrics online survey platform. Responses to the survey would then be downloaded into SPSS. A variety of statistical tests were planned to be utilized to answer the research questions associated with the study. Descriptive statistics would also be conducted on survey responses to check for normal distribution of responses to determine appropriateness of the various parametric testing planned for data analysis. Demographic factors such as age, length of program, and length of exposure to MEM would be collapsed into categories for statistical analysis for use when examining differences across mean responses.

Variables. The independent variables planned for this study were the various demographic factors of gender, age, religion, outlook, role in MEM, preferred group composition, and length of exposure to MEM. The dependent variables planned for this study were the students' perceptions and comfort levels with the pedagogical practice of MEM in their curriculum. These variables are discussed further in specific relation to each of the research questions of the study.

Research Questions 1 and 2. What are radiologic technology students' perceptions of the MEM experience as a pedagogical practice and what are radiologic technology students' comfort levels with MEM? The researcher planned to create a comfort score and perception score based upon participant responses to the first two sections of the SPMEM survey. An individual participant would have a comfort score calculated for each area of section one to include:

- comfort as a simulated patient with same gender peer as the examining technologist;
- comfort as a simulated patient with different gender peer as the examining technologist;
- comfort score as an examining technologist with same gender peer as simulated patient;
- comfort as an examining technologist with different gender peer as simulated patient;
- comfort as a simulated patient for a teacher of the same gender demonstrating the technologist role;
- comfort as a simulated patient for a teacher of a different gender demonstrating the technologist role; and
- comfort with being in the observer role.

Similarly, a perception score would be calculated for individual participants based on the perception scale responses on the eight questions provided under the second section of the survey. The researcher would also reverse code negative statements to produce a similar scale across all responses. A total score of positive perception of MEM would be calculated by determining the mean of agreement across all statements. The independent variables in these research questions were the demographic factors of participant gender, age, religion, outlook, role in MEM, BMI, preferred group composition, and length of exposure to MEM. The dependent variables would be the participant's comfort score for each area of section one and perception score in section two.

Frequency counts of participant responses on specific items in both section one and section two were also conducted to provide further descriptive analysis on student comfort and perception of MEM related to specific items. Additionally, frequency counts of the number of comments submitted for benefits, drawbacks, and suggestions for improvement from section four of the survey were analyzed to indicate participant perceptions of MEM. Collectively, these methods were used to address the first two research questions.

***Research Question 3*.** What demographic factors influence radiologic technology students' comfort levels of MEM? The calculated comfort scores from section one of the survey were grouped by demographics to examine differences in means across each of the various demographic factors through a one-way analysis of variance (ANOVA). This analysis helped to determine if, for example, males have discomfort palpating a fellow female student, if students are comfortable with a teacher of the same gender touching them, or if students with higher BMI values were uncomfortable with specific areas of the body being examined. The independent variables for this research question were the demographic factors of participant gender, age, religion, outlook, BMI, role in MEM, preferred group composition, and length of exposure to MEM. The dependent variables were the participant's comfort score calculated for each of the seven different comfort scales.

***Research Question 4*.** What demographic factors influence radiologic technology students' perceptions of MEM? Similarly, the researcher utilized the calculated perception score based upon responses to the eight questions in section 2 of the survey to conduct separate ANOVA tests across each of the demographic factors of age, race, gender, outlook, religion, preferred group composition, and BMI categories. This allowed for examination in differences in mean responses across the various demographics. The independent variables for this research question were the demographic factors of participant gender, age, religion, outlook, BMI, preferred group composition, and length of exposure to MEM. The dependent variables were the participant's calculated perception score.

Research Question 5. Is there a difference between roles a radiologic technology student participates in the MEM experience and comfort level with MEM? To examine research question five, the calculated comfort score for each of the seven questions of section one focused on role and gender in MEM were utilized to conduct planned paired sample *t*-tests. Comparisons were made among switching from a patient to a technologist role, switching between having a same gender peer as a patient or technologist versus a different gender peer as a patient or technologist, being a model for a same or different gender teacher, or evaluating between being a model for a peer versus a model for a teacher. For this research question, the independent variables were the role of the participant and the peer or teacher gender. The dependent variable was the comfort score for each specific section.

Research Question 6. Is there a relationship between roles a radiologic technology student participates in MEM experience and perceptions of MEM? The researcher planned to examine research question six by conducting a Pearson *r* correlation between participant calculated comfort score in the various roles from section one of the survey and the calculated perception score from section two of the survey. As this is a correlational test, there was not an independent variable (Price et al., 2017); rather, there were only dependent variables. The dependent variables were the comfort score from each of the roles identified in section one and the perception score from section two of the survey.

Limitations and Delimitations. Limitations of this study included survey access, sampling, and response rate. The researcher did not have access to the approximate 3,000 JRCERT-accredited bachelor’s degree programs’ radiologic technology student email addresses to directly recruit individual participants and had to rely upon program chairs to forward recruitment communication from the researcher to their respective students. This may have significantly limited the number of available participants' access to the survey due to potential failure of program chairs to forward the researcher's request and included survey link for survey participation. The researcher chose to use purposive sampling which is a form of nonrandom sampling presenting the limitation of the inability to potentially generalize the results beyond the group of participants at the specific time of survey completion. While bachelor's degree radiologic technology students were the intended population for the survey, other imaging modalities within imaging sciences, such as diagnostic medical sonography or magnetic resonance imaging, may have also been part of a bachelor's degree program with similar characteristics to radiologic technology students. Additionally, due to the nature of online surveys, response rate was expected to be low further limiting the study's generalizability across the entire population.

Delimitations for this study included limiting the study to bachelor's degree radiologic technology program students, only those students enrolled in JRCERT-accredited programs, and those radiologic technology programs that utilize MEM as a pedagogical practice. As the researcher is concerned with bachelor's degree radiologic technology students, there were 608 JRCERT-accredited radiography programs in the United States at the time of the study, there were only 50 accredited at the baccalaureate level (Joint Review Committee on Education in Radiologic Technology, 2019). While JRCERT is the most widely used accrediting body for radiologic technology educational programs, there are additional accreditation mechanisms for schools besides the JRCERT, so not all radiologic technology bachelor's degree students were included in this study. Additionally, not all JRCERT-accredited bachelor's degree radiologic technology programs utilize MEM within their curriculum. As this research study's focus is on the pedagogical practice of MEM, those schools which do not use this pedagogy were excluded by way of the program chair not forwarding the survey link onto students.

Conclusion

The full study for this dissertation sought to explore student perceptions and comfort levels with the pedagogical practice of MEM within JRCERT accredited bachelor's degreeradiologic technology programs in the United States. The associated pilot study detailed within this chapter sought to evaluate a newly created SPMEM survey tool for use in the formal dissertation research study that addressed the continuation of the longstanding practice of utilizing MEM within radiologic technology education. Literature suggested that not all students are comfortable with this practice even though educators can realize the ultimate benefit to the students' education.

The pilot study survey analysis of the researcher's developed SPMEM survey was measured for construct and criterion validity. Additionally, using data from the pilot study, the SPMEM survey instrument was evaluated for the reliability of survey items. This analysis of the SPMEM survey supported the future dissertation research study that utilized this instrument. While the results benefitted the final survey development, the actual responses from the pilot study were not used in the final study; however, details of the survey construction and analysis of the survey instrument may still benefit the community of educators in radiologic technology. The full study provided quantitative statistical analysis of the research questions related to student perceptions and comfort level with MEM as part of their educational curriculum.

Educators ultimately want students to succeed. Reflecting on pedagogical practices from a student perspective can be beneficial to everyone.

Chapter 4: Findings

This chapter will report the findings of the research questions for the study related to students' comfort level with MEM, perceptions of MEM, influential factors for these comfort levels and perceptions, and differences in comfort levels and perception relationships with the various roles as part of MEM. This chapter will also detail the research procedures followed for this research study.

Purpose

The purpose of this quantitative research study was to examine the perception and comfort levels of radiologic technology students participating in MEM as part of their educational program in a Joint Review Committee on Education in Radiologic Technology (JRCERT) accredited Bachelor of Science radiography program in the United States. This study sought to answer the following research questions:

1. What are radiologic technology students' perceptions of the MEM experience as a pedagogical practice?
2. What are radiologic technology students' comfort levels with MEM?
3. What demographic factors influence radiologic technology students' comfort levels of MEM?
4. What demographic factors influence radiologic technology students' perceptions of MEM?
5. Is there a difference between roles a radiologic technology student participates in the MEM experience and comfort level with MEM?

6. Is there a relationship between roles a radiologic technology student participates in MEM experience and perceptions of MEM?

Through a single, cross-sectional survey approach, this study sought to fill in gaps in the literature related to radiologic technology students' perceptions about medical educational modeling and the students' comfort and perception levels with this practice across multiple demographic factors. Examination of student roles in MEM (*e.g.*, whether the student participates as a simulated patient or takes on the role of the technologist practicing on a peer), teacher involvement in the practice, and how students perceive this practice in terms of benefits and drawbacks may potentially enlighten educators across multiple disciplines on the utilization of peers within the same cohort for education modeling. Student comfort levels with MEM could potentially shift the thought process of continuing to teach in this manner simply because it has always been done this way. The information from this study is needed to critically evaluate the practice and potentially transform educational approaches to teaching essential skills requiring physical touch in the future.

Population and Sample

The population for this study was students enrolled in JRCERT accredited bachelor' degree radiologic technology programs across the United States. There are currently 50 programs meeting these criteria in the country with an average of 60 students per program yielding an approximate population of 3,000 (Joint Review Committee on Education in Radiologic Technology, 2020). The researcher used purposive sampling to specifically target bachelor's degree radiologic technology students from JRCERT accredited programs to better understand their comfort levels and perceptions of MEM.

A total of 74 responses were received. Of the 74 responses, 7 surveys had missing data points and were therefore eliminated to prevent potential bias. The final sample size of 67 respondents represented approximately 2.23% of the approximated total population. Due to the sample size being lower than the initial expectation of 5%, the researcher conducted a wave analysis between week 1 and week 2 for student willingness to participate in MEM based upon gender and role. The wave analysis used comfort mean among roles to determine any statistically significant difference in responses between week 1 and week 2. This method (according to Cresswell, 2014) is used to check for biases between early and late respondents. In this study, no significant differences were found among the various data sets when looking at overall willingness for these specific categories (see Table 4).

Table 4

Wave Analysis Between Average Responses Week 1 Versus Week 2

Overall Willingness Score in Different Roles (Calculated as a Mean Score Amongst the Various Body Areas)			
Role	Average Willingness Score		
	Week 1 (n=25)	Week 2 (n=42)	*t*
Simulated Patient with Same Gender Peer	9.69	9.74	0.68
Simulated Patient with Different Gender Peer	9.36	9.35	0.94
Technologist Role with Same Gender Peer	9.87	9.75	0.39
Technologist Role with Different Gender Peer	9.74	9.44	0.12
Model for Same Gender Teacher	9.77	9.75	0.89
Model for Different Gender Teacher	9.66	9.41	0.25
Observer Only	9.96	9.94	0.75

Note. Average scale responses for various anatomical areas ranged from 1 (not at all willing) to 10 (willing)

When breaking the data down further by specific exams under examination, only one area (lower leg and foot as simulated patient for same gender peer acting as technologist) showed significant differences ($p<0.05$) between weeks 1 and week 2 of the survey (see Tables 5-11). Following the rationale by Ary et al. (2019) and Rea and Parker (2014) these results demonstrate no significant difference overall and therefore can assume the results are representative of the whole population even with the low response rate of approximately 2.23%.

Table 5

Wave Analysis Between Average Responses Week 1 Versus Week 2 for Overall Willingness to Participate in Specific Exams as Simulated Patient with Same Gender Peer in Technologist Role

Exam	Week 1 (n=25)	Week 2 (n=42)	*t*
Head and Neck	9.84	9.93	0.45
Hand	9.96	10	0.20
Arm & Shoulder	9.96	10	0.20
Upper Body	9.96	9.86	0.52
Abdomen	8.96	9.31	0.35
Back	9.84	9.88	0.77
Pelvis	9.52	9.40	0.72
Lower Leg & Foot	9.64	9.98	0.02*
Knee	9.96	9.95	0.89
Hip Joint	9.28	9.12	0.71

Note. *$p<.05$

Table 6

Wave Analysis Between Average Responses Week 1 Versus Week 2 for Overall Willingness to Participate in Specific Exams as Simulated Patient with Different Gender Peer in Technologist Role

Exam	Week 1 (n=25)	Week 2 (n=42)	*t*
Head and Neck	9.76	9.62	0.67
Hand	9.96	9.95	0.91
Arm & Shoulder	9.96	9.93	0.68
Upper Body	9.76	9.55	0.42
Abdomen	8.16	8.60	0.44
Back	9.92	9.62	0.28
Pelvis	8.56	8.2	0.95
Lower Leg & Foot	9.52	9.64	0.72
Knee	9.96	9.71	0.28
Hip Joint	8.08	8.31	0.72

Table 7

Wave Analysis Between Average Responses Week 1 Versus Week 2 for Overall Willingness to Participate in Specific Exams as Simulated Technologist with Same Gender Peer in Patient Role

Exam	Week 1 (n=25)	Week 2 (n=42)	*t*
Head and Neck	10	9.74	0.27
Hand	10	10	1.0
Arm & Shoulder	10	9.95	0.44
Upper Body	10	9.93	0.18
Abdomen	9.52	9.43	0.78
Back	10	9.86	0.37
Pelvis	9.64	9.55	0.72
Lower Leg & Foot	10	9.90	0.33
Knee	10	9.81	0.26
Hip Joint	9.56	9.36	0.54

Table 8

Wave Analysis Between Average Responses Week 1 Versus Week 2 for Overall Willingness to Participate in Specific Exams as Simulated Technologist with Different Gender Peer in Patient Role

Exam	Week 1 (n=25)	Week 2 (n=42)	*t*
Head and Neck	10	9.71	0.14
Hand	10	9.88	0.44
Arm & Shoulder	10	9.90	0.44
Upper Body	9.92	9.67	0.15
Abdomen	9.4	8.86	0.16
Back	10	9.64	0.18
Pelvis	9.28	8.86	0.27
Lower Leg & Foot	10	9.69	0.29
Knee	10	9.74	0.20
Hip Joint	8.80	8.46	0.54

Table 9

Wave Analysis Between Average Responses Week 1 Versus Week 2 for Overall Willingness to Participate in Specific Exams as Simulated Patient Model with Same Gender Teacher in Technologist Role

Exam	Week 1 (n=25)	Week 2 (n=42)	*t*
Head and Neck	10	9.74	0.20
Hand	10	9.90	0.44
Arm & Shoulder	10	9.90	0.44
Upper Body	10	9.83	0.24
Abdomen	9	9.29	0.49
Back	9.96	9.90	0.67
Pelvis	9.72	9.62	0.67
Lower Leg & Foot	9.92	9.88	0.78
Knee	10	9.88	0.35
Hip Joint	9.08	9.52	0.23

Table 10

Wave Analysis Between Average Responses Week 1 Versus Week 2 for Overall Willingness to Participate in Specific Exams as Simulated Patient Model with Different Gender Teacher in Technologist Role

Exam	Week 1 (n=25)	Week 2 (n=42)	*t*
Head and Neck	10	9.71	0.15
Hand	10	9.90	0.44
Arm & Shoulder	10	9.79	0.19
Upper Body	9.96	9.57	0.11
Abdomen	8.92	8.67	0.60
Back	10	9.76	0.23
Pelvis	9.08	8.79	0.51
Lower Leg & Foot	9.92	9.76	0.45
Knee	10	9.67	0.18
Hip Joint	8.68	8.45	0.69

Table 11

Wave Analysis Between Average Responses Week 1 Versus Week 2 for Overall Willingness to Participate in Specific Exams as an Observer

Exam	Week 1 (n=25)	Week 2 (n=42)	*t*
Head and Neck	10	9.95	0.44
Hand	10	9.95	0.44
Arm & Shoulder	10	9.95	0.44
Upper Body	10	9.95	0.44
Abdomen	9.84	9.90	0.62
Back	10	9.95	0.44
Pelvis	9.88	9.95	0.52
Lower Leg & Foot	10	9.95	0.44
Knee	10	9.95	0.44
Hip Joint	9.88	9.86	0.88

Descriptive Analysis

Descriptive statistics were conducted on the completed surveys to check for appropriateness of the various parametric tests planned for data analysis. Research questions 1-2 were simply reporting means of survey responses and were therefore not subjected to testing of normality. Responses related to research questions 3-6 were examined for normality to determine appropriateness of parametric testing. Initial results indicated significant skewness of data that would be used in examining questions 3-6 and therefore resulted in utilizing the nonparametric equivalent test for examining the results related to these questions (Astivia & Zumbo, 2017).

Frequency counts of the number of comments submitted for benefits, drawbacks, and suggestions for improvement on the practice of MEM from section four of the survey were analyzed to indicate participant perceptions of MEM. Results indicate of the 67 total complete surveys, 97 total comments were submitted by participants among the various roles and general practice of MEM. The majority of comments submitted were positive (n = 63/97, 64.95%). Overall, negative comments represented 25.77% (n = 25/97) of all comments submitted. Comments submitted as opportunities for improvement represented 9.28% (n = 9/97) of submitted comments (see Table 12).

Table 12

Frequency Counts of Positive, Negative, and Opportunity for Improvement Comments for Each Role in MEM

Role	Positive	Negative	Opportunity for Improvement	Total Comments by Role
Simulated Patient for Peer	15	8	3	26
Simulated Technologist with Peer as Simulated Patient	16	3	1	20
Simulated Patient for Teacher	11	8	1	20
General MEM	21	6	4	31
Overall Number of Comments by Perspective	63	25	9	97

Examining frequency counts of comments among the various roles that participants felt strongly enough to comment on within the survey demonstrate a variance of 9.64% among the number of comments submitted for actual roles of simulated patient for peer, simulated technologist with peer as simulated patient, and simulated patient for teacher. This percentage does not include comments relative to general MEM practice comments (see Figures 2-4).

Figure 2

Comments Submitted Regarding MEM as a Simulated Patient

MEM – As Simulated Patient		
Benefits	**Drawbacks**	**Suggestions for Improvement**
able to feel what it's like to be the patient as some positions can be uncomfortable to hold even in perfect conditions	I am very ticklish	balanced participation
Allows you to understand the patient perspective	Most places don't have a comfortable place to stimulate the exam, which can make it uncomfortable when laying on the floor/table	none
As a professional, I can help my classmates with physical contact do's and cautions.	none	someone takes a picture or switches position with "patient"
comfort	Not as helpful as doing the exam	
Easier to learn material	Not being able to see to learn	
Helps peer learn and helps give you the patient experience	too easy	
Helps peers and myself	unable to be hands on and see the exam	
It gives everyone an example to follow.	you can not observe what is going on	
It gives you the experience to communicate and understand what the patient has to do in order to get the best images as possible		
It helps me to understand what the patients are going through		
learn how to handle different patients		
learning experience		
Mem is very beneficial to learn hands on how to position patients		
We can learn from each other		
you can give your classmates suggestions		

Figure 3

Comments Submitted Regarding MEM as a Simulated Technologist

MEM – In the Technologist Role with Peers as the Simulated Patient		
Benefits	**Drawbacks**	**Suggestions for Improvement**
again, being able to perform exam under perfect conditions. great for hands on learners	it can make you very nervous with others watching	none
Different inputs	none	
Easier to learn material		
Get more input on how to position for multiple exams		
Getting feedback and tips to become a better tech.		
Good practice		
Helps with learning hands on		
helps you gain confidence and allows others to help you when you make mistakes		
I think it is essential to learn how to properly position and can be easy positioning for the first time with people you are familiar with		
It gives you live examples to use in your studies.		
It helps me demonstrate my positions before going into the clinical field		
It will allow the technologist to be reminded of what it is like to be a student and give the technologist an idea on how to explain certain aspects better		
Learn more tips and tricks		
learning experience		
Same benefits as MEM in general		
We could help each other with positioning issues		

Figure 4

Comments Submitted Regarding MEM as a Simulated Patient for Teacher

MEM – As an Example for Teacher in Front of Peers		
Benefits	**Drawbacks**	**Suggestions for Improvement**
Easier to learn material	a student loses the chance to practice for that one exam, overall not a huge deal	none
Helps my peers visualize what they should be doing	Can be awkward, some classmates do not volunteer, making the ones who do volunteer miss out on observing demonstrations	
Helps peer learn and teacher explain	Don't get to see the teaching	
I enjoy being an example for others	nervous	
It allows you to gain more knowledge and be more comfortable with different people and can even have new ways or better ideas on how to help the patient and get a great image	none	
It helps you understand the importance of peer practice.	Not being able to see what teacher is showing	
It is nice to be the example to know how a patient feels	The students dont get to practice themselves	
learning experience	you can not see what your professor is showing your peers	
Most useful in growing skillset to use on real patients		
My peers and I can learn		
students are able to see what the exam will look like before attempting, great for visual learners		

Radiologic Technology Students' Perceptions of the MEM Experience

To examine this question, the overall mean of student perceptions related to MEM was calculated across eight different questions related to the perception of MEM as a pedagogical practice (see Table 13). One negative statement of the eight statements was reverse coded to align with the other seven positive statements to formulate a unidirectional mean. Results demonstrate an overall positive perception of MEM (*M* = 3.43/4, *SD* = 0.43).

Table 13

Perception of Medical Educational Modeling

Perception Question	N	*M*	*SD*
It is inappropriate to perform MEM on persons that will be my future colleagues*	66	2.80	0.61
To perform MEM is an appropriate practice for the education of a radiologic technologist	67	3.84	0.57
To undergo MEM is an appropriate practice for the education of a radiologic technologist	67	3.69	0.80
In performing MEM, I (will) get useful feedback from my colleagues about my skill	67	3.78	0.52
It is a sign of professionalism as a student to accept to perform and undergo MEM	67	3.33	0.93
I believe it is important for me to participate in MEM	66	3.70	0.70
I am motivated to participate in MEM	67	3.52	0.82
Performing MEM improved my skills for clinical practice	67	3.76	0.55
Overall Mean	66.75	3.43	0.43

Note. Question marked with asterisk (*) was reverse coded.

Radiologic Technology Students' Comfort Level with MEM

This research question aimed to identify comfort levels among the various roles undertaken as part of the MEM pedagogical practice. The roles include being a simulated patient with a same gender peer (SPSGP), being a simulated patient with a different gender peer (SPDGP), participating in the role of simulated technologist with a same gender peer as simulated patient (TSGP), participating in the role of simulated technologist with a different gender peer as simulated patient (TDGP), being a simulated patient for a same gender teacher to demonstrate radiographic positioning (SPSGT), being a simulated patient for different gender teacher to demonstrate radiographic positioning (SPDGT), or as an observer watching the practice of MEM between other peers or peer and teacher (OBS). An overall comfort score was calculated as the mean value across all responses for the areas of the body for each role. The scale indicated a 1 as "not at all willing" to a 10 as "very willing" to participate in the stated role. The independent variables were each role a participant undertakes as part of MEM. The dependent variables would be the participant's overall comfort score and comfort scores across each area of the body for the different roles.

Comfort Score as a Simulated Patient with Same Gender Peer as the Simulated Examining Technologist

Results demonstrate an overall comfort score as a simulated patient with same gender peer as the examining simulated technologist of 9.72/10. The mean response of willingness did vary between the various areas of the body under examination. Specific examination categories ranged between comfort scores of 9.18 to 9.99/10 with 'hip joint" area being the lowest and the categories of “hand” and “arm and shoulder” procedures having the highest comfort score among examinations in this role.

Comfort Score as a Simulated Patient with Different Gender Peer as the Simulated Examining Technologist

Results demonstrate an overall comfort score as a simulated patient with different gender peer as the examining technologist of 9.35/10. The mean response of willingness varied between the various areas of the body under examination. ranging between comfort scores of 8.22 to 9.96/10. For this category, the “hip joint” area again was the lowest and the categories of “hand” and “arm and shoulder” procedures had the highest comfort score amongst examinations in this role.

Comfort Score as a Simulated Examining Technologist with Same Gender Peer as Simulated Patient

Results demonstrate an overall comfort score in the role as an examining technologist with same gender peer as the simulated patient of 9.8/10. The mean response of willingness varied between the various areas of the body under examination. ranging between comfort scores of 9.43 to 10/10. The “hip joint” was the lowest mean score while “hand” was the highest.

Comfort Score as a Simulated Examining Technologist with Different Gender Peer as Simulated Patient

Results demonstrate an overall comfort in the role as an examining technologist with different gender peer as the simulated patient of 9.55/10. The mean response of willingness varied between the various areas of the body under examination. ranging between comfort scores of 8.59 to 9.94/10. The “hip joint” was the lowest mean score while “arm and shoulder” was the highest in this category.

Comfort Score as a Simulated Patient for a Teacher of the Same Gender Demonstrating the Technologist Role

Results demonstrate an overall comfort score as a simulated patient for a same gender teacher in the examining technologist role of 9.76/10. The mean response of willingness varied between the various areas of the body under examination. ranging between comfort scores of 9.18 to 9.94/10. “Abdomen” was the lowest mean score while “hand” and “arm and shoulder” were the highest in this category.

Comfort Score as a Simulated Patient for a Teacher of a Different Gender Demonstrating the Technologist Role

Results demonstrate an overall comfort score as a simulated patient for a different gender teacher as the examining technologist of 9.5/10. The mean response of willingness varied between the various areas of the body under examination. ranging between comfort scores of 8.54 to 9.94/10. The “hip joint” was again the lowest mean score while “hand” was the highest in this category.

Comfort with Being in the Observer Role.

Results demonstrate an overall mean comfort score as an observer of medical educational modeling of 9.95/10. The mean response of willingness varied between the various areas of the body under examination. ranging between comfort scores of 9.87 to 9.97/10. The “abdomen” was the lowest mean score. The categories of “head and neck”, “hand”, “arm and shoulder”, "upper body", "back", "lower leg and foot", "knee" and "hip joint" were all scored the same and represent the highest scores.

Influence of Demographic Factors on Radiologic Technology Students' Comfort Levels of MEM

Some demographic factors such as age or length of exposure to MEM were collapsed into categories for statistical analysis for examining differences across mean responses. Due to the skewedness of the data, the calculated comfort scores from section one of the survey were grouped by demographics to examine differences in means across each of the various demographic factors through a Kruskal-Wallis test. The Kruskal-Wallis test is appropriate when descriptive results of the data reveal the data set to no longer be appropriate for an ANOVA parametric test (MacFarland & Yates, 2016). The independent variables for this research question were the demographic factors of participant gender, age, religion, outlook, BMI, preferred group composition, and length of exposure to MEM. The dependent variable was the participant's comfort score in each role of the seven different MEM comfort scales.

Comfort as a Simulated Patient with Same Gender Peer as the Examining Technologist

Results demonstrated an overall comfort score as a simulated patient with same gender peer as the examining technologist of 9.72/10 ($N = 67$). Comfort as a simulated patient with same gender peer in the examining technologist role was analyzed across each of the demographic factors to determine any influence on overall comfort score. Examining each of the demographic factors in relation to comfort as the simulated patient with same gender peer as technologist follows.

Gender. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the genders when acting as a simulated patient with a same gender peer in the examining technologist role. Comfort scores differed between groups of "male" (*n* = 12), "female" (*n* = 54), and "neither" (*n* = 1) gender groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between gender groups, $\chi^2(3) = .673$, $p = .714$ (see Table 14).

Table 14

Kruskal-Wallis Test of Variance Among Comfort Scores in Simulated Patient Role with Same Gender Peer as Simulated Technologist in MEM Across Gender

Variable	Gender	N	Mean Rank	Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of same gender	Male	12	32.75	.673	.714
	Female	54	34.03		
	Neither	1	47.5		
	Total	67			

Age. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the age groups when acting as a simulated patient with a same gender peer in the examining technologist role (*N* = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between age groups, $\chi^2(3) = .820$, $p = .365$ (see Table 15).

Table 15

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Same Gender Peer as Simulated Technologist in MEM Across Age

Variable	Age Group	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of same gender	18-22	39	33.94	.820	.365
	23-27	17	29.50		
	28-32	3	39.17		
	33-37	2	47.50		
	38-42	2	47.50		
	43-47	0	0		
	48-52	2	47.50		
	53-57	0	0		
	58-62	0	0		
	63-67	1	47.50		
	68-72	1	3.00		

Religion. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the different groups of religion when acting as a simulated patient with a same gender peer in the examining technologist role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00). Median comfort scores were statistically significantly different between groups, $\chi^2(3) = 19.141$, $p = .008$ (see Table 16).

Table 16

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Same Gender Peer as Simulated Technologist in MEM Across Religion

Variable	Religion	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of same gender	Christian	26	40.50	19.141	.008*
	Catholic	15	29.10		
	Mormon	3	25.17		
	Jehovah's Witness	0	0		
	Orthodox	0	0		
	Jewish	0	0		
	Muslim	2	4.25		
	Buddhist	0	0		
	Hindu	0	0		
	Other	0	0		
	Nothing in particular	11	26.77		
	Prefer Not to Answer	3	20.33		
	Atheist	3	47.00		
	Agnostic	3	47.00		

Note. $*p < .05$

Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed statistically significant differences in median comfort scores as a simulated patient with a peer of the same gender in the technologist role between the Muslim (8.50) and Christian (10.00) ($p = .004$), Muslim (8.50) and Atheist (10.00) ($p = .006$), Muslim (8.50) and Agnostic (10.00) ($p = .006$), Nothing in Particular and Christian ($p = .026$), and Catholic and Christian ($p = .040$). No other group combinations produced significant differences. These significant findings disappeared with the Bonferroni correction as demonstrated with the adjusted *p*-values presented most likely due to low sample sizes within these populations (see Figure 5) According to VanderWeele and Mathur (2019) this effect can happen when small sample sizes are utilized in pairwise comparisons as it is considered overly conservative in applying corrections to calculated significance.

Figure 5

SPSS Pairwise Comparison Output for Simulated Patient Role with Same Gender Peer as Simulated Technologist in MEM Across Religion

Pairwise Comparisons of Religion Affiliation and Comfort Score in Simulated Patient Role with Same Gender Peer as Simulated Technologist

Religion 1- Religion 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.*
Muslim-Prefer Not to Answer	-16.083	15.608	-1.030	.303	1.000
Muslim-Mormon	20.917	15.608	1.340	.180	1.000
Muslim-Nothing in Particular	-22.523	13.143	-1.714	.087	1.000
Muslim-Catholic	24.850	12.870	1.931	.054	1.000
Muslim-Christian	36.250	12.546	2.889	.004	.108
Muslim-Atheist	-42.750	15.608	-2.739	.006	.173
Muslim-Agnostic	-42.750	15.608	-2.739	.006	.173
Prefer Not to Answer-Mormon	4.833	13.960	.346	.729	1.000
Prefer Not to Answer-Nothing in Particular	6.439	11.136	.578	.563	1.000
Prefer Not to Answer-Catholic	8.767	10.813	.811	.418	1.000

Prefer Not to Answer-Christian	20.167	10.425	1.934	.053	1.000
Prefer Not to Answer-Atheist	-26.667	13.960	-1.910	.056	1.000
Prefer Not to Answer-Agnostic	-26.667	13.960	-1.910	.056	1.000
Mormon-Nothing in Particular	-1.606	11.136	-.144	.885	1.000
Mormon-Catholic	3.933	10.813	.364	.716	1.000
Mormon-Christian	15.333	10.425	1.471	.141	1.000
Mormon-Atheist	-21.833	13.960	-1.564	.118	1.000
Mormon-Agnostic	-21.833	13.960	-1.564	.118	1.000
Nothing in Particular-Catholic	2.327	6.787	.343	.732	1.000
Nothing in Particular-Christian	13.727	6.150	2.232	.026	.717
Nothing in Particular-Atheist	-20.227	11.136	-1.816	.069	1.000
Nothing in Particular-Agnostic	-20.227	11.136	-1.816	.069	1.000
Catholic-Christian	11.400	5.544	2.056	.040	1.000
Catholic-Atheist	-17.900	10.813	-1.655	.098	1.000
Catholic-Agnostic	-17.900	10.813	-1.655	.098	1.000
Christian-Atheist	-6.500	10.425	-.623	.533	1.000
Christian-Agnostic	-6.500	10.425	-.623	.533	1.000
Atheist-Agnostic	.000	13.960	.000	1.000	1.000

Note. Each row tests the null hypothesis that the Religion 1 and Religion 2 comfort score distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

*Significance values have been adjusted by the Bonferroni correction for multiple tests.

Outlook. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across outlook when acting as a simulated patient with a same gender peer in the examining technologist role (*N* = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between outlook groups, $\chi^2(3) = .368$, $p = .947$ (see Table 17).

Table 17

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Same Gender Peer as Simulated Technologist in MEM Across Outlook

Variable	Outlook	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of same gender	More Conservative than Average	12	36.29	.368	.947
	Within the Range of Average Conservative/Liberal Outlook	30	34.10		
	More Liberal than Average	14	33.32		
	Prefer Not to Answer	11	32.09		

BMI. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the BMI categories when acting as a simulated patient with a same gender peer in the examining technologist role (*N* = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all group, as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between BMI groups, $\chi^2(3) = 2.688$, $p = .442$ (see Table 18).

Table 18

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Same Gender Peer as Simulated Technologist in MEM Across Body Mass Index Categories

Variable	BMI Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of same gender	Underweight	2	23.00	2.688	.442
	Healthy Weight	31	28.65		
	Overweight	14	28.75		
	Obese	12	36.13		

Preferred Group Composition. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the preferred MEM group categories when acting as a simulated patient with a same gender peer in the examining technologist role ($N = 59$). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between the various groups, $\chi^2(3) = 1.549$, $p = .671$ (see Table 19).

Table 19

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Same Gender Peer as Simulated Technologist in MEM Across Preferred Group Composition Categories

Variable	Preferred Group Composition	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of same gender	Self-Assembled	5	26.20	1.55	.671
	Mixed-Gender	8	31.31		
	Same-Gender	8	33.25		
	No Preference	46	35.45		

Length of Exposure to MEM. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the length of exposure to MEM group categories when acting as a simulated patient with a same gender peer in the examining technologist role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between the various groups, $\chi^2(3) = 1.310$, $p = .518$ (see Table 20).

Table 20

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Same Gender Peer as Simulated Technologist in MEM Across Length of Program Completed

Variable	Length of Program Completed (Months)	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of same gender	0-3	6	39.33	13.103	.518
	4-6	5	21.50		
	7-9	9	29.22		
	10-12	3	47.00		
	13-15	8	25.44		
	16-18	6	26.33		
	19-21	8	37.19		
	22-24	6	37.17		
	25-28	3	34.00		
	29-31	1	47.00		
	32-34	3	40.00		
	35-38	3	47.00		
	39-41	1	47.00		
	42-44	2	25.75		
	45-48	2	36.50		

Comfort as a Simulated Patient with Different Gender Peer as the Examining Technologist

Results demonstrated an overall comfort score as a simulated patient with different gender peer as the examining technologist of 9.35/10 (*N* = 67). Comfort as a simulated patient with different gender peer in the examining technologist role was again analyzed across each of the demographic factors to determine any influence on overall comfort score between this role and gender combination. Examining each of the demographic factors in relation to comfort as the simulated patient with different gender peer as technologist follows.

Gender. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the genders when acting as a simulated patient with a different gender peer in the examining technologist role. Comfort scores differed between groups of "male" (*n* = 12), "female" (*n* = 54), and "neither" (*n* = 1) gender groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 4.90/10.00 to 10.00/10.00 for this category (*Mdn* = 9.70) but the differences were not statistically significant between gender groups, $\chi^2(3) = 2.986$, $p = .225$ (see Table 21).

Table 21

Kruskal-Wallis Test of Variance Among Comfort Scores in Simulated Patient Role with Different Gender Peer as Simulated Technologist in MEM Across Gender

Variable	Gender	N	Mean Rank	Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of different gender	Male	12	38.96	2.986	.225
	Female	54	32.55		
	Neither	1	53.00		
	Total	67			

Age. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the age groups when acting as a simulated patient with a different gender peer in the examining technologist role (*N* = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 4.90/10.00 to 10.00/10.00 for this category (*Mdn* = 9.70) but the differences were not statistically significant between age groups, $\chi^2(3)$ = 5.337, *p* = .619 (see Table 22).

Table 22

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Different Gender Peer as Simulated Technologist in MEM Across Age

Variable	Age Group	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of different gender	18-22	39	33.83	5.337	.619
	23-27	17	32.35		
	28-32	3	27.00		
	33-37	2	53.00		
	38-42	2	43.00		
	43-47	0	0		
	48-52	2	34.50		
	53-57	0	0		
	58-62	0	0		
	63-67	1	53.00		
	68-72	1	13.50		

Religion. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the different groups of religion when acting as a simulated patient with a different gender peer in the examining technologist role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 4.90/10.00 to 10.00/10.00 for this category (*Mdn* = 9.75). Median comfort scores were not statistically significantly different between religion groups, $\chi^2(3) = 12.534$, $p = .084$ (see Table 23).

Table 23

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Different Gender Peer as Simulated Technologist in MEM Across Religion

Variable	Religion	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of different gender	Christian	26	40.15	12.534	.084
	Catholic	15	27.07		
	Mormon	3	29.67		
	Jehovah's Witness	0	0		
	Orthodox	0	0		
	Jewish	0	0		
	Muslim	2	2.50		
	Buddhist	0	0		
	Hindu	0	0		
	Other	0	0		
	Nothing in particular	11	34.77		
	Prefer Not to Answer	3	22.17		
	Atheist	3	34.00		
	Agnostic	3	38.67		

Outlook. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the outlooks when acting as a simulated patient with a same gender peer in the examining technologist role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 4.90/10.00 to 10.00/10.00 for this category (Mdn = 9.70) but the differences were not statistically significant between outlook groups, $\chi^2(3) = 1.203$, $p = .752$ (see Table 24).

Table 24

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Different Gender Peer as Simulated Technologist in MEM Across Outlook

Variable	Outlook	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of different gender	More Conservative than Average	12	37.42	1.203	.752
	Within the Range of Average Conservative/Liberal Outlook	30	32.23		
	More Liberal than Average	14	36.86		
	Prefer Not to Answer	11	31.45		

BMI. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the BMI categories when acting as a simulated patient with a different gender peer in the examining technologist role ($N = 59$). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 4.90/10.00 to 10.00/10.00 for this category ($Mdn = 9.70$) but the differences were not statistically significant between BMI groups, $\chi^2(3) = 3.813$, $p = .282$ (see Table 25).

Table 25

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Different Gender Peer as Simulated Technologist in MEM Across Body Mass Index Categories

Variable	BMI Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of different gender	Underweight	2	33.00	3.813	.282
	Healthy Weight	31	29.34		
	Overweight	14	24.82		
	Obese	12	37.25		

Preferred Group Composition. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the preferred MEM group categories when acting as a simulated patient with a different gender peer in the examining technologist role (*N* = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 4.90 /10.00 to 10.00/10.00 for this category (*Mdn* = 9.70) but the differences were not statistically significant between the various groups, $\chi^2(3) = 4.636$, *p* = .200 (see Table 26).

Table 26

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient with Different Gender Peer as Simulated Technologist in MEM Across Preferred Group Composition Categories

Variable	Preferred Group Composition	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of different gender	Self-Assembled	5	44.60	4.636	.200
	Mixed-Gender	8	30.38		
	Same-Gender	8	23.56		
	No Preference	46	35.29		

Length of Exposure to MEM. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the length of exposure to MEM categories when acting as a simulated patient with a different gender peer in the examining technologist role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 4.90/10.00 to 10.00/10.00 for this category (*Mdn* = 9.70) but the differences were not statistically significant between the various groups, $\chi^2(3) = 13.624$, $p = .478$ (see Table 27).

Table 27

Kruskal-Wallis Test Among Comfort Scores in Simulated Patient Role with Different Gender Peer as Simulated Technologist in MEM Across Length of Program Completed

Variable	Length of Program Completed (Months)	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient role with simulated technologist of different gender	0-3	6	34.17	13.624	.478
	4-6	5	31.40		
	7-9	9	31.11		
	10-12	3	39.17		
	13-15	8	22.56		
	16-18	6	24.42		
	19-21	8	41.38		
	22-24	6	47.58		
	25-28	3	38.00		
	29-31	1	20.00		
	32-34	3	34.83		
	35-38	3	21.67		
	39-41	1	52.50		
	42-44	2	30.75		
	45-48	2	45.25		

Comfort as an Examining Technologist with Same Gender Peer as Simulated Patient

Results demonstrated an overall comfort score as a simulated examining technologist with same gender peer as the simulated patient of 9.80 /10 (N = 67). Comfort as a simulated technologist with same gender peer in the simulated patient role was again analyzed across each of the demographic factors to determine any influence on overall comfort score between this role and gender combination. Examining each of the demographic factors in relation to comfort as the simulated examining technologist with same gender peer as simulated patient follows.

Gender. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the genders when acting as an examining technologist with a same gender peer in the simulated patient role. Comfort scores differed between groups of "male" (n = 12), "female" (n = 54), and "neither" (n = 1) gender groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.20/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between gender groups, $\chi^2(3) = 1.321$, $p = .517$ (see Table 28).

Table 28

Kruskal-Wallis Test Among Comfort Scores as Simulated Technologist with Same Gender Peer in Patient Role in MEM Across Gender

Variable	Gender	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with same gender peer as patient	Male	12	29.92	1.321	.517
	Female	54	34.72		
	Neither	1	44.00		
	Total	67			

Age. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the age groups when acting as a simulated technologist with a same gender peer in the simulated patient role (*N* = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.20/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between age groups, $\chi^2(3) = 11.391$, $p = .122$ (see Table 29).

Table 29

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Same Gender Peer as Simulated Patient in MEM Across Age

Variable	Age Group	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of same gender	18-22	39	35.35	11.391	.122
	23-27	17	26.76		
	28-32	3	44.00		
	33-37	2	44.00		
	38-42	2	44.00		
	43-47	0	0		
	48-52	2	44.00		
	53-57	0	0		
	58-62	0	0		
	63-67	1	44.00		
	68-72	1	4.50		

Religion. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the different groups of religion when acting as a simulated technologist with a same gender peer in the simulated patient role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.20/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00). Median comfort scores were not statistically significantly different between religion groups, $\chi^2(3) = 13.172$, $p = .068$ (see Table 30).

Table 30

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Same Gender Peer as Simulated Patient in MEM Across Religion

Variable	Religion	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of same gender	Christian	26	37.54	13.172	.068
	Catholic	15	30.47		
	Mormon	3	23.67		
	Jehovah's Witness	0	0		
	Orthodox	0	0		
	Jewish	0	0		
	Muslim	2	4.50		
	Buddhist	0	0		
	Hindu	0	0		
	Other	0	0		
	Nothing in particular	11	31.41		
	Prefer Not to Answer	3	30.50		
	Atheist	3	43.50		
	Agnostic	3	43.50		

Outlook. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the outlooks when acting as a simulated technologist with a same gender peer in the simulated patient role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.20/10.00 to 10.00/10.00 for this category

(*Mdn* = 10.00) but the differences were not statistically significant between outlook groups, $\chi^2(3) = 3.189$, $p = .363$ (see Table 31).

Table 31

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Same Gender Peer as Simulated Patient in MEM Across Outlook

Variable	Outlook	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with same gender patient	More Conservative than Average	12	33.67	3.189	.363
	Within the Range of Average Conservative/Liberal Outlook	30	36.42		
	More Liberal than Average	14	34.93		
	Prefer Not to Answer	11	26.59		

BMI. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the BMI categories when acting as a simulated technologist with a same gender peer in the simulated patient role ($N = 59$). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.20/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between BMI groups, $\chi^2(3) = 5.207$, $p = .157$ (see Table 32).

Table 32

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Same Gender Peer as Simulated Patient in MEM Across Body Mass Index Categories

Variable	BMI Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of same gender	Underweight	2	39.50	5.207	.157
	Healthy Weight	31	31.97		
	Overweight	14	22.82		
	Obese	12	31.71		

Preferred Group Composition. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the preferred MEM group categories when acting as a simulated technologist with a same gender peer in the simulated patient role (*N* = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.20 /10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between the various groups, $\chi^2(3) = 1.182$, $p = .757$ (see Table 33).

Table 33

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Same Gender Peer as Simulated Patient in MEM Across Preferred Group Composition Categories

Variable	Preferred Group Composition	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of same gender	Self-Assembled	5	38.90	1.182	.757
	Mixed-Gender	8	26.69		
	Same-Gender	8	35.75		
	No Preference	46	33.91		

Length of Exposure to MEM. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the length of exposure to MEM group categories when acting as a simulated patient with a different gender peer in the examining technologist role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.20/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between the various groups, $\chi^2(3) = 19.257$, $p = .155$ (see Table 34).

Table 34

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Same Gender Peer as Simulated Patient in MEM Across Length of Program Completed

Variable	Length of Program Completed (Months)	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of same gender	0-3	6	43.50	19.257	.155
	4-6	5	19.50		
	7-9	9	38.89		
	10-12	3	43.50		
	13-15	8	21.19		
	16-18	6	33.33		
	19-21	8	30.38		
	22-24	6	32.00		
	25-28	3	43.50		
	29-31	1	18.50		
	32-34	3	35.17		
	35-38	3	43.50		
	39-41	1	43.50		
	42-44	2	26.00		
	45-48	2	43.50		

Comfort as an Examining Technologist with Different Gender Peer as Simulated Patient

Results demonstrated an overall comfort score as a simulated examining technologist with different gender peer as the simulated patient of 9.55/10.00 (N = 67). Comfort as a simulated technologist with different gender peer in the simulated patient role was again analyzed across each of the demographic factors to determine any influence on overall comfort score between this role and gender combination. Examining each of the demographic factors in relation to comfort as the simulated examining technologist with different gender peer as simulated patient follows.

Gender. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the genders when acting as a simulated patient with a different gender peer in the examining technologist role. Comfort scores differed between groups of "male" (n = 12), "female" (n = 54), and "neither" (n = 1) gender groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (*Mdn* – 9.80) but the differences were not statistically significant between gender groups, $\chi^2(3) = 1.413$, p = .493 (see Table 35).

Table 35

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Different Gender Peer as Simulated Patient in MEM Across Gender

Variable	Gender	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with different gender peer as patient	Male	12	30.79	1.413	.493
	Female	54	34.36		
	Neither	1	53.00		
	Total	67			

Age. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the age groups when acting as a simulated technologist with a different gender peer in the simulated patient role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (Mdn = 9.80) but the differences were not statistically significant between age groups, $\chi^2(3)$ = 8.592, p = .283 (see Table 36).

Table 36

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Different Gender Peer as Simulated Patient in MEM Across Age

Variable	Age Group	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of different gender	18-22	39	31.53	8.592	.283
	23-27	17	33.35		
	28-32	3	41.50		
	33-37	2	53.00		
	38-42	2	41.75		
	43-47	0	0		
	48-52	2	53.00		
	53-57	0	0		
	58-62	0	0		
	63-67	1	53.00		
	68-72	1	8.50		

Religion. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the different groups of religion when acting as a simulated technologist with a different gender peer in the simulated patient role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (Mdn = 9.80). Median comfort scores were not statistically significantly different between religion groups, $\chi^2(3) = 7.776$, p =.353 (see Table 37).

Table 37

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Different Gender Peer as Simulated Patient in MEM Across Religion

Variable	Religion	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of different gender	Christian	26	38.92	7.776	.353
	Catholic	15	29.43		
	Mormon	3	34.83		
	Jehovah's Witness	0	0		
	Orthodox	0	0		
	Jewish	0	0		
	Muslim	2	14.50		
	Buddhist	0	0		
	Hindu	0	0		
	Other	0	0		
	Nothing in particular	11	32.77		
	Prefer Not to Answer	3	21.00		
	Atheist	3	25.00		
	Agnostic	3	41.83		

Outlook. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the outlooks when acting as a simulated technologist with a different gender peer in the simulated patient role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category

(*Mdn* = 9.80) but the differences were not statistically significant between outlook groups, $\chi^2(3) = 3.928$, $p = .269$ (see Table 38).

Table 38

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Different Gender Peer as Simulated Patient in MEM Across Outlook

Variable	Outlook	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with different gender patient	More Conservative than Average	12	36.88	3.928	.269
	Within the Range of Average Conservative/Liberal Outlook	30	37.45		
	More Liberal than Average	14	30.64		
	Prefer Not to Answer	11	25.73		

BMI. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the BMI categories when acting as a simulated technologist with a different gender peer in the simulated patient role ($N = 59$). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (*Mdn* = 9.80) but the differences were not statistically significant between BMI groups, $\chi^2(3) = 3.790$, $p = .285$ (see Table 39).

Table 39

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Different Gender Peer as Simulated Patient in MEM Across Body Mass Index Categories

Variable	BMI Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of different gender	Underweight	2	38.50	3.790	.285
	Healthy Weight	31	32.90		
	Overweight	14	23.57		
	Obese	12	28.58		

Preferred Group Composition. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the preferred MEM group categories when acting as a simulated technologist with a different gender peer in the simulated patient role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40 /10.00 to 10.00/10.00 for this category (*Mdn* = 9.80) but the differences were not statistically significant between the various groups, $\chi^2(3) = 5.149$, $p = .161$ (see Table 40).

Table 40

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Different Gender Peer as Simulated Patient in MEM Across Preferred Group Composition Categories

Variable	Preferred Group Composition	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of different gender	Self-Assembled	5	35.10	5.149	.161
	Mixed-Gender	8	31.31		
	Same-Gender	8	20.75		
	No Preference	46	36.65		

Length of Exposure to MEM. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the length of exposure to MEM group categories when acting as a simulated technologist with a different gender peer in the simulated patient role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (*Mdn* = 9.80) but the differences were not statistically significant between the various groups, $\chi^2(3) = 10.131$, $p = .753$ (see Table 41).

Table 41

Kruskal-Wallis Test Among Comfort Scores in Simulated Technologist Role with Different Gender Peer as Simulated Patient in MEM Across Length of Program Completed

Variable	Length of Program Completed (Months)	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated technologist role with simulated patient of same gender	0-3	6	42.42	10.131	.753
	4-6	5	23.20		
	7-9	9	29.61		
	10-12	3	25.83		
	13-15	8	27.69		
	16-18	6	27.08		
	19-21	8	38.63		
	22-24	6	32.17		
	25-28	3	42.33		
	29-31	1	33.00		
	32-34	3	27.50		
	35-38	3	47.17		
	39-41	1	33.00		
	42-44	2	29.25		
	45-48	2	22.50		

Comfort as a Simulated Patient for a Teacher of a Same Gender Demonstrating the Technologist Role

Results demonstrated an overall comfort score as a simulated patient with same gender teacher demonstrating the technologist role of 9.76/10.00 (*N* = 67). Comfort as a simulated patient with same gender teacher demonstrating the technologist role was again analyzed across each of the demographic factors to determine any influence on overall comfort score between this role and gender combination. Examining each of the demographic factors in relation to comfort as the simulated patient with same gender teacher demonstrating the technologist role follows.

Gender. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the genders when acting as a simulated patient with a same gender teacher demonstrating the technologist role. Comfort scores differed between groups of "male" (*n* = 12), "female" (*n* = 54), and "neither" (*n* = 1) gender groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between gender groups, $\chi^2(3) = .982$, $p = .612$ (see Table 42)

Table 42

Kruskal-Wallis Test Among Comfort Scores Acting as a Simulated Patient for a Same Gender Teacher Demonstrating the Technologist Role in MEM Across Gender

Variable	Gender	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of same gender	Male	12	36.83	.982	.612
	Female	54	33.16		
	Neither	1	45.50		

Age. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the age groups when acting as a simulated patient with a same gender teacher demonstrating the technologist role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.00/10.00 to 10.00/10.00 for this category (Mdn = 10.00) but the differences were not statistically significant between age groups, $\chi^2(3)$ = 7.363, p = .392 (see Table 43).

Table 43

Kruskal-Wallis Test Among Comfort Scores Acting as a Simulated Patient for a Same Gender Teacher Demonstrating the Technologist Role in MEM Across Age

Variable	Age Group	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
	18-22	39	33.97		
	23-27	17	30.50		
	28-32	3	37.00		
	33-37	2	45.50		
	38-42	2	45.50		
Comfort as simulated patient with teacher of same gender	43-47	0	0	7.363	.392
	48-52	2	45.50		
	53-57	0	0		
	58-62	0	0		
	63-67	1	45.50		
	68-72	1	5.00		

Religion. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the different groups of religion when acting as a simulated patient with a same gender teacher demonstrating the technologist role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00). Median comfort scores were not statistically significantly different between religion groups, $\chi^2(3) = 10.910$, p =.143 (see Table 44).

Table 44

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Same Gender Teacher Demonstrating the Technologist Role in MEM Across Religion

Variable	Religion	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of same gender	Christian	26	37.71	10.910	.143
	Catholic	15	31.47		
	Mormon	3	26.17		
	Jehovah's Witness	0	0		
	Orthodox	0	0		
	Jewish	0	0		
	Muslim	2	4.75		
	Buddhist	0	0		
	Hindu	0	0		
	Other	0	0		
	Nothing in particular	11	30.05		
	Prefer Not to Answer	3	31.67		
	Atheist	3	45.00		
	Agnostic	3	36.67		

Outlook. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the outlooks when acting as a simulated patient with a same gender teacher demonstrating the technologist role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.00/10.00 to 10.00/10.00 for this category

(*Mdn* = 10.00) but the differences were not statistically significant between outlook groups, $\chi^2(3) = .615$, $p = .893$ (see Table 45).

Table 45

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Same Gender Teacher Demonstrating the Technologist Role in MEM Across Outlook

Variable	Outlook	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of same gender	More Conservative than Average	12	32.96	.615	.893
	Within the Range of Average Conservative/Liberal Outlook	30	33.72		
	More Liberal than Average	14	36.89		
	Prefer Not to Answer	11	32.23		

BMI. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the BMI categories when acting as a simulated patient with a same gender teacher demonstrating the technologist role (*N* = 59). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between BMI groups, $\chi^2(3) = 1.874$, $p = .599$ (see Table 46).

Table 46

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Same Gender Teacher Demonstrating the Technologist Role in MEM Across Body Mass Index Categories

Variable	BMI Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of same gender	Underweight	2	40.50	1.874	.599
	Healthy Weight	31	31.06		
	Overweight	14	26.82		
	Obese	12	29.21		

Preferred Group Composition. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the preferred MEM group categories when acting as a simulated patient with a same gender teacher demonstrating the technologist role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.00 /10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between the various groups, $\chi^2(3) = .727$, $p = .867$ (see Table 47).

Table 47

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Same Gender Teacher Demonstrating the Technologist Role in MEM Across Preferred Group Composition Categories

Variable	Preferred Group Composition	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of same gender	Self-Assembled	5	32.60	.727	.867
	Mixed-Gender	8	30.44		
	Same-Gender	8	37.25		
	No Preference	46	34.21		

Length of Exposure to MEM. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the length of exposure to MEM group categories as a simulated patient with a same gender teacher demonstrating the technologist role (*N* = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 6.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between the various groups, $\chi^2(3) = 9.362$, $p = .807$ (see Table 48).

Table 48

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Same Gender Teacher Demonstrating the Technologist Role in MEM Across Length of Program Completed

Variable	Length of Program Completed (Months)	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
	0-3	6	38.08		
	4-6	5	24.30		
	7-9	9	30.39		
	10-12	3	45.00		
	13-15	8	30.13		
	16-18	6	29.17		
	19-21	8	37.56		
Comfort as simulated patient with teacher of same gender	22-24	6	28.75	9.362	.807
	25-28	3	34.17		
	29-31	1	20.00		
	32-34	3	35.33		
	35-38	3	45.00		
	39-41	1	45.00		
	42-44	2	32.50		
	45-48	2	45.00		

Comfort as a Simulated Patient for a Teacher of a Different Gender Demonstrating the Technologist Role

Results demonstrated an overall comfort score as a simulated patient with a different gender teacher demonstrating the technologist role of 9.50/10.00 (*N* = 67). Comfort as a simulated patient with different gender teacher demonstrating the technologist role was again analyzed across each of the demographic factors to determine any influence on overall comfort score between this role and gender combination. Examining each of the demographic factors in relation to comfort as the simulated patient with different gender teacher demonstrating the technologist role follows.

Gender. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the genders when acting as a simulated patient with a different gender teacher demonstrating the technologist role. Comfort scores differed between groups of "male" (*n* = 12), "female" (*n* = 54), and "neither" (*n* = 1) gender groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (*Mdn* = 9.80) but the differences were not statistically significant between gender groups, $\chi^2(3) = 3.499$, $p = .174$ (see Table 49)

Table 49

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Different Gender Teacher Demonstrating the Technologist Role in MEM Across Gender Categories

Variable	Gender	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of different gender	Male	12	41.38	3.499	.174
	Female	54	32.02		
	Neither	1	52.50		

Age. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across age groups when acting as a simulated patient with a different gender teacher demonstrating the technologist role ($N = 67$). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category ($Mdn = 9.80$) but the differences were not statistically significant between age groups, $\chi^2(3) = 5.502$, $p = .599$ (see Table 50).

Table 50

Kruskal-Wallis Test Among Comfort Scores Acting as a Simulated Patient for a Different Gender Teacher Demonstrating the Technologist Role in MEM Across Age

Variable	Age Group	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
	18-22	39	32.77		
	23-27	17	35.29		
	28-32	3	32.67		
	33-37	2	26.00		
	38-42	2	41.00		
Comfort as simulated patient with teacher of different gender	43-47	0	0	5.502	.599
	48-52	2	52.50		
	53-57	0	0		
	58-62	0	0		
	63-67	1	52.50		
	68-72	1	10.50		

Religion. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the different groups of religion when acting as a simulated patient with a different gender teacher demonstrating the technologist role (*N* = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (*Mdn* = 9.80). Median comfort scores were not statistically significantly different between religion groups, $\chi^2(3) = 13.740$, $p = .056$ (see Table 51).

Table 51

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Different Gender Teacher Demonstrating the Technologist Role in MEM Across Religion

Variable	Religion	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of different gender	Christian	26	40.29	13.740	.056
	Catholic	15	28.97		
	Mormon	3	33.00		
	Jehovah's Witness	0	0		
	Orthodox	0	0		
	Jewish	0	0		
	Muslim	2	8.50		
	Buddhist	0	0		
	Hindu	0	0		
	Other	0	0		
	Nothing in particular	11	31.36		
	Prefer Not to Answer	3	11.00		
	Atheist	3	36.00		
	Agnostic	3	42.33		

Outlook. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the outlooks when acting as a simulated patient with a different gender teacher demonstrating the technologist role (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category

(*Mdn* = 9.80) but the differences were not statistically significant between outlook groups, $\chi^2(3) = 1.243$, $p = .743$ (see Table 52).

Table 52

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Different Gender Teacher Demonstrating the Technologist Role in MEM Across Outlook

Variable	Outlook	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of different gender	More Conservative than Average	12	39.00	1.243	.743
	Within the Range of Average Conservative/Liberal Outlook	30	32.10		
	More Liberal than Average	14	34.68		
	Prefer Not to Answer	11	32.86		

BMI. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the BMI categories when acting as a simulated patient with a different gender teacher demonstrating the technologist role ($N = 59$). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (*Mdn* = 9.80) but the differences were not statistically significant between BMI groups, $\chi^2(3) = 4.926$, $p = .177$ (see Table 53).

Table 53

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Different Gender Teacher Demonstrating the Technologist Role in MEM Across Body Mass Index Categories

Variable	BMI Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of different gender	Underweight	2	45.50	4.926	.177
	Healthy Weight	31	32.03		
	Overweight	14	23.00		
	Obese	12	30.33		

Preferred Group Composition. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the preferred MEM group categories when acting as a simulated patient with a different gender teacher demonstrating the technologist role (*N* = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40 /10.00 to 10.00/10.00 for this category (*Mdn* = 9.80) but the differences were not statistically significant between the various groups, $\chi^2(3) = 4.541$, $p = .209$ (see Table 54).

Table 54

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Different Gender Teacher Demonstrating the Technologist Role in MEM Across Preferred Group Composition Categories

Variable	Preferred Group Composition	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as simulated patient with teacher of different gender	Self-Assembled	5	37.30	4.541	.209
	Mixed-Gender	8	29.19		
	Same-Gender	8	22.56		
	No Preference	46	36.47		

Length of Exposure to MEM. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the length of exposure to MEM group categories when acting as a simulated patient with a different gender teacher demonstrating the technologist role (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 5.40/10.00 to 10.00/10.00 for this category (*Mdn* = 9.80) but the differences were not statistically significant between the various groups, $\chi^2(3) = 9.723$, $p = .782$ (see Table 55).

Table 55

Kruskal-Wallis Test Among Comfort Scores as Simulated Patient for a Different Gender Teacher Demonstrating the Technologist Role in MEM Across Length of Program Completed

Variable	Length of Program Completed (Months)	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
	0-3	6	33.50		
	4-6	5	29.40		
	7-9	9	24.94		
	10-12	3	37.33		
	13-15	8	27.81		
	16-18	6	34.42		
	19-21	8	44.44		
Comfort as simulated patient with teacher of different gender	22-24	6	32.42	9.723	.782
	25-28	3	41.33		
	29-31	1	35.00		
	32-34	3	28.83		
	35-38	3	38.17		
	39-41	1	17.50		
	42-44	2	33.00		
	45-48	2	52.00		

Comfort with Being in the Observer Role.

Results demonstrated an overall comfort score as a simulated patient with a different gender teacher demonstrating the technologist role of 9.95/10.00 (N = 67). Comfort as an observer of MEM was again analyzed across each of the demographic factors to determine any influence on overall comfort score for this role. Examining each of the demographic factors in relation to comfort as an observer of MEM follows.

Gender. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the genders when observing MEM. Comfort scores differed between groups of "male" (n = 12), "female" (n = 54), and "neither" (n = 1) gender groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between gender groups, $\chi^2(3) = 1.180$, $p = .554$ (see Table 56).

Table 56

Kruskal-Wallis Test Among Comfort Scores as Observer of MEM Across Gender Categories

Variable	Gender	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
	Male	12	31.33		
Comfort as an observer	Female	54	34.54	1.180	.554
	Neither	1	37.00		

Age. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across age groups when observing MEM (N = 67). Comfort scores ranged from

8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00). Results demonstrated a statistically significant difference between the age groups, $\chi^2(3) = 14.264$, $p = .047$ (see Table 57).

Table 57

Kruskal-Wallis Test Among Comfort Scores as Observer of MEM Across Age

Variable	Age Group	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
	18-22	39	32.77		
	23-27	17	37.00		
	28-32	3	37.00		
	33-37	2	37.00		
	38-42	2	37.00		
Comfort as an observer	43-47	0	0	14.264	.047*
	48-52	2	37.00		
	53-57	0	0		
	58-62	0	0		
	63-67	1	37.00		
	68-72	1	2.00		

Note. * p<.05

Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed adjusted statistically significant differences in median comfort scores as an observer of MEM among 68-72 years age group with three age groups: 18-22 years ($p = .046$), 23-27 years ($p = .012$), and 28-32 years ($p = .047$). No other group combinations produced significant results. (see Figure 6).

Figure 6

SPSS Pairwise Comparison Output for Comfort Scores of Observer Role in MEM

Pairwise Comparisons of Comfort Scores Across Age

Age Group 1 - Age Group 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.*
68-72-18-22	30.744	9.774	3.145	.002	.046
68-72-23-27	35.000	9.931	3.524	.000	.012
68-72-28-32	35.000	11.144	3.141	.002	.047
68-72-33-37	35.000	11.820	2.961	.003	.086
68-72-38-42	35.000	11.820	2.961	.003	.086
68-72-48-52	35.000	11.820	2.961	.003	.086
68-72-63-67	35.000	13.649	2.564	.010	.289
18-22-23-27	-4.256	2.805	-1.518	.129	1.000
18-22-28-32	-4.256	5.782	-.736	.462	1.000
18-22-33-37	-4.256	6.997	-.608	.543	1.000
18-22-38-42	-4.256	6.997	-.608	.543	1.000
18-22-48-52	-4.256	6.997	-.608	.543	1.000
18-22-63-67	-4.256	9.774	-.435	.663	1.000
23-27-28-32	.000	6.044	.000	1.000	1.000
23-27-33-37	.000	7.215	.000	1.000	1.000
23-27-38-42	.000	7.215	.000	1.000	1.000
23-27-48-52	.000	7.215	.000	1.000	1.000
23-27-63-67	.000	9.931	.000	1.000	1.000
28-32-33-37	.000	8.810	.000	1.000	1.000

28-32-38-42	.000	8.810	.000	1.000	1.000
28-32-48-52	.000	8.810	.000	1.000	1.000
28-32-63-67	.000	11.144	.000	1.000	1.000
33-37-38-42	.000	9.651	.000	1.000	1.000
33-37-48-52	.000	9.651	.000	1.000	1.000
33-37-63-67	.000	11.820	.000	1.000	1.000
38-42-48-52	.000	9.651	.000	1.000	1.000
38-42-63-67	.000	11.820	.000	1.000	1.000
48-52-63-67	.000	11.820	.000	1.000	1.000

Note. Each row tests the null hypothesis that the Age Group 1 and Age Group 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

* Significance values have been adjusted by the Bonferroni correction for multiple tests.

Religion. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the different groups of religion when observing MEM (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00). Median comfort scores were not statistically significantly different between religion groups, $\chi^2(3) = 9.241$, $p = .236$ (see Table 58).

Table 58

Kruskal-Wallis Test Among Comfort Scores as Observer of MEM Across Religion

Variable	Religion	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as an observer	Christian	26	35.31	9.241	.236
	Catholic	15	29.73		
	Mormon	3	26.17		
	Jehovah's Witness	0	0		
	Orthodox	0	0		
	Jewish	0	0		
	Muslim	2	36.50		
	Buddhist	0	0		
	Hindu	0	0		
	Other	0	0		
	Nothing in particular	11	36.50		
	Prefer Not to Answer	3	25.00		
	Atheist	3	36.50		
	Agnostic	3	36.50		

Outlook. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the outlooks when observing MEM (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between outlook groups, $\chi^2(3) = 1.444$, $p = .695$ (see Table 59).

Table 59

Kruskal-Wallis Test Among Comfort Scores as Observer of MEM Across Outlook

Variable	Outlook	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as an observer	More Conservative than Average	12	34.38	1.444	.695
	Within the Range of Average Conservative/Liberal Outlook	30	34.75		
	More Liberal than Average	14	34.57		
	Prefer Not to Answer	11	30.82		

BMI. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the BMI categories when observing MEM (*N* = 59). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between BMI groups, $\chi^2(3) = 4.402$, $p = .221$ (see Table 60).

Table 60

Kruskal-Wallis Test Among Comfort Scores as Observer of MEM Across Body Mass Index Categories

Variable	BMI Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as an observer	Underweight	2	32.50	4.402	.221
	Healthy Weight	31	30.60		
	Overweight	14	26.18		
	Obese	12	32.50		

Preferred Group Composition. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the preferred MEM group categories when observing MEM (N = 67). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00 /10.00 to 10.00/10.00 for this category (*Mdn* = 10.00) but the differences were not statistically significant between the various groups, $\chi^2(3) = 1.563$, $p = .668$ (see Table 61).

Table 61

Kruskal-Wallis Test Among Comfort Scores as Observer of MEM Across Preferred Group Composition Categories

Variable	Preferred Group Composition	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Comfort as an observer	Self-Assembled	5	37.00	1.563	.668
	Mixed-Gender	8	37.00		
	Same-Gender	8	33.06		
	No Preference	46	33.32		

Length of Exposure to MEM. A Kruskal-Wallis H test was conducted to determine if there were differences in comfort scores across the length of exposure to MEM group categories when observing MEM (N = 66). Comfort scores differed between the various groups. Distributions of comfort scores were similar for all groups as assessed by visual inspection of a boxplot. Comfort scores ranged from 8.00/10.00 to 10.00/10.00 for this category (*Mdn* = 10.00). Results demonstrated a statistically significant difference between the groups, $\chi^2(3) = 31.460$, p = .005 (see Table 62).

Table 62

Kruskal-Wallis Test Among Comfort Scores as an Observer in MEM Across Length of Program Completed

Variable	Length of Program Completed (Months)	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
	0-3	6	36.50		
	4-6	5	23.40		
	7-9	9	36.50		
	10-12	3	36.50		
	13-15	8	36.50		
	16-18	6	30.92		
	19-21	8	32.63		
Comfort as an observer	22-24	6	36.50	31.460	.005*
	25-28	3	36.50		
	29-31	1	36.50		
	32-34	3	36.50		
	35-38	3	36.50		
	39-41	1	36.50		
	42-44	2	2.50		
	45-48	2	36.50		

Note. *p < .05

Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed adjusted statistically significant differences in median comfort scores as an observer of MEM among reported length of program completed of 42-44 months with eleven other groups including: 0-3 months (p = .001), 7-9 months (p = .001), 10-12 months (p = .011), 13-15 months (p = .001), 16-18 months (p = .029), 19-21 months (p = .007), 22-24 months (p = .001), 25-28 months (p = .011), 32-34 months (p = .011), 35-38 months (p = .011) and 45-48 months (p = .040). No other group combinations produced significant results. (see Figure 7).

Figure 7

SPSS Pairwise Comparison Output for Comfort Scores of Observer Role in MEM

Pairwise Comparisons of Length of Program Completed (in Months)

Month category 1 - Month category 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.*
42-44 months-0-3 months	34.000	7.816	4.350	.000	.001
42-44 months-4-6 months	20.900	8.010	2.609	.009	.952
42-44 months-7-9 months	34.000	7.484	4.543	.000	.001
42-44 months-10-12 months	34.000	8.739	3.891	.000	.011
42-44 months-13-15 months	34.000	7.568	4.492	.000	.001
42-44 months-16-18 months	28.417	7.816	3.635	.000	.029
42-44 months-19-21 months	30.125	7.568	3.980	.000	.007
42-44 months-22-24 months	34.000	7.816	4.350	.000	.001
42-44 months-25-28 months	34.000	8.739	3.891	.000	.011
42-44 months-29-31 months	34.000	11.725	2.900	.004	.392
42-44 months-32-34 months	34.000	8.739	3.891	.000	.011
42-44 months-35-38 months	34.000	8.739	3.891	.000	.011
42-44 months-39-41 months	34.000	11.725	2.900	.004	.392
42-44 months-45-48 months	-34.000	9.573	-3.552	.000	.040

Note. *p < .05

Demographic Factors Influence on Radiologic Technology Students' Perceptions of MEM

Similar to the demographic factors influence on radiologic technology students' comfort level with MEM, the perception score of MEM was used to examine differences across any of the demographic factors under examination. In examining the perception scores, the skewness and kurtosis revealed that parametric testing was not appropriate. The researcher again utilized the nonparametric equivalent to the ANOVA of a Kruskal-Wallis H test to examine the student perception across the various demographic factors.

Demographic Factors

Gender. Survey responses yielded 12 male and 54 female participants with 1 participant not identifying as either male or female. Overall mean perception score across gender varied between 2.25 to 4.00/4.00. Male perception was 3.24/4.00 while female perception was 3.47/4.00. The respondent who did not identify as either male or female had a mean perception score of 3.63/4.00. Median perception scores across gender revealed no statistically significant differences between the groups, $\chi^2(2) = .734$, $p = .693$ (see Table 63).

Table 63

Kruskal-Wallis Test Among Perception Score of MEM Across Gender

Variable	Gender	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Perception Score of MEM Across Gender	Male	12	29.42	.734	.693
	Female	54	34.95		
	Neither	1	37.50		
	Total	67			

Age. Individual responses were coded and divided among 4-year increments. Overall mean perception score across age varied between 2.25 to 4.00/4.00. The majority of participants indicated their age to be within the first two categories of 18-22 (n = 39) and 23-27 (n = 17). The remaining 11 participants were spread amongst the remaining age categories up through the 68-

72 category (n = 1) with no participants within the in the 43-47, 53-57, 58-62, or any age category above 72. The age category of 68-72 had the lowest perception score (2.25) while the category of 48-52 and 63-67 had the highest perception (3.75). Perception scores varied between the groups. Comparing the medians across the different age groups yielded no significant differences $\chi^2(7) = 9.267$, $p = .234$ (see Table 64).

Table 64

Kruskal-Wallis Test Among Perception Score of MEM Across Age

Variable	Age Group	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
	18-22	39	35.59		
	23-27	17	32.35		
	28-32	3	29.83		
	33-37	2	28.25		
	38-42	2	14.25		
Perception Score of MEM Across Age	43-47	0	0	9.267	.234
	48-52	2	54.50		
	53-57	0	0		
	58-62	0	0		
	63-67	1	54.50		
	68-72	1	2.00		

Religion. Of the religious category selections available on the survey, only 8 were selected by participants. Overall mean perception score across religious groups varied between 2.25 to 4.00/4.00. The majority of participants selected "Christian" while "Catholic" and "Nothing in Particular" were the next most popular choices. Comparing the medians across the different religions yielded a statistically significant result $\chi^2(7) = 18.205$, $p = .011$ (see Table 65).

Table 65

Kruskal-Wallis Test Among Perception Score of MEM Across Religion

Variable	Religion	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Perception Score of MEM Across Religion	Christian	26	34.96	18.205	.011*
	Catholic	15	35.77		
	Mormon	3	53.50		
	Jehovah's Witness	0	0		
	Orthodox	0	0		
	Jewish	0	0		
	Muslim	2	8.25		
	Buddhist	0	0		
	Hindu	0	0		
	Other	0	0		
	Nothing in particular	11	30.55		
	Prefer Not to Answer	3	6.67		
	Atheist	3	24.00		
	Agnostic	3	53.50		

Pairwise comparisons were performed using Dunn's (1964) procedure. Significance values were adjusted with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed no specific adjusted statistically significant differences in median perception scores of MEM among the various categories of religion (see Figure 8). Similar to what occurred with comfort scores among simulated patient and technologist of same gender, the Bonefroni correction may have been conservative given the small sample sizes in some of these groups under investigation. Looking back at the initial mean ranks of the data, it is clear that both “Muslim” and “Prefer not to Answer” categories had a much lower mean ranks included in the perception score as well as much lower number of respondents which may be causing variances in significance calculations while “Agnostic” and “Mormon” categories had much higher mean ranks along with a lower number of respondents. These factors combined may be used to explain why some of these initial significance levels increased with the Bonferroni correction.

Figure 8

SPSS Pairwise Comparison Output for Comfort Scores of MEM Across Religion

Pairwise Comparisons of Perception Scores Across Religion					
Religion 1 – Religion 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.*
Prefer Not to Answer-Muslim	1.583	17.028	.093	.926	1.000
Prefer Not to Answer-Nothing in Particular	-17.333	15.231	-1.138	.255	1.000
Prefer Not to Answer-Atheist	23.879	12.150	1.965	.049	1.000
Prefer Not to Answer-Christian	28.295	11.374	2.488	.013	.360
Prefer Not to Answer-Catholic	29.100	11.798	2.467	.014	.382
Prefer Not to Answer-Mormon	46.833	15.231	3.075	.002	.059
Prefer Not to Answer-Agnostic	-46.833	15.231	-3.075	.002	.059
Muslim-Nothing in Particular	-15.750	17.028	-.925	.355	1.000
Muslim-Atheist	-22.295	14.339	-1.555	.120	1.000

Muslim-Christian	26.712	13.688	1.951	.051	1.000
Muslim-Catholic	27.517	14.042	1.960	.050	1.000
Muslim-Mormon	45.250	17.028	2.657	.008	.221
Muslim-Agnostic	-45.250	17.028	-2.657	.008	.221
Nothing in Particular-Christian	6.545	12.150	.539	.590	1.000
Atheist-Christian	10.962	11.374	.964	.335	1.000
Nothing in Particular-Catholic	11.767	11.798	.997	.319	1.000
Atheist-Catholic	29.500	15.231	1.937	.053	1.000
Nothing in Particular-Mormon	-29.500	15.231	-1.937	.053	1.000
Atheist-Mormon	4.416	6.709	.658	.510	1.000
Nothing in Particular-Atheist	5.221	7.405	.705	.481	1.000
Nothing in Particular-Agnostic	22.955	12.150	1.889	.059	1.000
Atheist-Agnostic	-22.955	12.150	-1.889	.059	1.000
Christian-Catholic	-.805	6.048	-.133	.894	1.000
Christian-Mormon	-18.538	11.374	-1.630	.103	1.000
Christian-Agnostic	-18.538	11.374	-1.630	.103	1.000
Catholic-Mormon	-17.733	11.798	-1.503	.133	1.000
Catholic-Agnostic	-17.733	11.798	-1.503	.133	1.000
Mormon-Agnostic	.000	15.231	.000	1.000	1.000

Note. Each row tests the null hypothesis that the Religion 1 and Religion 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

* Significance values have been adjusted by the Bonferroni correction for multiple tests.

Outlook. Participant responses based upon general outlook were divided amongst the categories of more conservative than average (*n* = 12), within the range of average conservative/liberal (*n* = 30), more liberal than average (*n* = 14), and prefer not to answer (*n* = 11). Perception scores ranges from 2.25 to 4.00/4.00. No significant differences were found amongst the medians $\chi^2(7) = 4.130$, $p = .248$ (see Table 66).

Table 66

Kruskal-Wallis Test Among Perception Score of MEM Across Outlook

Variable	Outlook	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Perception Score of MEM Across Outlook	More Conservative than Average	12	36.88	4.130	.248
	Within the Range of Average Conservative/Liberal Outlook	30	35.53		
	More Liberal than Average	14	36.54		
	Prefer Not to Answer	11	23.45		

BMI. Only 59 participants provided appropriate data to be able to calculate the BMI. Participants ranged across all four categories used in this study: “underweight” (*n* = 2), “healthy weight” (*n* = 31), “overweight” (*n* = 14), and “obese” (*n* = 12). Perception scores ranges from 2.25 to 4.00/4.00. Comparing the medians across the different BMI categories yielded a statistically significant result $\chi^2(3) = 9.138$, $p = .028$ (see Table 67).

Table 67

Kruskal-Wallis Test Among Perception Scores of MEM Across Body Mass Index Categories

Variable	BMI Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Perception Score of MEM Across BMI Categories	Underweight	2	41.00	9.138	.028*
	Healthy Weight	31	34.03		
	Overweight	14	18.64		
	Obese	12	31.00		

Note. * p<.05

Pairwise comparisons were performed using Dunn's (1964) procedure. Significance values were adjusted with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed an adjusted statistically significant difference in median perception scores of MEM between the categories of "overweight" and "healthy weight" (see Figure 9).

Figure 9

SPSS Pairwise Comparison Output for Perception Scores of MEM Across BMI

Pairwise Comparisons of Perception Scores Across Religion					
BMI Category 1 – BMI Category 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.*
Overweight – Obese	-12.357	6.589	-1.875	.061	.364
Overweight – Healthy Weight	15.389	5.393	2.853	.004	.026
Overweight- Underweight	22.357	12.662	1.766	.077	.465
Obese – Healthy Weight	3.032	5.695	.532	.594	1.000
Obese - Underweight	10.000	12.793	.782	.434	1.000
Healthy Weight - Underweight	6.968	12.220	.570	.569	1.000

Note. Each row tests the null hypothesis that the BMI Category 1 and BMI Category 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Note. * Significance values have been adjusted by the Bonferroni correction for multiple tests ($p < .05$).

Preferred group composition. The majority of participants ($n = 46$) had no preference for MEM group composition. Remaining participants were pretty evenly divided amongst desire for same gender groups ($n = 8$), mixed gender groups ($n = 8$), or self-selected groups ($n = 5$). The overall mean perception score with this demographic factor yielded a result range of 2.25 to 4.00/4. There was no significant difference amongst the groups for perception score $\chi^2(3) = 1.704$, $p = .636$ (see Table 68).

Table 68

Kruskal-Wallis Test Among Perception Scores of MEM Across Preferred Group Composition Categories

Variable	Preferred Group Composition Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Perception Score of MEM Across Preferred Group Composition	Self-Assembled	5	40.80	1.704	.636
	Mixed Gender	8	32.00		
	Same Gender	8	27.63		
	No Preference	46	34.72		

Length of exposure to MEM. A Kruskal-Wallis H test was conducted to determine if there were differences in perception scores across the length of exposure to MEM group categories (*N* = 66). Perception scores differed between the various groups. Distributions of perception scores were similar for all groups as assessed by visual inspection of a boxplot. Perception scores ranged from 2.25/4.00 to 4.00/4.00 for this category (*Mdn* = 3.63/4.00) but the differences were not statistically significant between the various groups, $\chi^2(3) = 12.606$, $p = .558$ (see Table 69).

Table 69

Kruskal-Wallis Test Among Perception Scores of MEM Across Length of Exposure to MEM Categories

Variable	Length of Exposure (in Months) Category	N	Mean Rank	Kruskal-Wallis Chi-square	Sig.
Perception Score of MEM Across Length of Exposure to MEM	0-3	6	35.33	12.606	.558
	4-6	5	26.60		
	7-9	9	24.89		
	10-12	3	15.83		
	13-15	8	32.63		
	16-18	6	31.83		
	19-21	8	31.88		
	22-24	6	31.67		
	25-28	3	42.67		
	29-31	1	37.50		
	32-34	3	33.67		
	35-38	3	45.00		
	39-41	1	27.00		
	42-44	2	29.50		
	45-48	2	60.00		

Difference Among Comfort Levels with MEM and Role Participation

To examine the differences among the comfort levels of medical educational modeling and role participation, the researcher utilized the calculated comfort scores for each of the seven different role and gender questions in section one of the survey to evaluate for any significant differences. The researcher examined the independent variables of role of the participant and the peer or teacher gender with the dependent variable of comfort score for each question.

Results

The comfort scores reported for role and gender demonstrated asymmetric distribution. This again made a parametric paired sample *t*-test inappropriate for this analysis. Therefore, the researcher elected to perform a Wilcoxon signed-rank test to analyze the differences among gender related to role participation and comfort level. Results indicate significant differences among the roles and gender of learning partner as simulated patient ($z = -4.60$, $p < .001$), simulated technologist ($z = -4.59$, $p < .001$), and as a patient for teacher of either gender ($z = -3.79$, $p < .001$) (see Table 70).

Table 70

Wilcoxon-Signed Rank Test Among Comfort Scores of MEM Across Roles and Gender in MEM Categories

	Negative Ranks			Positive Ranks			Test Statistics		
Role	*n*	Mean rank	Sum of ranks	*n*	Mean rank	Sum of ranks	Ties	*z*	*p*
Simulated patient role with same gender peer as simulated technologist to simulated patient role with different gender peer as simulated technologist	29	18.53	537.5	4	5.88	23.5	34	-4.599	.000*
Simulated technologist role with same gender peer as simulated patient to simulated technologist role with different gender peer as simulated patient	29	16.6	481.5	2	7.25	14.5	36	-4.585	.000*
Simulated patient role with same gender teacher as simulated technologist to simulated patient role with different gender teacher as simulated technologist	25	15.7	392.5	4	10.63	42.5	38	-3.790	.000*

Note. $*p<.05$

When examining the role of observer in comparison to any role or gender combination, significant differences were found between the comfort scores of observing examinations being performed on any group composition of genders and roles: observer to simulated patient with same gender peer as technologist (z = -3.94, p < .001), observer to simulated patient with different gender peer in technologist role (*z* = -4.98, *p* < .001), observer to technologist role with same gender peer as patient (*z* = -2.99, *p* < .001), observer to technologist role with different gender peer as patient (*z* = -4.80, *p* < .001), observer to peer being patient for teacher of same gender (*z* = 3.29, *p* = .001), and observer to peer being patient for teacher of different gender (*z* = -4.81, *p* < .001) (see Table 71).

Table 71

Summary of Wilcoxon Signed Rank Test Results in Comfort Scores as an Observer to Each Simulation

	Negative Ranks			Positive Ranks			Test Statistics		
Simulation Observation	*n*	Mean rank	Sum of ranks	*n*	Mean rank	Sum of ranks	Ties	*z*	*p*
Simulated patient role with simulated technologist of same gender	26	14.46	376.00	2	15.00	30.00	39	-3.943	.000*
Simulated patient role with simulated technologist of different gender	38	19.64	746.50	1	33.50	33.50	28	-4.978	.000*
Simulated technologist role with same gender peer as patient	17	9.94	169.00	2	10.50	21.00	48	-2.985	.003*
Simulated technologist role with different gender peer as patient	36	18.58	669.00	1	34.00	34.00	30	-4.796	.000*
Simulated Patient with Teacher of Same Gender	19	11.05	210.00	2	10.50	21.00	46	-3.291	.001*
Simulated Patient with Teacher of Different Gender	36	18.61	670.00	1	33.00	33.00	30	-4.810	.000*

Note. *$p<.05$

Relationship Between Perception of MEM and Role Participation

The researcher planned to examine the relationship between perception of medical educational modeling and role participation using participant calculated comfort score in the various roles from section one of the survey and the calculated perception score from section two of the survey. In correlational tests, there is not an independent variable (Price et al., 2017); rather, there are only dependent variables. The dependent variables were the comfort score from each of the roles identified in section one and the perception score from section two of the survey.

Results

Due to the skewedness of the data set, the Pearson *r* correlation was deemed no longer appropriate and a nonparametric equivalent of Spearman rank-order (r_s) was conducted to determine relationship between perception of medical educational modeling and role participation (Astivia & Zumbo, 2017). The Spearman's rank-order correlation was run to assess the relationship between student perception of MEM and the comfort score in the various roles of MEM. There were a total of 67 respondents for this section of the survey. Visual assessment of scatter plots across the various roles indicated a monotonic relationship for all roles. There was a statistically significant, strong positive correlation between perception of MEM and comfort score as a simulated technologist with a different gender peer as simulated patient, $r_s(67) = .317$, $p < .05$. There was also a statistically significant, moderate positive correlation between perception of MEM and comfort score in the role of simulated technologist with same gender peer ($r_s(67) = .254$, $p < .05$) and in the role as patient for instructor of a different gender ($r_s(67) = .312$, $p < .05$). There was no statistically significant correlation between perception score of

MEM and comfort score in the role of simulated patient with either same gender or different gender peer as simulated technologist, the role of patient for instructor of the same gender, or in the role of observer (see Table 72).

Table 72

Correlations of Perception Score and Comfort Score in Various Roles of MEM

	Perception of Medical Educational Modeling in Each Role	
Comfort of MEM in Each Role	r_s	*p*
Comfort as simulated patient with same gender peer as simulated technologist	.015	.902
Comfort as simulated patient with different gender peer as simulated technologist	.070	.576
Comfort as simulated technologist with same gender peer as simulated patient	.254	.038*
Comfort as simulated technologist with different gender peer as simulated patient	.317	.009*
Comfort as simulated patient for same gender teacher	.103	.405
Comfort as simulated patient for different gender teacher	.312	.010*
Comfort as observer of MEM	.095	.443

*$p<0.05$

Limitations and Delimitations

Limitations of this study included survey access, sampling, and response rate. The researcher did not have access to the approximate 3,000 JRCERT-accredited bachelor's degree programs' radiologic technology student email addresses to directly recruit individual participants and had to rely upon program chairs to forward recruitment communication from the researcher to their respective students. This may have significantly limited the number of available participants' access to the survey. The researcher chose to use purposive sampling, which is a form of nonrandom sampling, presenting the limitation of the inability to potentially generalize the results beyond the group of participants at the specific time of survey completion. While bachelor's degree radiologic technology students were the intended population for the survey, other imaging modalities within imaging sciences, such as diagnostic medical sonography or magnetic resonance imaging, may have also been part of the bachelor's degree programs surveyed with similar characteristics to radiologic technology students. Additionally, due to the nature of online surveys, response rates were expected to be low, further limiting the study's generalizability across the entire population.

Delimitations for this study included limiting the study to bachelor's degree radiologic technology program students, only those students enrolled in JRCERT-accredited programs, and those radiologic technology programs that utilize MEM as a pedagogical practice. While the researcher is concerned with bachelor's degree radiologic technology students, there are currently 608 JRCERT-accredited radiography programs in the United States with only 50 accredited at the baccalaureate level (Joint Review Committee on Education in Radiologic Technology, 2019). While JRCERT is the most widely used accrediting body for radiologic technology educational programs, there are additional accreditation mechanisms for schools besides the JRCERT so not all radiologic technology bachelor's degree students may have been included in this study. Additionally, not all JRCERT-accredited bachelor level radiologic technology programs utilize MEM within their curriculum. As this research study's focus is on the pedagogical practice of MEM, those schools which do not use this pedagogy were excluded by way of the program chair not forwarding the survey link onto students.

Conclusion

The full study for this dissertation sought to explore student perceptions and comfort levels with the pedagogical practice of MEM within JRCERT accredited bachelor's degree radiologic technology programs in the United States. The associated pilot study detailed previously sought to evaluate a newly created SPMEM survey tool for use in this formal dissertation research study that addressed the continuation of the longstanding practice of utilizing MEM within radiologic technology education. Literature suggests that not all students are comfortable with this practice even though educators can realize the ultimate benefit to the students' education.

The full study provided analyses of quantitative statistics for the research questions related to student perceptions and comfort level with MEM as part of their educational curriculum. These results may be beneficial to the educational practice of MEM. Reflection and consideration should be given to the significant findings of this study.

Chapter 5: Conclusion

The purpose of this quantitative research study was to examine the perception and comfort levels of radiologic technology students participating in medical educational modeling (MEM) as part of their educational programs in Joint Review Committee on Education in Radiologic Technology (JRCERT) accredited bachelor-level radiography programs in the United States. This chapter discusses major findings of the research study related to the literature on the educational practice of medical educational modeling from a student perspective. The discussion includes perceptions and comfort levels with MEM across various roles and demographic factors involved with the practice. This chapter also highlights possible implications for the continuation of this practice. The chapter concludes with a discussion of study limitations and ideas for future research. This chapter focuses on discussion related to answering the following research questions:

1. What are radiologic technology students' perceptions of the MEM experience as a pedagogical practice?
2. What are radiologic technology students' comfort levels with MEM?
3. What demographic factors influence radiologic technology students' comfort levels of MEM?
4. What demographic factors influence radiologic technology students' perceptions of MEM?
5. Is there a difference between roles a radiologic technology student participates in the MEM experience and comfort level with MEM?

6. Is there a relationship between roles a radiologic technology student participates in MEM experience and perceptions of MEM?

As multiple studies focused on MEM in medical and health profession fields demonstrated significant differences among gender and roles of participants in MEM, this study sought to examine not only overall perception of the practice but comfort level with the practice across multiple demographic factors specifically related to the field of imaging sciences (Chang & Power, 2000; Chen et al., 2011; Power & Center, 2005; Rees et al., 2005; Reid et al., 2012; Vaughan & Grace, 2016; Wearn et al., 2013). The majority of studies previously conducted related to the practice of MEM are focused on medical education and not related specifically to many of the allied health fields, such as imaging sciences (Grace, et al., 2019). This study sought to fill in the gaps within the literature for the hands-on profession of imaging sciences.

Student Perceptions of MEM

Student perception of MEM was an important factor to consider within this study. In particular, the overall perception, influence of various demographic factors, and how the perception may have changed across various roles involved in MEM was of importance to understanding the student perspective. Student perceptions of the practice of MEM can affect student performance in the laboratory setting and overall learning outcomes for students (Consorti, et al., 2013, Vaughan & Grace, 2016).

Research Question 1: Overall Perceptions

The pedagogical practice of MEM as viewed by students within JRCERT accredited bachelor's degree radiologic technology programs across the United States was positive overall. These results are similar to other findings in the literature (Braunack-Mayer, 2001; Chinnah, et al., 2011; Das, et al., 1998; Hendry, 2013; Hilton & Barrett, 2009). Specifically, similar to Vaughan and Grace (2016), students' perceptions of MEM improved with longer exposure to the pedagogical practice. Multiple comments submitted on the benefits of MEM align with findings of Vaughan and Grace (2016), Wearn and Vnuk (2005), Wearn and Bhoopatkar (2006), and Wearn et al. (2008) in that MEM provides perspective and understanding on the patient perspective in practice.

Research Question 4: Demographic Factors of Influence on Perception

This study examined multiple demographic factors and found that specific factors of gender and role can be strongly correlated to positive perceptions of MEM. This was in conflict with some literature stating that gender may have a negative impact on student perception of MEM (Barnette, et al., 2000, O'Neill, et al., 1998; Taylor & Shulruf, 2016, Vnuk & Wearn, 2017). However, similar to Power and Center (2005) and Rees (2007), age may play a factor in the perception of MEM although statistical significance was not found in this study.

Religious affiliation did provide an area of statistical significance when examining perception. However, post hoc analysis yielded no significant differences most likely due to the low number of participants within certain categories when compared with other categories and the conservative measures assumed by the nonparametric testing (VanderWeele & Mathur, 2019). Chinnah et al. (2011) support this notion of lack of significance among religious affiliation of participants. Additionally, Grace et al. (2013) go on to further elaborate that students entering into the health disciplines may present with a preconceived notion that MEM will be part of the curriculum within Western cultures and is therefore accepted regardless of held belief systems. Hendry (2013) also explains that religion as a demographic factor of influence on perception may be dependent upon each individual's interpretation of associated religious doctrine. Consideration should also be given to the fact that this study elicited participants from within the United States. Rees et al. (2009b) contends that when students are from a more diverse area such as the United States with its increasing diversity among the general population, some of the typical stereotypes that may be noted about specific religions no longer hold true.

Another area of significance in terms of perception of MEM was related to participants' BMI. Contradicting results found in the literature, this study demonstrated a significant difference in perception of MEM across BMI categories of "healthy weight" and "overweight" (Burgraff et al., 2018). For participants calculated in the "overweight" category of BMI, perception scores were lower overall compared to other categories. With the imaging sciences being a highly female dominant profession, Rees et al. (2009b) notes that the rationale behind this finding may be related to females being less comfortable with individual perceptions of body image.

Group composition related to perception within MEM was also examined within this study. While multiple research studies present the idea that students' perception of MEM may be altered based on group composition (e.g. whether they get to select their partners or the teacher selects them and whether they are mixed gender or same gendered groupings), the vast majority had no preference how groups were formed in this study (Burgraff, et al., 2018; Power & Center, 2005; Rees et al., 2009a; Rees et al., 2009b; Taylor & Shulruf, 2016). Likewise, length of exposure to MEM produced no statistical difference in perception which contradicted earlier studies related to perceptions of MEM over time (Rees et al., 2009b).

Research Question 6: Perception and Roles in MEM

Similar to Hendry (2013), Hilton & Barrett (2009), and O'Neill, et al. (1998), this study found that students agreed with the notion of participating in MEM to gain the patient perspective of imaging. While Chen et al. (2011) found that males did not always perceive MEM in a positive light due to the nature of being almost forced into volunteering, this study found no significant difference among gender related to perception and roles in MEM. Similar to Rees, et al. (2009a) and Barnette et al. (2000), some submitted comments alluded to the difference between student relationships compared to that of patient and technologist relationships. This factor may cause a discomfort with the practice of MEM (Rees, et al., 2009a; and Barnette et al., 2000).

Student Comfort with MEM

Student comfort level with MEM was also an important factor to consider within this study. Comfort level was examined not only from an overall perceptive but also among the various demographic factors and how comfort levels may have changed in various roles undertaken within MEM. Similar to student perception levels of MEM, student comfort levels within the practice of MEM can also affect student performance in the laboratory setting and overall learning outcomes for students (Consorti, et al., 2013, Vaughan & Grace, 2016).

Research Question 2: Overall Comfort

While some of the literature expressed discomfort with the practice of MEM, this study revealed overall positive comfort levels with the pedagogical practice (Chen, et al., 2011; Das, et al., 1998; Grace, et al., 2017; Grace, et al., 2019; Hendry, 2013; Hilton & Barrett, 2009; O'Neill, et al., 1998; Pols, et al, 2013; Power & Center, 2005; Rees, et al., 2009b; Rees, et al., 2005;

Vnuk, et al., 2017; Wearn, et al., 2008). There are multiple demographic factors to consider when examining comfort levels with MEM from a student perspective. Additionally, consideration should also be given to correlations between comfort levels and the various roles undertaken as part of MEM.

Research Question 3: Demographic Factors of Influence on Comfort Levels

When reviewing the various demographic factors associated with comfort of MEM, this study examined gender, age, religion, outlook, BMI, and length of exposure to MEM as a pedagogical practice. Only three of these demographic factors were statistically significant in any combination of roles under examination. While some literature suggests gender of role participants to be a key factor in determining comfort levels with the practice of MEM, this study did not reveal this as a significant finding (Barnette, et al., 2000; Taylor & Shulruf, 2016; Vnuk, et al., 2017).

Similar to Burgraff et al. (2018), Hilton and Barrett (2009), Rees, et al. (2009a), and Reid, et al. (2012), a significant difference among the factor of religious affiliation was demonstrated, but only in the role of simulated patient with same gender peer as simulated technologist. The other remaining role and gender combinations aligned with other findings that religion in MEM was not a significant factor for consideration (Chinnah, et al., 2011; Grace et al., 2019; Rees, et al., 2009b). This finding indicates that there may be additional variables that influence religion as a factor in comfort level with MEM as suggested by Hendry (2013).

Age and length of exposure were also significant factors in comfort levels within MEM among the various roles, particularly with examining the role of observer to other roles as a simulated patient or simulated technologist in the various role and gender combinations. Comfort levels were much higher in the role of observation only compared to actual participation in the process of MEM as either a simulated patient or simulated technologist. This finding supports findings of Martineau, et al. (2013) that observation of MEM prior to conducting MEM can result in a greater comfort level and positive learning gains.

Even though some of the literature suggests that age has no bearing on comfort level with MEM, some studies suggested that age would be a significant factor; especially across multiple role and gender combinations (Chinnah, et al., 2011; Power & Center, 2005; Rees, et al., 2009b). Similar to the finding of Rees (2007), this study did find that older females were more uncomfortable with MEM overall but this result did not yield significance. Likewise, both younger and older males under examination for this study did not yield a significant difference in comfort levels among various roles as found in Power and Center (2005).

Length of exposure to MEM has been shown to impact comfort levels with the pedagogical practice in that the longer students are exposed to MEM, the more comfortable they become with it as a practice (Outram & Nair, 2008; Tolsgaerd, et al., 2014; Vaughan & Grace, 2016; Vnuk, et al., 2017). While this study showed a significant difference among the longer exposure to MEM category compared to that of shorter exposure to MEM groups, this finding is most likely the result of consistency among the mean ranks affecting the H statistic in calculation of significance (Chan & Walmsley, 1997).

Research Question 5: Comfort Levels and Roles in MEM

When examining comfort levels with roles in MEM, overall comfort scores in each of the roles as simulated patient for either same gender peer or different gender peer in the simulated technologist role, simulated technologist with either a same gender peer or different gender peer in the simulated patient role, and as a simulated patient for a teacher of either the same gender or different gender demonstrating the technologist role for peers in MEM were compared to determine if comfort levels differed between the different roles assumed in MEM. Similar to several other studies, significant differences were found in these group compositions for MEM (Hilton & Barrett, 2009; Power & Center, 2005; Rees, et al, 2009a). While Chinnah, et al. (2011), Hendry, (2013), Hilton and Barrett, (2009), O'Neill, et al. (1998), Pols, et al. (2003), Power and Center (2005), Vaughan and Grace (2016), Wearn and Bhoopatkar (2006), Wearn et al. (2008), and Wearn and Vnuk (2005) contend that taking on the patient role may help students develop empathy for patient perspectives, this study found participants are not always comfortable in each of the roles utilized in MEM; especially when the roles involve peers of opposite genders or being utilized as a simulated patient for a teacher of either gender to demonstrate radiographic positioning. Barnette, et al. (2000) and Chen et al. (2011) emphasize this with their findings that some participants in MEM feel there is a distinct difference between the relationship with peers compared to that of what would be found in actual practice between a healthcare provider and patient. Specifically, Chen et al. (2011) note that gender of the examiner and examinee played a part in willingness to be examined within MEM and that some students felt pressured into being a model based upon their gender, making it a more uncomfortable experience.

Some studies have previously identified a desire among students within MEM to be able to select their own groups for learning (Power & Center, 2005; Rees et al., 2009a). While this allows for greater control over comfort level with the pedagogical practice, Taylor and Shulruf (2016) discourage self-selection as gender segregation may occur if students are left to laboratory group formation resulting in potential missed learning opportunities. This study found that the majority of participants had no preference for how MEM groups were determined. Additionally, while not explicitly discussed within the findings of this research study, exams involving sensitive body regions such as “hip joint” were involved in the calculation of overall comfort scores as indicated in the initial wave analysis. These sensitive regions do impact the overall comfort level of MEM (Power & Center, 2005; Rees, et al, 2009a). Wearn and Vnuk (2005) support that these types of exams are important in MEM as it can help develop professionalism for students when dealing with sensitive regions of the body.

Major Findings

Through the use of a quantitative paradigm, this study identified several significant factors that influence student comfort levels and perceptions of MEM as noted previously. The strong positive correlation found between student perception of MEM and comfort level of MEM as a simulated technologist with a different gender peer as simulated patient was an interesting note. Previous studies concluded that gender and role should be considered in the design of MEM curriculum (Burgraff, et al., 2019; Barnette, et al., 2000; Chen et al., 2011). However, within this study related to the imaging sciences, students appear to have a positive perception of MEM when practicing with students of either gender in the simulated patient role.

The comfort level of MEM as measured by the SPMEM survey instrument did produce a significant finding in the role of simulated patient with same gender peer as simulated technologist across the variable of religion. Additionally, comfort level as an observer across the age and length of exposure to MEM variables as a pedagogical practice also demonstrated significance. This significance may not have been fully understood based upon population size indicating a need for further research.

Study Limitations

A major limitation of this study was the small sample size utilized for analysis (*N* = 67). While statistical analysis was utilized to demonstrate the validity of this small sample size, having a greater number of respondents may have produced different results. Another limitation that may be related to this small sample size was the skewedness of the data. The researcher had initially planned on utilizing parametric tests which may be considered more robust for interpreting findings but due to the skewedness of the data set, nonparametric testing was deemed more appropriate.

Some categories of demographics also had relatively small or non-existent sample sizes for representation of the group under examination. While statistical measures were followed to correct for these discrepancies, this could lead to potential bias in interpretation of the findings from this study. When examining the demographic factors for this study, it is important to note that not all potential demographic factors that may influence the practice of MEM were collected or analyzed for this study. Additionally, as the researcher had to rely on educators to forward the survey onto potential student participants, all student perceptions and comfort levels with the practice of MEM may not be represented within this study due to not having the survey forwarded for whatever reason.

The timing of the survey distribution and distribution method of electronic mail may have also played a factor in limiting the study population. As the study was conducted during a spring semester, many programs and students across the nation are preoccupied with other tasks related to program completion, graduation deadlines, and preparing for certification exams. These important tasks may have overshadowed the request for participants.

Another limitation of this study was that it only examined radiologic technology students. The imaging science profession has expanded rapidly over the last few decades resulting in numerous specialties within the field of imaging sciences that may have more or less hands-on approaches to imaging and MEM which could alter perceptions and comfort levels of MEM. Additionally, only JRCERT-accredited programs were initially contacted. While JRCERT is the most widely recognized accreditation agency for imaging science programs, other accreditation agencies exist for imaging science programs. Input from programs under these other types of accreditation agencies (or no accreditation), was not collected.

Finally, this study examined the research questions from a quantitative paradigm. While the results of this study can be helpful in addressing the practice of MEM, the qualitative perspective of MEM was not analyzed or discussed for this study. Understanding the "why" behind the numbers may potentially shed further light on the continued practice of MEM.

Implications for Practice

As this study sought to examine comfort and perception levels of students involved in MEM, consideration should be given to the demographic factors that produced significant differences in student perception and comfort level with MEM. In particular, examining student group composition in relation to genders involved, roles in MEM undertaken, and specifically age and religious beliefs of participants could be beneficial in ensuring a positive student experience in laboratory practice utilizing MEM. Also, while many of the demographic factors did not produce significant results within this study, it may be beneficial for educators to understand the influence these factors have had in other professions that utilize MEM. Educators could utilize this information to develop policies and guidance for students in the practice of MEM to ensure a conducive learning environment.

Ideas for Future Research

As the imaging science field continues to evolve, this study could be expanded with future research by repeating this study with another group of participants to further validate the findings of this study. This study could also be conducted with associate's degree level programs as they were excluded from this study in order to be able to more equitably compare results of the findings across the various variables utilized in the study with a more homogenous participant group. By expanding this study to include more participants, more data may be obtained to further understand the student dimension of MEM within imaging sciences.

This study could also be repeated to investigate other demographic factors that were not considered as part of this study. One key area that was not examined in this study was the practice of consent within MEM. Another factor that was not included within this study was examining relationships between participants' reported participation levels in MEM with comfort levels and perceptions of MEM.

This study collected comfort scores in the various genders and roles around specific regions of the body to create a calculated comfort score. The individual results of each of the body regions were used in descriptive results related to comfort score but these individual body region scores were not correlated specifically with comfort or perception scores. Understanding more into what specific procedures of the body lead to discomfort could be advantageous to curriculum design or potentially utilizing standardized patients for areas deemed sensitive by student feedback.

The validated survey instrument could be utilized to examine these same concepts of comfort and perception levels for students among various other professions. Other healthcare disciplines may utilize MEM in their training, such as nursing, occupational and physical therapy, or other allied health professions where patient care requires a high level of direct patient contact. Many fields within healthcare could potentially benefit from understanding student perception and comfort level with MEM.

As part of this study focused on the instructor's role and gender within MEM, another idea for future research would be to conduct a similar study focused on instructor comfort and perception level to further guide the practice of MEM in radiologic technology education. This information would be beneficial to imaging sciences programs across the nation in terms of course structure and guidelines for laboratory practice. This type of study may also help to define regulations and ethics for the educational practice of MEM for other professions beyond imaging sciences.

A final idea would be to correlate comfort levels or perception scores with overall academic or clinical performance. Ultimately the use of MEM is intended to prepare students to practice in a professional environment. Determining performance measurements within clinical education or even professional practice that could be correlated with comfort and perception levels of MEM would be beneficial in determining potential avenues for additional consideration and education in the preparation of future imaging professionals.

Conclusion

Student perception and comfort levels in imaging sciences with the long-standing practice of MEM are important factors to consider in curriculum design and execution. Through a single, cross-sectional survey design using quantitative methods, this study sought to fill in gaps in the literature related to radiologic technology students' perceptions about medical educational modeling and the students' perceptions and comfort levels with this practice across multiple demographic factors. While some of the literature suggests that this pedagogical approach may not be the best practice for today's students, this study revealed a general acceptance of the practice from the student perspective. With a few exceptions noted among specific demographic factors in certain roles of MEM, this study demonstrated a positive overall perception and strong comfort levels among the various roles associated with MEM.

Understanding the perspectives of students involved with MEM in terms of what they find comfortable and beneficial can guide educators to adapt educational strategies to meet the needs of their learners. When students feel comfortable within their educational setting, the transfer of knowledge and gains in learning can be positive. Consideration in pedagogical practice should be given to the various demographic factors noted in this study that influence student perception and comfort level with MEM.

Examination of student roles in MEM (*e.g.* whether the student participates as a simulated patient or takes on the role of the simulated technologist practicing on a peer), teacher involvement in the practice, and how students perceive this practice in terms of benefits and drawbacks could potentially enlighten educators across multiple disciplines on the utilization of peers within the same cohort for education modeling. Student comfort levels with MEM may potentially shift the thought process of continuing to teach in this manner simply because it has always been done this way. The information from this study is needed to critically evaluate the practice and potentially transform educational approaches to teaching essential skills requiring physical touch in the future.

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Appendices

Appendix A: Survey Use Permissions

Schmuck, Heather M

Subject: FW: Greeting from the USA Request for permission to use survey instrument

Begin forwarded message:

From: Fabrizio Consorti <fabrizio.consorti@uniroma1.it>
Date: April 23, 2020 at 11:35:22 AM CDT
To: "Cook, Joy A" <jacook3@usi.edu>
Subject: Re: Greeting from the USA Request for permission to use survey instrument

*** This message was sent from a non-USI address. Please exercise caution when responding, clicking on links or opening attachments. ***

Dear dr. Cook,
thank you for your interest in our research.
You can use our survey and modify it as for your needs, giving credits as usual. Knowledge exists to be used and shared ...

Greeting from Rome
:-)

Fabrizio Consorti

Il giorno gio 23 apr 2020 alle ore 18:05 Cook, Joy A <jacook3@usi.edu> ha scritto:

> Dear Dr. Consorti,
>
> Greetings from the United States. Our names are Joy A. Cook and Heather Schmuck, faculty of the Radiologic and Imaging Sciences program at the University of Southern Indiana (USI) in Evansville, IN, USA. We are also current Doctorate of Education students at USI. For our doctoral dissertation we are looking at the use of Peer Physical Examination (PPE) among radiography students and faculty. We are writing to gain permission to use your survey and modify the survey you created to explore the acceptability and value of the practice of PPE for our current research. Of course, we will be giving the appropriate credit for use of the survey. We look forward to your response or additional communication from you. Thank you for your time in advance.
>
> *Joy A. Cook*
>
> Joy A. Cook, MS, RT (R)(CT)(MR) ARRT
>
> Associate Professor, Chair & Program Director
>
> Radiologic and Imaging Sciences Program
>
> *Heather Schmuck*
>
> Heather Schmuck, MS, RT(R)
>
> Clinical Associate Professor and Clinical Coordinator,
>
> Radiologic and Imaging Sciences

Schmuck, Heather M

From: Paul Oneill <paul.oneill3@me.com>
Sent: Wednesday, May 6, 2020 12:06 PM
To: Cook, Joy A
Cc: Paul O'neill; Schmuck, Heather M
Subject: Re: Greeting from the USA Request for permission to use survey instrument

*** This message was sent from a non-USI address. Please exercise caution when responding, clicking on links or opening attachments. ***

Hi

At present, I am preoccupied with the Covid pandemic (with my clinical work) so sorry for the delay in responding. Yes, happy for you to use.

Regards

Paul O'Neill

On 30 Apr 2020, at 00:18, Cook, Joy A <jacook3@usi.edu> wrote:

From: Cook, Joy A
Sent: Thursday, April 23, 2020 11:08 AM
To: Paul.A.ONeill@manchester.ac.uk
Cc: Schmuck, Heather M <hmschmuck@usi.edu>
Subject: Greeting from the USA Request for permission to use survey instrument

Dear Dr. O'Neill,

Greetings from the United States. Our names are Joy A. Cook and Heather Schmuck, faculty of the Radiologic and Imaging Sciences program at the University of Southern Indiana (USI) in Evansville, IN, USA. We are also current Doctorate of Education students at USI. For our doctoral dissertation we are looking at the use of Peer Physical Examination (PPE) among radiography students and faculty. We are writing to gain permission to use your survey and modify the Examining Fellow Students survey for our current research. Of course, we will be giving the appropriate credit for use of the survey. We look forward to your response or additional communication from you. Thank you for your time in advance.

Joy A. Cook

Joy A. Cook, MS, RT (R)(CT)(MR) ARRT
Associate Professor, Chair & Program Director
Radiologic and Imaging Sciences Program
Office: HP 3066

Heather Schmuck

Heather Schmuck, MS, RT(R)
Clinical Associate Professor and Clinical Coordinator,
Radiologic and Imaging Sciences

University of Southern Indiana
8600 University Blvd.
Evansville, IN 47712

Appendix B: Student Perceptions and Considerations for Medical Educational Modeling (SPMEM) Survey Instrument

UNIVERSITY OF SOUTHERN INDIANA

Student Perceptions of Medical Educational Modeling

IRB 1708274

Informed Consent

Online or Web Based Survey

You are invited to participate in a research study on student perceptions and comfort levels with utilizing peers for simulated patient when learning radiographic positioning. This study is being conducted by Heather Schmuck from the University of Southern Indiana Educational Leadership Doctoral Student with Dr. Bonnie Beach as faculty sponsor. Heather Schmuck can be reached at HP3065, 8600 University Blvd. Evansville, IN 47712, hmschmuck@usi.edu, or 812-228-5066. Dr. Bonnie Beach can be reached at EC1104, 8600 University Blvd., Evansville, IN 47712, blbeach@usi.edu, or 812-465-1620. Additional questions can be directed to USI Office of Sponsored Projects & Research Administration 812-465-7000, rcr@usi.edu

This study will take approximately 15 minutes of your time. You will be asked to complete an online survey about your comfort level with various areas of the body being examined ***by*** you on another student or ***on*** you by another student or teacher.

Your decision to participate or decline participation in this study is completely voluntary and you have the right to terminate your participation at any time without penalty. Consent is implied when you begin the survey. You may skip any questions you do not wish to answer. If you do not wish to complete this survey simply do not proceed to the link or if started, simply close your browser.

Your participation in this research will be completely confidential. The benefit to participating in this survey is that your responses will be used to add to the knowledge of students' perspectives in the use of medical educational modeling as a pedagogical practice in radiographic procedures courses. There is a risk of participant discomfort in answering some of the survey questions. Participants have the option to skip questions. No individually identifiable information will be obtained as part of this survey. Responses will be presented in aggregate form. If a specific quote is taken from your response, a pseudonym will be used. No compensation will be awarded for participation in this study.

Please print a copy of this consent form for your records, if you so desire.

UNIVERSITY OF SOUTHERN INDIANA

Student Perceptions of Medical Education Modeling (SPMEM) Survey

Imaging Science curriculum oftentimes utilizes enrolled students for educational modeling as simulated patients in learning radiographic positioning. This process is known as Medical Educational Modeling (MEM) or Peer Physical Examination (PPE). This survey seeks to collect information on students' comfort level and perception of utilizing MEM within their educational program.

Using a scale of 1-10, with **1 being "Not at All Willing"** and **10 being "Very Willing"**, rate your willingness to participate in the following situations:

How willing are you to participate in MEM as the **patient** with a **same gender** peer for the following areas:

Not at All Willing									Very Willing
1	2	3	4	5	6	7	8	9	10

head and neck (e.g. skull, cervical spine).

hand (e.g. fingers, hand, wrist).

arm and shoulder (e.g. humerus, scapula, elbow, shoulder).

upper body (e.g. chest, sternum, bony thorax).

abdomen (e.g. KUB, UGI, barium enema).

back (e.g. thoracic, lumbar).

pelvis (e.g. bladder, pelvic anatomy, sacrum/coccyx).

lower leg and foot (e.g. tibia, fibula, ankle, toes, foot).

knee (e.g. tunnel view, sunrise view, knee, distal femur).

hip joint (e.g. proximal femur, judet views, groin palpation).

How willing are you to participate in MEM as the **patient** with a **different gender** peer for the following areas:

Not at All Willing — Very Willing

1 2 3 4 5 6 7 8 9 10

head and neck (e.g. skull, cervical spine).

hand (e.g. fingers, hand, wrist).

arm and shoulder (e.g. humerus, scapula, elbow, shoulder).

upper body (e.g. chest, sternum, bony thorax).

abdomen (e.g. KUB, UGI, barium enema).

back (e.g. thoracic, lumbar).

pelvis (e.g. bladder, pelvic anatomy, sacrum/coccyx).

lower leg and foot (e.g. tibia, fibula, ankle, toes, foot).

knee (e.g. tunnel view, sunrise view, knee, distal femur).

hip joint (e.g. proximal femur, judet views, groin palpation).

Previous Continue

UNIVERSITY OF SOUTHERN INDIANA

Using a scale of 1-10, with **1 being "Not at All Willing"** and **10 being "Very Willing"**, rate your willingness to participate in the following situations:

How willing are you to participate in MEM as the **technologist** with a **same gender** peer for the following areas:

Not at All Willing									Very Willing
1	2	3	4	5	6	7	8	9	10

head and neck (e.g. skull, cervical spine).

hand (e.g. fingers, hand, wrist).

arm and shoulder (e.g. humerus, scapula, elbow, shoulder).

upper body (e.g. chest, sternum, bony thorax).

abdomen (e.g. KUB, UGI, barium enema).

back (e.g. thoracic, lumbar).

pelvis (e.g. bladder, pelvic anatomy, sacrum/coccyx).

lower leg and foot (e.g. tibia, fibula, ankle, toes, foot).

knee (e.g. tunnel view, sunrise view, knee, distal femur).

hip joint (e.g. proximal femur, judet views, groin palpation).

How willing are you to participate in MEM as the **technologist** with a **different gender** peer for the following areas:

Not at All Willing								Very Willing	
1	2	3	4	5	6	7	8	9	10

head and neck (e.g. skull, cervical spine).

hand (e.g. fingers, hand, wrist).

arm and shoulder (e.g. humerus, scapula, elbow, shoulder).

upper body (e.g. chest, sternum, bony thorax).

abdomen (e.g. KUB, UGI, barium enema).

back (e.g. thoracic, lumbar).

pelvis (e.g. bladder, pelvic anatomy, sacrum/coccyx).

lower leg and foot (e.g. tibia, fibula, ankle, toes, foot).

knee (e.g. tunnel view, sunrise view, knee, distal femur).

hip joint (e.g. proximal femur, judet views, groin palpation).

Previous

Continue

UNIVERSITY OF SOUTHERN INDIANA

Using a scale of 1-10, with **1 being "Not at All Willing"** and **10 being "Very Willing"**, rate your willingness to participate in the following situations:

How willing are you to participate in MEM as the the **model** for a **teacher** of the **same gender** to demonstrate radiographic position and centering with

Not at All Willing 1	2	3	4	5	6	7	8	Very Willing 9	10

head and neck (e.g. skull, cervical spine).

hand (e.g. fingers, hand, wrist).

arm and shoulder (e.g. humerus, scapula, elbow, shoulder).

upper body (e.g. chest, sternum, bony thorax).

abdomen (e.g. KUB, UGI, barium enema).

back (e.g. thoracic, lumbar).

pelvis (e.g. bladder, pelvic anatomy, sacrum/coccyx).

lower leg and foot (e.g. tibia, fibula, ankle, toes, foot).

knee (e.g. tunnel view, sunrise view, knee, distal femur).

hip joint (e.g. proximal femur, judet views, groin palpation).

How willing are you to participate in MEM as the the **model** for a **teacher** of the **different gender** to demonstrate radiographic position and centering with

Not at All Willing 1	2	3	4	5	6	7	8	Very Willing 9	10

head and neck (e.g. skull, cervical spine).

hand (e.g. fingers, hand, wrist).

arm and shoulder (e.g. humerus, scapula, elbow, shoulder).

upper body (e.g. chest, sternum, bony thorax).

abdomen (e.g. KUB, UGI, barium enema).

back (e.g. thoracic, lumbar).

pelvis (e.g. bladder, pelvic anatomy, sacrum/coccyx).

lower leg and foot (e.g. tibia, fibula, ankle, toes, foot).

knee (e.g. tunnel view, sunrise view, knee, distal femur).

hip joint (e.g. proximal femur, judet views, groin palpation).

Previous

Continue

UNIVERSITY OF SOUTHERN INDIANA

Using a scale of 1-10, with **1 being "Not at All Willing"** and **10 being "Very Willing"**, rate your willingness to participate in the following situation:

How willing are you to participate as an **observer** when a teacher is using **another student** to demonstrate radiographic position and centering for the following areas:

Not at All Willing 1	2	3	4	5	6	7	8	Very Willing 9	10

head and neck (e.g. skull, cervical spine).

hand (e.g. fingers, hand, wrist).

arm and shoulder (e.g. humerus, scapula, elbow, shoulder).

upper body (e.g. chest, sternum, bony thorax).

abdomen (e.g. KUB, UGI, barium enema).

back (e.g. thoracic, lumbar).

pelvis (e.g. bladder, pelvic anatomy, sacrum/coccyx).

lower leg and foot (e.g. tibia, fibula, ankle, toes, foot).

knee (e.g. tunnel view, sunrise view, knee, distal femur).

hip joint (e.g. proximal femur, judet views, groin palpation).

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Perception Scale

Using the following scale of **0 being "strongly disagree"** to **4 being "strongly agree"**, rate your agreement with each of the following statements.

	Strongly Disagree 0	1	2	3	Strongly Agree 4
It is inappropriate to perform MEM on persons that will be my future colleagues	○	○	○	○	○
To perform MEM is an appropriate practice for the education of a radiologic technologist	○	○	○	○	○
To undergo MEM is an appropriate practice for the education of a radiologic technologist	○	○	○	○	○
In performing MEM I (will) get useful feedback from my colleagues about my skill	○	○	○	○	○
It is a sign of professionalism as a student to accept to perform and undergo MEM	○	○	○	○	○
I believe It is important for me to participate in MEM	○	○	○	○	○
I am motivated to participate in MEM	○	○	○	○	○
Performing MEM improved my skills for clinical practice	○	○	○	○	○

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Drag the slider to indicate your response for the questions below:

0 10 20 30 40 50 60 70 80 90 100

How many times have you volunteered to participate as the model for the teacher in front of a group of students

How many times have you volunteered to participate as the model in MEM within a group of students?

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What is your preferred composition of groups for practicing imaging exams?

self-assembled

mixed gender

same gender

no preference

In relation to a central line between conservative and liberal being "average", do you think your outlook is:

more conservative than average

within the range of average conservative/liberal outlook

more liberal than average

prefer not to answer

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Share a little about yourself:

Age ▼

Gender ▼

Race ▼

What is your religious affiliation?

Christian	Buddhist
Catholic	Hindu
Mormon	Other
Jehovah's Witness	Atheist
Orthodox	Agnostic
Jewish	Nothing in particular
Muslim	Prefer not to answer

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One aspect under study is student comfort level with MEM as it relates to various factors. As part of consideration, student body image is being considered. For this reason, BMI calculation of respondents will be calculated based on information provided below. If you prefer not to answer, simply leave it blank.

	Answer
Height (inches)	
Weight (pounds)	

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What are your views regarding Medical Educational Modeling (MEM)? In the space provided, you are invited to respond with your thoughts on benefits, drawbacks, or any suggestions you may have regarding MEM. Respond only for those items for which you have strong feelings; leave other spaces blank.

	Benefits	Drawbacks	Suggestions for Improvement
When thinking of MEM in general			
When thinking of participating in MEM as a simulated patient with peers			
When thinking of participating in MEM as a technologist with peers			
When thinking of participating as the example patient in front of your peers with a teacher acting as the technologist			

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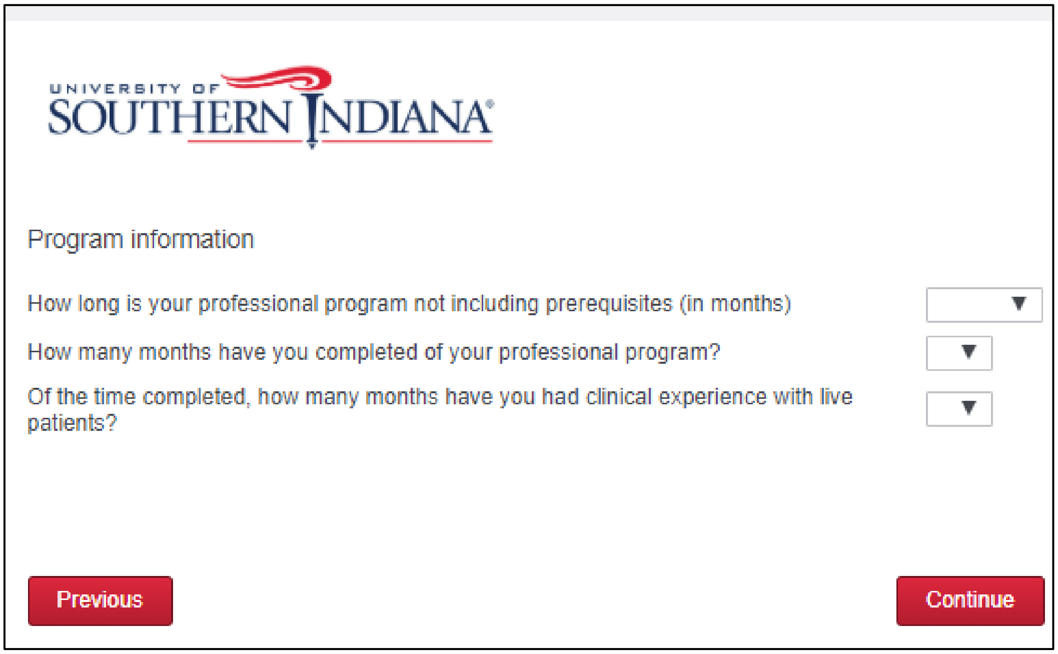
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Program information

How long is your professional program not including prerequisites (in months)

How many months have you completed of your professional program?

Of the time completed, how many months have you had clinical experience with live patients?

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Appendix C: E-mail Recruitment Language

IRB012345

Hello Program Directors!

I am examining the pedagogical practice of medical educational modeling within a radiographic procedures course. Medical educational modeling defined in this study is the use of peers in the same cohort serving as simulated patients for the purposes of their fellow students being able to practice and learn radiographic positioning in preparation for clinical practice. My goal is to compare student perceptions and comfort levels related to this practice within baccalaureate level programs across the United States. I am asking for all Program Directors of JRCERT accredited Bachelor of Science programs that utilize medical educational modeling within their programs to please forward the survey information below onto their students. Thank you in advance for your consideration of this request!

Forward this to students:
Hello from Indiana!
You are invited to participate in a research study on student perceptions and comfort levels with utilizing peers for simulated patients when learning radiographic positioning. This study is being conducted by Heather Schmuck from the University of Southern Indiana, Educational Leadership Doctoral Student with Dr. Bonnie Beach as faculty sponsor. Heather Schmuck can be reached at HP3065, 8600 University Blvd. Evansville, IN 47712, hmschmuck@usi.edu, or 812-228-5066. Dr. Bonnie Beach can be reached at ED1104, 8600 University Blvd. Evansville, IN 47712, blbeach@usi.edu, or 812-465-1620

This study will take approximately 15 minutes of your time. You will be asked to complete an online survey about your comfort level with various areas of the body being examined **by** you on another student or **on** you by another student.

Your decision to participate or decline participation in this study is completely voluntary and you have the right to terminate your participation at any time without penalty. Consent is implied when you begin the survey. You may skip any questions you do not wish to answer. If you do not wish to complete this survey simply do not proceed to the link or if started, simply close your browser.

Your participation in this research will be completely confidential. There is a risk of participant discomfort in answering some of the survey questions. Participants have the option to skip questions. No compensation will be awarded for participation in this study.
Should you have any questions or concerns, please do not hesitate to contact us.

Click here to begin the survey or use this link:
https://usisurvey.az1.qualtrics.com/jfe/preview/SV_1LdEIFtPkRB54bj?Q_SurveyVersionID=current&Q_CHL=preview

Appendix D: Informed Consent Document

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Student Perceptions and Considerations for Medical Educational Modeling in Radiologic Technology Procedures Courses

IRB012345

Informed Consent Document

Online or Web Based Survey

You are invited to participate in a research study on student perceptions and comfort levels with utilizing peers for simulated patients when learning radiographic positioning. This study is being conducted by Heather Schmuck from the University of Southern Indiana, Educational Leadership Doctoral Student with Dr. Bonnie Beach as faculty sponsor. Heather Schmuck can be reached at HP3065, 8600 University Blvd. Evansville, IN 47712, hmschmuck@usi.edu, or 812-228-5066. Dr. Bonnie Beach can be reached at ED1104, 8600 University Blvd. Evansville, IN 47712, blbeach@usi.edu, or 812-465-1620. Additional questions can be directed to USI Office of Sponsored Projects & Research Administration, 812-465-7000, rcr@usi.edu

This study will take approximately 15 minutes of your time. You will be asked to complete an online survey about your comfort level with various areas of the body being examined ***by*** you on another student or ***on*** you by another student.

Your decision to participate or decline participation in this study is completely voluntary and you have the right to terminate your participation at any time without penalty. Consent is implied when you begin the survey. You may skip any questions you do not wish to answer. If you do not wish to complete this survey simply do not proceed to the link or if started, simply close your browser.

Your participation in this research will be completely confidential. The benefit to participSating in this survey is that your responses will be used to add to the knowledge of students' perspectives in the use of peer educational modeling as a pedagogical practice in radiographic procedures courses. There is a risk of participant discomfort in answering some of the survey questions. Participants have the option to skip questions. No individually identifiable information will be obtained as part of this survey. Responses will be presented in aggregate form. If a specific quote is taken from your response, a pseudonym will be used. No compensation will be awarded for participation in this study.

Please print a copy of this consent form for your records if you so desire.