Augmented Reality Simulation in Entry-Level Radiography Education: The Students' Perspective

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Abstract: The general purpose of the pilot program was to explore and describe the use of augmented virtual reality (VR) software to identify the benefits and barriers related to the use of such technology, and to identify areas of improvement to current practices in the skills training of entry-level radiologic technologist in the Diagnostic Medical Imaging-Radiology program at Austin Community College. The specific purpose of the pilot was to understand best practices for implementing and utilizing the emerging technology with the current radiology curriculum to develop appropriate practices and policies to improve students' deep learning of patient positioning, obtaining optimal images, and enhancing current learning practices and procedures. The participants were first-year students enrolled in the DMI- Radiology program at Austin Community College. A response rate of 70% (n-36) on all but one of the survey questions was received. For the final question presented in Table 6 a response rate of 59% (n=33) was received. The ability to see radiology images and quality of images based on technical factors used rated favorable among students. The surveyed students also indicated a like for the opportunity to have unlimited attempts at practicing patient positioning in the VR simulated environment, but issues with positioning limitations of the VR mannequins and equipment posed consistent problems. Fifty-six percent of the students participating in the survey (n=20) stated the VR simulation technology can be beneficial in improving clinical skills, image evaluation, and promoting critical thinking.

Keywords: Augmented Reality, Radiology Simulation Software, Virtual Reality, Immersive Learning

Introduction

Radiographers require considerable technological expertise in the production of diagnostic medical images and have the responsibility of delivering ionizing radiation to patients. This expertise is amassed through didactic education, simulated skills labs, and clinical placement. Simulated skills labs provide students with an opportunity to gain experience in a safe environment through simulated patient positioning without exposing lab partners to ionizing radiation. Simulated lab training, role play, and skills practice is essential to the clinical skills development of student radiographers. Virtual reality simulation software for radiography can be a beneficial tool for undergraduate radiography education and students as it enables students to develop their clinical skills in a safe environment and is a valuable pedagogical approach to teaching technical and soft skills (Shanahan, 2016; Shiner, 2018). The costs associated with installation and maintenance of X-ray equipment can be extremely high. Lab access can be limited by class size and equitable scheduling of practice times. Students are not able to perform actual imaging on each other due to safety and legal reasons, and the acquisition of radiographic images during lab activities where anthropomorphic radiographic phantoms are used to produce images must be supervised by qualified faculty. Image acquisition is an important aspect of learning. It elicits critical thinking, enables students

to recognize and correct errors related to patient positioning, equipment manipulation, beam centering, and the selection of technical factors to produce optimal radiographic images. At the beginning of the Covid-19 pandemic there was a cessation of physical skills labs and clinical rotations for students. There was an immediate need to seek alternative means to deliver training and computer-based virtual environments offered a way to introduce immersive VR simulation environments to overcome limited access to physical skills labs at the height of the pandemic. Virtual reality is an innovative technology that allows students the option to practice radiography in a virtual environment simulating real-life clinical patient scenarios. Students must apply their didactic knowledge to perform radiographic examinations in the virtual environment.

Literature Review

As a part of a diagnostic imaging – radiology program students are placed in hospitals and clinics to develop the skills required of technologists. The clinical placements are essential to developing the knowledge to deliver ionizing radiation that is as low as reasonably achievable to produce quality diagnostic images. To prepare for clinical placement, students are able to simulate patient positioning in a controlled, safe environment within radiology labs on college campuses. Students are able to role play patient and technologist situations using radiation equipment without actually delivering ionizing radiation. Although the lab simulations are effective and instrumental to the instruction of radiology students, the absence of producing images during these simulations limits the students' and instructors' ability to see actual technological and at times positioning errors. Lab instruction also consists of the use of anthropomorphic phantoms. The phantoms, however, come with limitations and often are not suitable for radiographic imaging and positioning that requires significant degrees of manipulation (O'Connor, Stowe, Potocnik, Giannotti, Murphy, & Rainford, 2021). The use of VR simulation addresses some of those limitations by giving students the ability to simulate real world radiographic examinations, employ critical thinking skills, and create an active learning experience without the use of ionizing radiation exposure (O'Connor et al., 2021).

Hazell, Lawrence, & Friedrich-Nel (2020) explored the role of simulation-based learning in facilitating clinical readiness in Radiography. Their research revealed that students are best prepared for clinical placement by employing simulations that are authentic, realistic, relevant, builds confidence in a safe environment, and elicits collaboration and active participation. Prince (2004) suggests that active student learning, rather than passive learning, improves the quality of student learning, their learning experience, and students must think about what they are doing and be engaged in the learning process. Sapkaroski, Baird, Mundy, & Dimmock (2019) found that novice students perceived VR to be as equally effective as role-play training in the skills labs, had the added advantage of being easily accessible, enabled users to correct mistakes at their own pace, and found that students who practiced extremity radiography using VR software performed better in a practical extremity examination than those trained using conventional simulated role-play (Sapkaroski, Mundy, & Dimmock, 2020). Students can work in a realistic environment where they can change variables and see the results on a computer screen.

Several simulators have been developed within the last decade to include: Projection VR™ by Shaderware, Medspace VR™, Medical Imaging Training Immersive Environment (MITIE), Clinical Education Training Solution (CETSOL) VR Clinic, and VR software by Virtual Medical Coaching Ltd. Literature on the benefits of immersive VR radiography simulation is limited as it has yet to be implemented in most undergraduate Radiography programs. In this pilot study, Virtual Medical Coaching Ltd.'s VR software was piloted as an educational tool for first-year radiography students at Austin Community College (ACC). User feedback was retrieved to:

- Identify learning curves
- Identify the importance of technology in learning
- Identify students' previous experience with use of VR technology
- Identify challenges associated with the use of the selected technology
- Identify benefits of the selected technology

Institutional Support

In September 2019, radiology program faculty established contact with Virtual Medical Coaching Ltd to inquire about VR software and the possibility of allowing faculty and students the opportunity to demo the VR software to determine if it would be a useful instructional tool for the ACC radiography program. The demo software was sent to a computer lab at the Northridge campus by the company representative. The Northridge campus was selected due to the VR headsets and gaming style computers available at that location. At the time, the software was not readily used in the United States. The company is located in New Zealand, but with advancements in technology and the ability to communicate and meet remotely, we were able to set up a live demo with three senior students, faculty, and representatives from Virtual Medical Coaching Ltd. After the scheduled demo, students were surveyed for feedback regarding the use and potential educational benefits of the virtual platform (see Appendix A).

After the initial demo, program faculty contacted the Teaching and Learning Excellence Division (TLED) at Austin Community College. Discussions involved support from the division to conduct a full pilot of the VR software that would involve all of the radiology students. The VR software would be delivered at no cost to the college during the pilot. The requested support from TLED involved technology. The radiology program did not have access to gaming style computers or VR headsets that were needed to support the software. TLED agreed to provide the necessary computers and the VR headsets were purchased from the radiology program budget. The computers would be ordered during the fall 2019 semester and the pilot program would be conducted during the spring 2020 semester in the RADR 2431 Advanced Radiographic Positioning course.

In spring 2020, the pilot program was delayed due to the COVID-19 pandemic. All ACC campuses were closed indefinitely, and face-to-face instruction was greatly limited or completely halted. As a result, radiology students were not able to utilize the VR software and equipment on campus. Delays in shipping of computers also hindered

implementing the pilot program. Virtual Medical Coaching Ltd allowed access to their new desktop version of the VR software so that students would be able to use and pilot the software from their personal desktop computers. The desktop version was utilized by students during the spring 2020, fall 2020, and spring 2021 semesters. Although no initial financial support for the purchase of the VR software was needed, with disruptions to the delivery of course and face-to-face lab instruction, and equipment caused by COVID-19, ACC purchased software licenses for new radiology students entering the program in the fall 2021 semester. The software purchase extended the pilot program and allowed the collection of data during the fall 2021 and spring 2022 semesters.

Method

At the onset of the fall 2021 semester, incoming radiography students were given instructions on how to establish their student licensing accounts with Virtual Medical Coaching Ltd. The accounts allowed for access to both the desktop and the on-campus VR software. Students were provided with training videos on how to set up accounts and how to access the positioning modules. All instructional videos were uploaded to ACC's LMS platform, Blackboard. One-on-one face-to-face training for initial on-campus use of the VR headsets and software was provided by radiology program faculty in the VR suites located at the Eastview and Round Rock campuses. The length of time it took for students to acclimate to the on-campus equipment ranged from 10 to 30 minutes. Technology used in the on-campus VR suites consisted of HTC VIVE Cosmos headsets and the gaming computers provided by TLED. The blackboard modules accessible to students were complementary to the existing pedagogical approaches and didactic lectures used in the fall semester course RADR 1411, Basic Radiographic Procedures, and the spring semester course RADR 2431, Advanced Radiographic Procedures.

The desktop and on-campus platforms both contained modules that students could use to practice patient positioning and technical factors (figs. 1 and 2). Once students felt proficient with the practice modules, they were able to progress to the assessment side of the platform. The assessment modules consisted of a quiz pertaining to anatomy, positioning, and pathology. After completing the quiz, students were directed to a virtual radiology room with a patient. In the room students were able to perform patient positioning, set technical factors, and produce a radiographic image (figs. 3 and 4). The image produced a visual for students to determine if the patient positioning employed and the technical factors used produced a diagnostic image. Upon completion of the routine radiology exam, a report was emailed to the student. The report identified parameters such as type of exam, technical factors used, length of exam, equipment management, and safety measures utilized. At the end of each semester students created a portfolio that consisted of required images from specified exams outlined in the course assignment (see Appendix B). Students also completed a survey on their experience using the VR desktop and on-campus learning platforms.

Fig. 1 Virtual Medical Coaching Ltd

Fig. 2 Virtual Medical Coaching Ltd

Fig 3. Student using on-campus simulation

Fig 4. Faculty using on-campus simulation

Data Collection

An online survey was conducted through SurveyMonkey at the conclusion of the fall 2021 and spring 2022 positioning courses. The link to the survey was included in the portfolio template of the course assignment. Each semester consisted of sixteen weeks of didactic, lab, and VR instruction. The spring semester also included a clinical component. The spring semester would be the cohorts first semester in the clinical environment. First-year radiography students participated in the survey (n=36) and the survey consisted of ten open-ended questions. The survey was used as a part of the pilot program and at the conclusion of the fall 2021 and spring 2022 semesters to:

- Determine the importance of technology in course instruction and content delivery

- Determine usability of both desktop and on-campus versions of the software
- Identify challenges and areas of needed improvement for each platform
- Determine additional supports needed

Results

The survey was distributed to first-year radiology students at the end of the fall 2021 and spring 2022 semesters. The survey was a part of the VR portfolio assignment for each course (see Appendix B). The student survey consisted of ten open-ended questions. The first question identified the students name and campus location. Questions 2 through 4 surveyed the students' perceptions on the importance of technology in learning (fig. 1), the students' ability to learn and use the VR technology (fig. 2), and identify previous experience using VR technology (fig. 3). The remaining questions and feedback are identified in tables 1 through 6. The tables highlight overarching themes from each question posed. There were fifty-three first-year radiology students enrolled during the fall 2021 and spring 2022 semesters. The survey yielded a response rate of 70% (n=36).

Table 1 outlines the themes identified for the question asked regarding the use of the desktop version of the VR simulation modules. Thirty-six percent (n=13) liked the ability to be able to see the images produced from the patient positioning and technical factors used while not exposing patient to ionizing radiation. Twenty-eight percent (n=10) of the students stated they found the ability to practice patient positioning and skills learned in the on-campus labs an unlimited number of times proved to be beneficial with regards to critical thinking and remembering steps required on specific patient positions. Seventeen percent (n=6) of the students liked the convenience of at-home use of the software, eight percent (n=3) found the desktop version to be fun and new, while eight percent (n=3) did not find and benefit to the use of the desktop version of the VR software. Three percent (n=1) of students found the VR desktop software to be a realistic adaptation of a real-life imaging exam.

Table 2 outlines challenges experienced by students with regards to the use of the VR desktop simulation software. Thirty-five percent (n=12) of students experienced issues with manipulating the patient into different positions and utilizing the controls to move the equipment around the radiology room. Twenty-seven percent (n=10) of students found the responsiveness of the software to be challenging and the movements would lag at times. Some did not find the software to be intuitive. Nineteen percent (n=7) found it too time consuming to complete a single module while thirteen percent (n=5) of students found acclimation to the software challenging. Three percent (n=1) of students stated there was frustration related to the delay in receiving the completed images via email and three percent (n=1) stated the VR modules were not relevant to the current course curriculum.

Table 3 outlines the positives experiences by students when using the on-campus VR simulation platform. Forty-four percent (n=16) of the students reported on the benefits of viewing images based on patient positioning, technical factor selections, the added benefits of being able to see anatomical structures beneath the bodies surface, and the ability to maneuver around the virtual room. Nineteen percent (n=7) of students felt the on-campus VR simulation modules served as a good supplemental tool to the on-campus practice and face-to-face simulation labs. Seventeen percent (n=6) of students said the VR simulations mimicked real-world exam experiences. Fourteen percent (n=5) of students found no reportable benefits to the use of the VR simulation modules. Three percent (n=1) of the students were not able to use the on-campus VR simulation equipment due to technical and equipment issues and three percent (n=1) of students stated the technology was beneficial in the absence of a partner when practicing in the routine radiology simulation labs.

Table 4 highlights the overarching themes presented by students on the challenges they faced while using the on-campus VR simulation software. Forty-four percent (n=16) of the students surveyed stated difficulties with the hardware, issues with the constant need to reboot the software, and movements often glitchy. Twenty-two percent (n=8) of students identified issues with manipulating the virtual patient and working within the set parameters in the virtual environment. Eleven percent (n=4) of students did not have issues or concerns associated with the use of the on-campus VR equipment or software. Eight percent (n=3) of students felt a wireless headset option would provide a safer environment during use. Three percent (n=1) of students identified a delay in receiving emailed reports on their completed exams, three percent (n=1) would like to have built-in instructions, and three percent (n=1) of students stated the assessment modules were not relevant to the current course curriculum. Finally, six percent (n=2) of students found the use of the on-campus VR simulation software difficult to use and time consuming.

Table 5 depicts the responses submitted by students on their views of whether the addition of the VR simulation technology improves patient positioning clinical skills. Most of the students surveyed, fifty-six percent (n=20), stated the addition of the VR technology was beneficial in improving patient positioning skills, image evaluation, promoting critical thinking, and is a good tool to have when having a practice partner utilizing the routine radiology simulation labs is not possible. Thirty percent (n=11) of students found no identifiable benefits with the addition of the technology. Those students stated the technology does not mimic real-life scenarios, does not involve the use of clinical skills needed, and the VR patient is not the same as performing radiology exams on real patients. Eight percent (n=3) of students suggested more updates to the VR software is needed along with the need for tutorials. Three percent (n=1) stated the current radiology

labs are more helpful and three percent (n=1) prefer the at-home desktop version of the VR software to be more beneficial.

Table 6 outlines the suggestions made by students regarding the needed improvements and support that would better facilitate the use of the VR technology. Previous survey questions yielded seventy percent (n=36) respondents. For this specific question, a fifty-nine percent (n=33) response rate was received. Forty-three percent (n=14) of the respondents would like to see updates to the software and hardware to combat operating and technical issues experienced, specifically with the on-campus software and hardware. Better button controls and navigation around the virtual room on the desktop version were suggested needed improvements. The respondents stated a readily available user manual along with more faculty assistance and support, and a wireless option for the VR headset to create a safer environment. Thirty-three percent (n=11) did not identify specific areas of needed support or improvements. Twenty-four percent (n= 8) of students responding to the question regarding support needed to improve technology and use stated more available on campus practice time is needed and assignments associated with the use of the equipment should be optional. Figures 4, 5 and 6 present information collected on the importance of technology in the learning environment, learning curves associated with new technology, and students' experience with the use of VR technology.

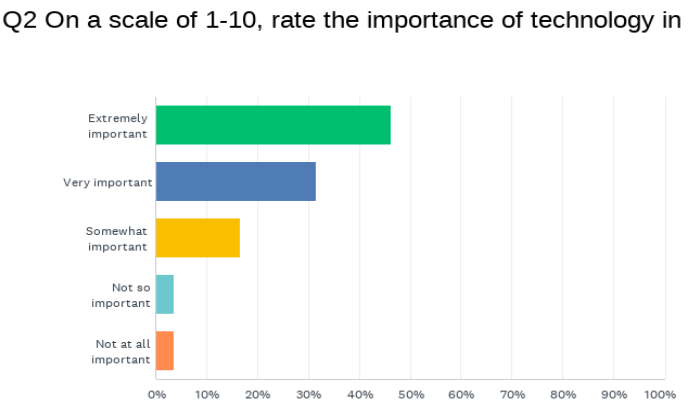

Figure 4: Students' opinions on the importance of technology in learning (N=36)

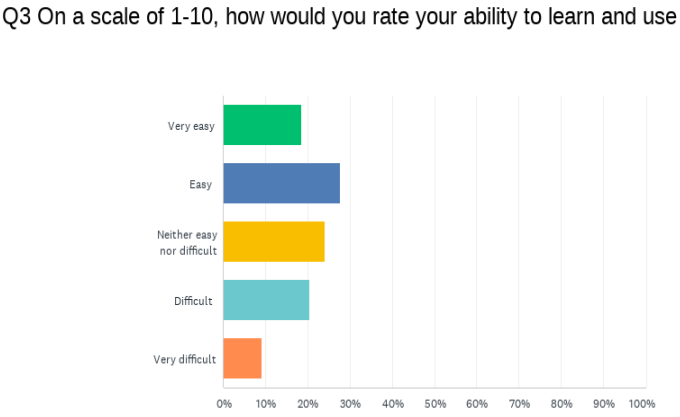

Figure 5: Students' reporting on learning curve associated with use of VR technology (N=36)

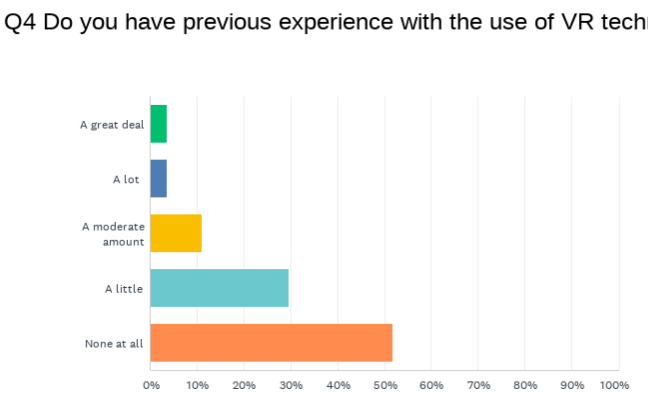

Figure 6: Identification of students' familiarity with the use of VR technology (N=36)

Table 1: Outline 3 things you like about the Virtual Medical Coaching Ltd. (Skilitics) ***desktop*** simulation modules.

Ability to use software at home
Provides a very realistic simulation
Ability to test different techniques without exposing patients to radiation
Can see the x-ray image
Practicing what was learned in class

Realistic and intuitive
Fun to use
Great for practicing skills
Offers a unique learning experience
Interactive and entertaining

Table 2: List 3 challenges associated with the use of the ***desktop*** simulation modules

Lack of procedures to practice on
Movement of the patient is limited
Time consuming
No user manual included.
Controls can be clunky at times.
Experienced technical issues
Difficult to see radiographic landmarks
Difficulty navigating the exam room
Buttons were confusing at times
Program cannot be used on iPad

Table 3: identify 3 things you like about the ***on-campus*** VR simulation

Movement is easier than desktop version
Ability to simulate a real exam to include producing an image
Ability to move around the equipment
Good selection of exams
Fun to use

Ability to practice on a “patient”
Hands on, prepares you for clinical
Fund, educational, interactive
Included everything needed to sharpen skillset
Ability to manipulate equipment

Table 4: List 3 challenges associated with the ***on-campus*** VR simulation modules

Inconsistent email reports on completed exams
Headset is uncomfortable, often fogs obscuring vision especially at right angles
Difficulty manipulating patient and equipment
Consistent technical difficulties
Questionnaires not in alignment with course curriculum
Software extremely glitchy
Process can be too time consuming due to learning curve
No wireless capability causing potential safety hazard
Difficulty navigating around the virtual exam room
Difficulty with setting technical factors needed to produce a diagnostic image

Table 5: Does the technology aid in improving patient positioning skills?

No, they do not replicate real-world conditions
Yes, it is like being an actual tech positioning and conducting image evaluation
No, already work in a clinical setting
Very much, used it before attending clinicals
Maybe a little, good for a refresher
Yes, good supplement to lab practice
Yes, repetitions are helpful
No, cannot touch patient landmarks
Yes, it helps with muscle memory and sharpens critical thinking
Yes, more practice the better

Table 6: What suggested improvements are needed to better support the use of this technology?

Switch to a wireless headset
Fixing issues related to consistent hardware and software malfunctions
Improving control selections on desktop version
Include a user manual to minimize the learning curve, better instruction
Provide a chart with technical factors that work with the software
Include an evaluation accuracy mechanic allowing comparison of correct/incorrect images
Improvements in ability to better position patient
Include a live chat option
Ability to use software on all browsers
Add ability to rotate image receptor

Study Limitations

In spring 2020, the pilot program was delayed due to the COVID-19 pandemic. All ACC campuses were closed indefinitely, and face-to-face instruction was

greatly limited or completely halted. As a result, radiology students were not able to utilize the VR software and equipment on campus. Delays in shipping of computers also hindered implementing the pilot program. Although student responses are subjective based on many factors, circumstances such as delayed equipment, limited access to on-campus equipment due to restricted access, only one computer setup per campus, and technical and connectivity issues associated with the software and hardware may have negatively influenced their evaluation and perception of the technology.

Conclusion

The VR simulation pilot study was implemented to access if the addition of this emerging technology would be a beneficial tool for the first-year radiology students. Virtual radiography simulation programs such as the one developed by Virtual Medical Coaching Ltd. represents the future of education and technology in undergraduate radiology programs. With continued advances in technology simulation will be an important and valuable pedagogical approach (Shiner, 2018) to educating entry-level radiography students. As students indicated in their survey responses, the technology cannot replace the hands-on clinical training and the face-to-face lab simulations with other students and program instructors but can be a valuable tool to supplement current instructional methods. More training and education for program faculty is essential to effectively facilitate the use and instruction of the VR technology. It will be imperative to address the concerns presented by students in the pilot study to better access the benefits of its continued use and implementation into the radiology curriculum.

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Appendix A

VR Feedback

Please answer the following questions regarding your experience with the Virtual Reality Positioning App.

Name *

[redacted]

Do you have previous experience with VR? How well did you acclimate to using the headset and controls?

I've put a VR headset on before and looked around, but never tried to perform a task. I think that it would just take a few times of doing it to get acclimated to the software.

What did you like about the VR positioning app?

I like that you can see the bones through the patient's body. I think it would be helpful when positioning oblique views and learning spine work.

What did you not like about the VR positioning app?

I didn't like that the knee was tabletop. I don't think anyone should practice like that, because we had students who did tabletop in lab challenge and got counted off for it. I didn't think to check if there was an option to switch to table bucky on the console or add a grid.

Do you feel the VR positioning accurately reflected radiographing a real patient?

Somewhat - I wish you could move the patient more, but I also feel that just starting off it would be great practice and a good way to improve your speed and accuracy.

Would you recommend this VR experience be offered to students in the Radiology program? Why?

I would. It's a great way to tie all the elements together and actually see an x-ray of your positioning. The more you know about what the x-ray for a certain body part is supposed to appear like and that your evaluation criteria is met, the better you'll be starting out in clinic. You appear more confident and competent as a student when you can take an x-ray and know if it's good or needs to be repeated without looking to the tech you're working with for guidance.

Think about the demands of the program during the first semester. How much time each week do you feel you could have spent with the VR system?

A significant amount of time that first semester is spent on campus practicing anyway. I don't think it would add to a student's workload to spend some of that time practicing with the VR system. I probably could have spent 1-2 hours a week depending on the availability of the VR system.

VR Feedback

Please answer the following questions regarding your experience with the Virtual Reality Positioning App.

Name *

[redacted]

Do you have previous experience with VR? How well did you acclimate to using the headset and controls?

Yes, I have had experience with VR. I felt like I acclimated fairly quickly with the headset and controls for today's VR. The controllers were just a bit different than the ones I tried before, but still they are very much similar and I think I got comfortable with it after a few minutes.

What did you like about the VR positioning app?

What I really liked about it is that you can actually take an x-ray and see the image. This will help more with eval criteria and help give you an idea of what it's like taking an x-ray and see how well you are positioning. What I also really liked is that you have to set your own techniques. As a junior, I remember not being comfortable with techniques and I think this will definitely help us get used to thinking about techniques.

What did you not like about the VR positioning app?

I don't think there was anything that I didn't like about it

Do you feel the VR positioning accurately reflected radiographing a real patient?

I think it did!

Would you recommend this VR experience be offered to students in the Radiology program? Why?

Yes, I think it will help students with what they need to work on and their mental checklist in what they need to do before making an exposure. Knowing that this VR program has a feature to make a portfolio for the student on their strengths and weaknesses will help the student have an idea of what they need to work on.

Think about the demands of the program during the first semester. How much time each week do you feel you could have spent with the VR system?

I think I would spend time with the VR after class and even the days we don't have class. I feel like the more time with it, the more it will help you remember things you need to know for lab challenges and exams.

VR Feedback

Please answer the following questions regarding your experience with the Virtual Reality Positioning App.

Name *

[redacted]

Do you have previous experience with VR? How well did you acclimate to using the headset and controls?

Used VR with a previous employer. I acclimated to using the controls well today.

What did you like about the VR positioning app?

The finer details of positioning, collimation, SID, etc.

What did you not like about the VR positioning app?

It was difficult when trying to grab certain items such as the position marker.

Do you feel the VR positioning accurately reflected radiographing a real patient?

Yes

Would you recommend this VR experience be offered to students in the Radiology program? Why?

Yes. It gives those (such as myself) a chance to work with a patient who isn't a student. It also benefits students who prefer to work alone or have trouble finding people to show up to practice.

Think about the demands of the program during the first semester. How much time each week do you feel you could have spent with the VR system?

Several hours per week easily. I try to make it to the open lab as much as possible so this program would definitely be a benefit.

Appendix B

Portfolio Assignment

VR Portfolio instructions:

For RADR 2431 you will create a portfolio of images utilizing both the desktop version and the on-campus VR simulation lab. Further instructions outlined below:

1. Create a copy of the Spring VR Portfolio using your ACC EMAIL address in order to gain full credit.
2. For all the on-campus simulations **except the 1411 refresher section,** you will need to answer questions in the VR modules in BB to create your patient. Modules are required for the *abdomen, cross table hip, lateral face, and PA Skull.*
3. For all desktop simulations (at home), you may use the practice mode.
4. You will be required to perform the pre-selected exams listed under the pages and upload to their corresponding section in your VR portfolio.
5. For your **on-campus simulation requirement**, you will need to complete the following:
   - 3 on-campus exams for the 1411 refresher page, *select any one from upper extremity, one from lower extremity, and a chest PA*
   - 1 *AP abdomen supine* view for the Fluoro abdomen page.
   - 1 *cross-table hip* view for the Trauma page
   - 1 *Lateral Face* for the facial bones page
   - 1 *PA skull* for the skull page
6. For your **desktop simulation requirement,** you will need to complete the following
   - In the 1411 refresher page, you will complete 9 exams: *hand PA, Wrist Lat, Forearm Lat, Elbow AP, Humerus Lat, Shoulder AP, Clavicle AP Axial, 1st digit AP, and 2nd digit lat*
   - In the fluoro abdomen page, you will complete 1 exam: *AP Abdomen Supine*
   - In the Trauma page, you will complete 3 exams: *AP Pelvis, AP Hip, and a cross table Hip*
   - In the facial bones page, you will complete 3 exams: *PA, Waters view, and Lateral*
   - In the Skull page, you will complete 3 exams: *PA, PA Caldwell, and Lateral Skull*
7. Upload each report/image to their corresponding item in their specific pages in your portfolio. All reports must be in their correct place in order to gain full credit.