Augmented Reality in Paramedic Training: A Pilot Study

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Abstract

Emergency management of critically ill patients and a high expectation of mastery of technical medical skills are an essential aspect in a paramedics’ scope of practice. An entry-level paramedic with limited exposure to high-risk critical patients is expected to perform interventions and utilize critical thinking skills at a mastery level when entering the workforce (Zautchke, Lee, & Ethingon, 1987). Paramedic programs in the United States continue to deliver the bulk of the course curriculum in a traditional classroom lecture format using 2-dimensional methods such as PowerPoint and lecture. Traditional methods can hinder paramedic students’ ability to witness the direct impact of their decisions. The term augmented reality refers to technology that enhances the user’s sensory perception in a synthetic environment. Augmented Reality or A.R. can replace a real environment into a more controlled sterile simulation that parallels the 3-dimensional world. Whereas, traditional education using lectures, PowerPoints, and videos are only 2-dimensional. A progression to replace the traditional method of instruction to a more immersive 3D environment could provide greater realism, thus increasing the active decision-making process (Folguera, Forner, & Rodriguez-Lozazo, 2018). This preliminary case study will test the application of augmented reality, AR, in instruction versus traditional methods of teaching.

**Keywords:** Augmented Reality, AR, 3D, 2-dimensional, 3-dimensional

Introduction

The specific area of this study will focus on teaching paramedic students the flow of blood through the heart. The experimental class will learn the blood flow through augmented
reality, and the control class will learn from a traditional lecture. Both classes will have a pre and post written assessment during the lesson.

**Research Problem/Purpose of the Research Study**

*Our Hypothesis:* Can AR improve the paramedic students’ self-perception of knowledge retention when learning the physiology of the blood flow through the heart thereby improving assessed learning outcomes when compared to traditional methods of learning?

*Null Hypothesis:* AR has the same outcomes as traditional methods of learning.

Based on the hypothesis, this study will attempt to answer the following questions:

- Will participants using AR have increased performance on the assessment?
- Will participants using AR have higher performance perception of the subject?
- Will AR participants retain the information long-term compared to the participants from the traditional lecture?

**Sample population**

All participants were first-semester paramedic students’ ages ranging from 18 to 42 with a mean age of 26. Six participants were female (15%), and 33 (85%) were male. Participants had varied levels of education including two participants with the highest level of education of a GED (0.05%), seventeen participants with the highest level of education of a traditional High School diploma (44%) and one participant holding a master’s degree (0.03%). The remainder of the participants had some level of undergraduate education (51%). All participants had some field experience as EMT’s with a mean of 6 months or less. Students were recruited from a local college that offered an accredited EMS program with the State of Florida and CoAEMSP.

**Literature Review**

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1 Committee on Accreditation of Educational Programs for the Emergency Medical Services Professions
Recent research suggests that AR is effective in creating an immersive environment for the learner that reflects real world situations thus improving critical thinking and competency levels (Barsom, Gaafland & Schijen, 2016; Albrecht, Folta-Schoofs, Behrends, & von Jan. 2013; Conradi, Kavia, Burden, Rice, Woodham, Beaumont, Poulton, 2009). Most research on AR in the classroom agrees that problem-based learning is an excellent way to teach skills that require quick thinking in a life and death situation without possible deadly consequences. This framework for reality without consequences is extremely useful in the medical field. The available research dictates that there is a growing need for Augmented Reality in medical training. More and more universities are investing in new technology to give students an advantage over competitors. The immersive interaction with different scenarios gives the student the ability to learn and interact through first person experience. This allows the learner to assimilate the increased knowledge more purposefully and readily recall the scenario when needed (Mantovani, F. Castelnuobvo, G., Gaggiolo, A. & Riva, G. 2003). While most of the data collected from the research is limited there was one study that directly correlates to this pilot. In this study, students were tested in a control group as well as an experimental group to determine their cognitive load and academic success learning anatomy through AR. An additional aspect that was studied is the satisfaction of students who could use a mobile version of study through AR versus learning strictly through textbooks (Küçük, S., Kapakin, S. and Göktaş, Y. 2016). These factors directly correlate with this pilot study being conducted and will assist in providing another data point for the effectiveness of AR in learning.

The research shows promising potential for the integration of Augmented technologies in the classroom for the education of EMS professionals. An essential part of each students’ experience in the classroom should mirror real-world scenarios particularly those that allow the
student to practice high-risk, low-volume diagnoses and skills that will inevitably be a part of their professional career. The integration of Augmented Reality technology in an EMS classroom could enhance students’ practical skills, professional demeanor, and demonstrate clinical reasoning in a safe environment. Furthermore, Augmented Reality technology could engage the learner in a more immersive scenario and provide a higher-level learning opportunity which has not been previously available. This would include clinical decision-making, prioritization, and delegation of skills. Hence, research of Augmented Reality integration in the EMS classroom may warrant future studies.

**Methodology**

**Data Collection**

Participants total N=41, control group using the dependent variable of traditional lecture method was n=20. The experimental group using the independent variable of A.R. self-guided lesson was n=21. Two participants were excluded from the experimental group due to technical issues with the Wi-Fi connection which was a requirement for A.R. app and “Quizizz” ™ app. After two exclusions due to technical errors the total participants N=39, control group n=20, experimental group n=19.

**Instructional Materials**

The material used in the control group was a PowerPoint lecture on the pathophysiology on the blood flow through the heart from the participants’ text Nancy Caroline’s Emergency Care in the Streets 8th Edition 2014. The participants in the experimental group used an A.R. free app that they downloaded, “Anatomy 4D” by DAQRI. In order to utilize the app a hard copy of the required marker was provided to each participant. Both groups were given a multiple-choice post-assessment on the blood flow through the heart, based on Florida
Department of Education Framework for Paramedics standard MLO 31.0 and 31.04, using the game app “Quizizz”™. The usability test was conducted using instructors for the paramedic program. The reliability test was conducted using SPSS software independent sample test and Analysis of Variance test (f=t) 2. F is the variance between the samples and t refers to the test. The results of t=.0392 ≈ f=.002 suggests test reliability since the f (variance) is extremely low. Participants in the experimental group were given an online post survey using Survey Monkey. The reliability test was conducted using SPSS which returned a Cronbach’s Alpha, a statistical measure used to assess internal consistency of test items, of 0.918 suggesting relatively high internal consistency.

Assessment Procedure

The participants N=39 were randomly selected into two groups. Group 1 n=20 was the control group. Group 2 n=19 (two were excluded due to technical issues and were unable to download the required app) was the experimental group. Group 1 had a 30-minute traditional lecture on the pathophysiology of the blood flow through the heart. The PowerPoint used was referenced from the current paramedic textbook used in the program, Nancy Carolines Emergency Care in the Streets 8th Edition 2014. The instructor delivering the lecture was the regular instructor for the paramedic program. Post-lecture, students participated in a post-test assessment. The assessment was given using the “Quizizz”™ app via the participants’ phone. For anonymity, students were given a number that was generated by a number randomizing program to use instead of their name. The assessment had 6 multiple choice questions with each question requiring the participant to identify the area of the heart were the blood was flowing. Each question had a 15 second time limit. Group 2 n=19 (two were excluded) were given verbal instructions to download the A.R. app Anatomy 4D by Darqi and given the associated marker.
No further direction was given to the participants on how to use the app or the marker. The participants were told to break up into groups of their choosing or work as an individual to learn about the pathophysiology of the blood flow through the heart using the A.R. app. A 30-minute time limit was given, and participants were told there would be a short assessment after the self-guided lesson. Instructors were told not to give any assistance to the participants. Group 2, self-guided lesson participants, were given the same post-test assessment as group 1. Group 2 participants were asked to take an online survey via survey monkey. Each participant, n=19, was emailed the link, 17 surveys were returned. One participant was randomly selected for a phone interview and one participant was randomly selected for a face to face interview using 7 predetermined questions.

**Data Analysis of the Post-Test Assessment**

Post-assessment for group 1, control group, using traditional methods of instruction n=20 mean 78.5238 with a standard deviation of 20.48565 and a standard error mean of 4.47034. Post-test assessment for group 2, experiment group, using A.R. method of instruction n=19 means 84.2222 with a standard deviation of 22.53427 and a standard error mean of 5.31096. An independent t-test results (p=0.417). Table 3 is a one-sample test using the test value of 78 from the results of the mean from group one results (p=0.258).
Data Analysis – Survey

The survey was distributed via email to the participants using survey monkey. 19 surveys were sent out and 17 surveys returned.

Results and Findings

The hypothesis for this research study was to determine if AR can improve the paramedic students’ self-perception of knowledge retention when learning the physiology of the blood flow through the heart thereby improving assessed learning outcomes compared to traditional methods of learning. At first impression, the post-test assessment scores did show an improvement. Group 1, the control group had a mean score of 78% and group 2, the experimental group, had a mean score of 84%. The independent t-test results of (p=0.417) and the one-sample test using the test value of 78 from the results of the mean from group one results (p=0.258) suggests there is not a significant difference using (p=0.5). Therefore, the null hypothesis cannot be rejected. Furthermore, the survey for group 2 resulted in only 35.3% of the students indicating the use of A.R. would increase their test scores.

Interestingly, the survey results state that 64% of the participants did acknowledge A.R. should be used moderately in the classroom. The participant interviews paralleled the same results as the online survey. The face to face interview participant did opine that perception, technology comfort level and use of AR may differ based on the age of the learners. The participant gave the example of an older or non-traditional paramedic student introduced to the app may be hesitant to use it and may prefer traditional learning methods. The phone interviewee felt that AR would be a good alternative for those students who consider themselves visual learners. These are two possible factors that could have led to the survey results of AR only being used moderately in the classroom and not the sole method of instruction.
Conclusion

The preliminary research presented by this study did not prove the hypothesis. An assumption can be made this was due to challenges and confounding variables that were not originally accounted for in the scope of the project. The first challenge was no funding was available for this project. Therefore, a free version of the AR app and marker was used in this pilot study. The app used for the A.R. technology was perhaps an over simplified representation of the heart whereas a more robust A.R app may have been better suited for this research. The second challenge was the A.R. app proved to have glitches with freezing or positional loss of the A.R.

Instructors did observe that the participants appeared engaged in active learning and facilitating self-guided discussion using A.R. to learn about the blood flow through the heart versus passive learning through the traditional method. There were no issues with the participants learning how to use the app.

Limitations

Limitations that could have affected the results are maturity, scope, and support. The scope of the study had limited participants based on the availability of students in the program. A more robust study using a larger sample size and multiple paramedic programs may yield a higher confidence factor. The maturity of the program was also a limitation. This program is somewhat new and not widely utilized so there was no basis for comparison. Support for such a program was not addressed. There was instructor support, but institutional support was not known. This would be a good variable to look at for future research.
Ethical Considerations

There were no anticipated risks associated with this study. Participants were notified of the research question (hypothesis), scope and process of the study. They were also told participation in this study was purely voluntary, they could choose to discontinue participation at any time without harm or retribution. No compensation either monetarily or extra credit was awarded as evidenced by the Informed Consent document. For anonymity, students were given a number that was generated by a number randomizing program to use instead of their name. All the applicable guidelines set forth by the Institutional Review Board, (IRB), were followed to protect the privacy of the participants and the objectivity of this study.

Suggestions for Further Research

This preliminary research can conclude that further investigation is necessary to determine whether A.R. can enhance learning, therefore, improving assessment outcomes. Most of the participants agreed that A.R. could be a useful way of learning in addition to the traditional method. A broader, larger scale study is suggested with multiple participants if possible. An additional recommendation for extended follow up and assessment of the participants is suggested. Assessing participant knowledge retention at a later date for both groups may help answer suggested research question number three stated in this study, will A.R. participants retain the information long-term compared to the participants from the traditional lecture?
References


