Virtual Reality Simulation and Self-Efficacy

Theresa Keegan, Maribel Mueller, and Balee Winters

Department of Nurse Anesthesia, AdventHealth University

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Dr. Christina Mandalis-Defour

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Abstract

Virtual reality (VR) has long been utilized to enhance learning opportunities among trainees in a multitude of medical professions. Implementation of VR has grown in popularity over the years due to the ability of students to immerse themselves in real-world clinical environments that provide safe and effective experiences to enhance clinical skills. In contrast to human patient simulators or mannequin-based training, VR offers student registered nurse anesthetists (SRNAs) the ability to visualize a more anatomically correct representation of the human body. The aim of this QA/QI study at AdventHealth University was to incorporate Anatomage tables in learning the airway and respiratory tract, an understanding that is critical to the skill of intubation in the education of SRNAs. The goal was to determine if exposure to this technology increased feelings of preparedness in the 2026 cohort regarding their ability to appropriately identify airway anatomy and successfully intubate before approaching real-life clinical scenarios. Outcomes were measured through a single post-test for all participants utilizing the Self-Efficacy Scale (SES) modeled after the Learning Self-Efficacy Scale. The results determined that Anatomage tables provided a statistically significant enhancement to the novice SRNAs training in airway anatomy, suggesting their integration into the DNAP program at AHU for future cohorts. Recommendations based on the results were communicated to AdventHealth University faculty regarding the benefit of VR, specifically Anatomage tables, for the overall preparedness or self-efficacy students perceive before starting clinical rotations within the Doctor of Nurse Anesthesia Practice program.

Keywords: self-efficacy, student registered nurse anesthetist, virtual learning

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APPENDICES

Virtual Reality Simulation and Self-Efficacy

Virtual Reality (VR) is a powerful educational tool, especially in the field of medicine. Instead of learning online, in a classroom, or waiting for an opportunity to arise in clinical practice, an educator can utilize VR software that immerses students in real-world learning opportunities for a variety of clinical skills (Nesenbergs et al., 2020). This is especially relevant currently to nurse anesthesia education as clinical opportunities have been lessened by the COVID-19 pandemic, but important procedural skills still need to be mastered. It is important to determine if this tool can provide students with adequate confidence in their abilities compared to traditional training techniques, such as intubation mannequins and human patient simulators (HPS).

Significance & Background of Clinical Problem

Airway management is a critical component of nurse anesthesia training. Traditional tools like intubation mannequins or HPS do not adequately resemble real-life airway anatomy, and a resulting lack of familiarity with the airway may create additional anxiety and intubation failures for students in their initial clinical experiences (Ayoub et al., 2010; Kaplan & Ward, 2011). VR is an emerging trend in the education of medical professionals due to the immersive opportunity it provides learners to practice clinical skills in a safe, controlled environment. Several studies have shown equal or improved preparedness or self-efficacy with VR simulation as opposed to conventional methods of practice in graduate medical training (Francis et al., 2020; Johnson et al., 2014; Pulijala et al., 2018). However, few of these studies have been conducted in

nurse anesthesia education. It is important to explore the feasibility of VR simulation in the setting of doctoral nurse anesthesia education to determine if self-efficacy or clinical preparedness can be improved for nurse anesthesia students prior to entering their initial clinical experiences. AdventHealth University (AHU), the site for this QA/QI study, offers a growing program with an emphasis on improving educational technologies.

PICOT Evidence Review Questions

Two questions were developed in PICO format to assist in the systematic review of literature (Roush, 2019). The first question addressed the problem: For graduate-level healthcare trainees including medical students, physician assistant students, and nurse anesthesia students (P), do virtual reality training modules (I) increase self-efficacy (O) within their professional role compared to mannequin-based training? The second question addresses the innovation: For student nurse anesthetists at AdventHealth University (P), does implementation of training with Anatomage virtual reality tables (I), compared to intubation mannequin training (C), improve self-efficacy and clinical preparedness to perform intubations in a clinical setting (O)?

Search Strategy and Results

The search strategy included three databases: PubMed, Ovid, and Google Scholar. A total of 149 articles were initially retrieved. Thirteen studies met inclusion criteria. Article breakdown resulted in 78 articles having a study group consisting of non-graduate students and were eliminated and 58 studies that measured performance and did not measure self-efficacy and were also eliminated. Key search terms and MeSH combinations included: *virtual reality* AND *simulation* AND *graduate student,* AND *healthcare,* AND *anesthesia,* AND *self-efficacy,* AND *confidence,* AND *education*. The search limits were: English language, research article, human subjects, and publication within the last 20 years.

GRADE Criteria

The literature was reviewed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework. An initial rating of four was given to the evidence quality for use of randomized controlled trials, most of which were blind or double-blind. The rating was decreased to a three due to study limitations including small sample sizes and convenience sampling which resulted in imprecision. Most of these studies were limited to the students enrolled in the researchers' programs. No indirectness, inconsistency, or publication biases were detected in these studies. The evidence gathered results in moderate confidence in the effect. Based on an evaluation of the evidence using the GRADE framework, it is recommended that virtual reality simulation be used in the graduate-level healthcare education setting as a means for improving self-efficacy and clinical preparedness in students (See Appendix A for Matrix Tables).

Literature Review and Synthesis of Evidence

Simulation training has long been utilized as a standard in graduate-level healthcare professional training and substantial evidence supports its ability to enhance knowledge and self-efficacy across programs and modalities (Francis et al., 2020; Pulijala et al., 2018). However, the majority of evidence dedicated to the use of virtual reality platforms is within medical student and physician assistant student populations, with no studies representing nurse anesthesia students.

Enhanced Self-Confidence and Self-Efficacy

The terms self-confidence and self-efficacy are used interchangeably among the studies and will be referred to in this literature review as self-efficacy. Self-efficacy has been considered by many researchers to generate improved clinical performance post-simulation training (Francis

et al., 2020; Johnson et al., 2014; Pulijala et al., 2018). When students are able to engage in a high-fidelity learning environment, critical thinking skills are honed and managed effectively prior to real-world clinical experiences (Johnson et al., 2014). Post-simulation self-efficacy scores identified through participant surveys revealed increased perceived self-efficacy, including high fidelity mannequin simulation; this suggests that the increase in perceived self-efficacy persists across modalities, including virtual reality platforms (Ahlborg et al., 2015; Francis et al., 2020; Fukuta et al., 2021; Lamblin et al., 2020; Pulijala et al., 2018; Vincent et al., 2008).

Enhanced Safety

From a safety perspective, simulation can help trainees achieve clinical skills without placing vulnerable populations at risk for training purposes (Ahlborg et al., 2015). Additionally, simulation and virtual reality have become more central to curricula as the COVID-19 pandemic created an at-risk clinical environment and cadavers became unavailable, resulting in a need to rapidly shift a way of teaching and learning that has been in use since the 1700's (Bradford et al., 2021; Iwanaga et al., 2020).

Anatomage Table Benefits

One specific adaptation of virtual reality aimed at teaching anatomy is the Anatomage table, which is a fully segmented real human 3D anatomy system (Anatomage, 2018). Several studies have been conducted on the use of Anatomage tables testing numerous variables including confidence, knowledge, excitement, perceived degree of learning, and preference after using the tables as compared with traditional methods of learning (Alasmari, 2021; Banjoko et al., 2021; Baratz et al., 2019; Brown et al., 2015; George & Clarke, 2021; Owolabi et al., 2022). Studies showed medical students had increased confidence after using the tables; they preferred

using these tables in addition to cadavers as opposed to learning on cadavers alone, and the tables improved understanding of relationships between internal structures better than the cadavers (Alasmari, 2021; Banjoko et al., 2021). Students who learned with the Anatomage tables had a greater perceived degree of learning and were more excited before and after their simulations than their peers who did not use Anatomage tables (Baratz et al., 2019). The groups using the tables also found the technology more engaging and were more likely to recommend this to their peers (Baratz et al., 2019; Brown et al., 2015). Studies conducted with 79 graduate anatomy professors (Owolabi et al., 2022) and approximately 200 medical students (George & Clark et al., 2021) determined Anatomage tables would be complementary to cadaver lab education.

Research suggests the best method of teaching anatomy is multimodal (Baratz et al., 2019). Currently at AHU, SRNAs learn anatomy via traditional lecture and human-patient simulator modalities. With the evidence supporting the use of virtual reality, and specifically Anatomage tables, to improve self-efficacy and preparedness in graduate students in other medical fields, this project is designed to introduce the Anatomage table to the nurse anesthesia curriculum and assess whether similar results can be achieved.

Project Aims

The primary purpose of this QA/QI assessment project was to evaluate the Anatomage tables within the AHU simulation lab as a modality for training student registered nurse anesthetists in the cohort of 2026 appropriate airway anatomy during intubation training by determining perceived preparedness and self-efficacy. The project objectives are outlined below.

1. Obtain current Anatomage tables, intubation mannequins, and McGrath Video Laryngoscopes within the simulation lab for use during the summer 2023 trimester with

the class of 2026 cohort.

2. Assess the perceived self-efficacy and preparedness participants experience specific to airway anatomy after instruction with both the Anatomage tables and traditional intubation mannequins utilizing the McGrath Video Laryngoscopes.
3. Assess the perceived self-efficacy and preparedness participants experience specific to airway anatomy after instruction with only the traditional intubation mannequins utilizing the McGrath Video Laryngoscopes.
4. Compare results of self-efficacy and perceived readiness between the two groups having received different types of instruction.
5. Compose recommendations for the implementation of Anatomage tables within DNAP courses for future cohorts.

Methods

Design

A quasi-experimental, two group, post-test design was utilized for this study to evaluate participant's self-efficacy and perceived readiness to intubate after training with the Anatomage tables for identifying airway anatomy prior to intubation training. A post-test design included collecting data after an intervention had taken place. Our independent variables included the use of the Anatomage tables and the traditional intubation mannequins utilizing the McGrath video laryngoscope to visualize oropharyngeal anatomy while our dependent variables are self-efficacy and perceived readiness to intubate in the clinical setting. All participants were exposed to the intubation mannequins via the McGrath video laryngoscope to visualize and familiarize themselves with oropharyngeal airway anatomy. 14 of the 2026 DNAP cohort participants also attended an in-person instruction with the Anatomage tables in addition to their intubation

mannequin training. All participants, regardless of which training modality they received, participated in a post-test survey during the summer of 2023, determining their self-efficacy and perceived readiness to perform intubations.

Sample and Recruitment

A convenience sample was utilized for this project (n = 29). All participants were first year students in the AHU class of 2026 DNAP cohort in their first trimester. These are full-time doctoral students who attend a private, faith-based university in Central Florida. Inclusion criteria was any SRNA in the 2026 cohort at AHU. Exclusion criteria was any SRNA in the 2024 or 2025 cohort as well as students who had exited the program. Vulnerable populations were not anticipated or encountered in this research project.

The subjects of this research study were those who volunteered to participate from the 2026 cohort of SRNA's. An email was sent to the 2026 cohort in May of 2023 for recruitment purposes with a letter of voluntary participation and a flyer explaining our project (See Appendix B & C). Those who replied to the recruitment email with a desire to participate, were randomly split into a control and intervention group. During one of three pre-scheduled dates, all participants attended an educational, in-person session focusing on airway anatomy. The control group visualized the airway anatomy on the intubation mannequins with the McGrath. The intervention group had a session with the Anatomage Tables to familiarize themselves with airway anatomy prior to working with the mannequins. During the summer of 2023, all participants performed a post-test survey determining their level of self-efficacy and readiness to perform intubations. Results from both groups were used to compare self-efficacy levels and determine if the addition of Anatomage Table learning has a positive impact on a student's perceived readiness for clinical practice in regard to airway anatomy.

No risks were identified for the group of participants and no vulnerable populations were utilized. A notice of voluntary consent and participation with no compensation was given to all subjects before the research commenced (See Appendix C).

Data Collection

The data for this study was collected by conducting an anonymous survey after the students completed their learning sessions of airway anatomy. A Quick Response (QR) Code was provided to participants after their sessions, containing a link to the post-test survey. The survey instrument was a Self-Efficacy Scale (SES) modeled after the Learning Self-Efficacy Scale. The subjects were contacted a total of three times: the first to seek participants in the study, the second to explain the simulation they are to attend, and the third time to conduct the study.

Instruments

The Learning Self-Efficacy Scale is a short scale that serves as a generic assessment tool for measuring medical students' learning self-efficacy for clinical skills. It is based on the framework of Bloom's taxonomy and was generated via expert consensus and content validity index calculation (Kang et al., 2019) (See Appendix D). Permission was obtained from the creators of this scale to allow for modification and use of this scale in this research study (See Appendix E). The original scale includes three domains: cognitive, affective, and psychomotor. This study will modify this to include only cognitive and psychomotor domains. The questions were modified, with permission, to be more specific to the skill being learned with the tables or with the intubation mannequins.

Data Analysis

The data was analyzed by R 4.2.0 using a Wilcoxon Sum Test to compare the mean

values of self-efficacy, preparedness, and readiness to perform results of the control and test groups. Additionally, the data was analyzed via an SPSS computer program. The data will remain anonymous by sharing via password protected software. The data will be stored for 7 years and then deleted. Rigor was ensured in this study through thoughtful and deliberate planning, diligent and ongoing application of researcher reflexivity, and honest communication with subjects and audience.

Planning and Procedures/Limitations

Planning

Two of our key stakeholders who participated in this scholarly project were identified according to their role at AHU: Todd Larson, Director of Simulation and Innovative Technologies and Brandon Baker, Director of the Immersive Technology Lab. As the DNAP program has yet to utilize the Anatomage Tables and it is important to see the long-term benefits in a student who has used them, our end user was a current second-year student in the physician assistant program at AHU, Ammal Shelleh. Our stakeholders are essential to the implementation of virtual learning at AHU and their involvement and active participation in our project was integral to encouraging new, successful virtual modalities being incorporated at the university.

Implementation

After researching current educational modalities among the graduate-level healthcare trainee population and performing a literature review, the subject of VR learning compared to the traditional teaching methods with intubation mannequins was chosen. A problem was identified with a PICOT question formed and communicated to AHU faculty for approval during May of 2022. Following approval, key players were identified and interviewed. Our scholarly project team received feedback and created a method design based on recommendations from reviewers

and statisticians at AHU. Following Institutional Review Board (IRB) approval, plans to engage our study sample with Anatomage learning occurred during the summer of 2023 with a follow-up in both our sample group and our control group by way of a survey at the time of participation within the study. These survey responses were compiled in a Microsoft Excel spreadsheet and communicated to our statistician for statistical analysis.

Barriers and Facilitators

Anticipated barriers included a willingness of students to participate in the project and discomfort if not technologically adept. Directors from other nurse anesthesia programs contacted suggested further barriers may exist, including faculty or simulation facilitator fatigue. As the identified key players are critical to the implementation of virtual learning at the university, any change in their support would have presented challenges to the project. Strategies employed to mitigate these risks included active collaboration with our key players as well as our DNAP faculty and committee to ensure evidence-based recommendations were made to enhance learning and student engagement.

Procedures to Sustain

The intervention was sustained by ensuring open and clear communication with DNAP faculty, key players, participants, and the Simulation Department at AHU. Ensuring unencumbered access to participants on intervention days, availability of the Anatomage tables, as well as reservation of airway mannequins and the McGrath Video Laryngoscope was vital to ensuring the sustainability of our intervention.

Project Timeline

This scholarly project’s implementation and data collection began in the summer of 2023 when the class of 2026 was in their first trimester. The control group was trained on airway

anatomy through intubation mannequins and McGrath Video Laryngoscopes, while the experimental group was introduced to the Anatomage tables in addition to the mannequin training. Both groups completed a post-education survey on the level of self-efficacy they felt after each training modality. Post-implementation data was analyzed in the fall of 2023 after surveys had been returned. The completed project timeline (See Appendix F) did not vary from the anticipated timeline set forth at the beginning of the project planning period.

Results

The final sample included 29 participants (n = 29), with 15 students in the control and 14 students in the experimental groups. There was a one-hundred and three percent response rate to the post-test survey and no participants were excluded from the analysis state. Sample demographic included SRNAs in the graduating cohorts of 2026 DNAP program. Although all genders were included, no data was collected regarding participants' gender, age or other background. The online survey delivered through a QR code was confidential with all data stored in a secure Microsoft Forms account.

The data was analyzed by the AHU statistician using a Wilcoxon Rank Sum Test due to non-normality of data: 30 responses were recorded in the data analysis of Microsoft Forms survey, 15 for the control group and 15 for the experimental group, but only 29 participants were recruited. The extra response was noted in the experimental group. Results revealed statistically significant results of a Z value of 60.5, translating to a p-value of 0.0304. It can be concluded that for both of the surveyed domains, the use of Anatomage tables provided higher rates of self-efficacy when learning airway anatomy essential to the skill of intubations.

Discussion

As technology evolves, so does the need to question long-standard practices of

mannequin-based simulation training. VR platforms can deliver high fidelity clinical simulation with an increased degree of self-efficacy or perceived readiness as compared to traditional mannequin-based training tools while still offering the ability to train and develop skills in tenuous clinical situations without compromising patient or trainee safety. A gap in the current evidence exists specific to training with virtual reality or Anatomage tables within the nurse anesthesia student population. Although an increase in self-efficacy scores exists post VR simulation, it is not shown to be statistically significant compared to traditional modalities of simulation training. However, studies reviewed specific to the implementation of Anatomage tables did reveal an increase in these variables suggesting this particular adaptation of VR may be a great tool for active learning and student engagement within the student nurse anesthesia population. The aim of this scholarly project was to conduct research to determine if this modality is more effective at producing higher rates of self-efficacy and preparedness among students in identifying airway anatomy for intubations than the intubation mannequins presently used.

Results of this study show significant increase in the average scores between both cognitive and affective measures within the posttest survey ($p < 0.05$). It can be concluded the Anatomage tables provide a quality learning tool in aiding the graduate student of nurse anesthesia within their training and identification of airway anatomy prior to performing intubations in clinical practice.

Key Findings

Key findings of this scholarly project include a significant increase in SRNAs perception of self-efficacy of clinical preparedness after completing the in-person training of airway anatomy specific to intubation utilizing the Anatomage tables. This particular study contributes

knowledge to further the practice of utilizing virtual reality in the education of students within the field of nurse anesthesia. Further, this study promotes feasibility of an existing, but underutilized educational tool already available within AdventHealth University that has not been utilized for learning within the DNAP program.

Sample Demographics

This scholarly project did not collect any sample demographics while performing this study. The sample included SRNAs within the graduating cohorts of the 2026 AHU DNAP program. All genders were included and age was not elicited from any participant. Sample was elicited as a convenience sample from an on-campus class conducted during the Spring of 2023. Of the 30 potential participants surveyed, 29 students voluntarily participated in our study.

Interpretation of Results

Our results are consistent among participants, with the exception of one participant in the experimental group submitting two surveys by accident. Results analyzed provided a clear answer to our PICOT question strongly suggesting in-person training with an Anatomage tables during the learning of airway anatomy prior to intubation along with the use of the mannequins provides a stronger perceived clinical readiness and self-efficacy than by use of the mannequins alone among students in the DNAP program at AHU. The aims set forth by this scholarly project to procure the Anatomage tables, video laryngoscope and mannequins for use, along with the assessment of student's perceived self-efficacy and clinical preparedness after the training was met. Further aims of compiling and performing statistical analysis on our survey results were achieved as well. Results suggest use of these tables to be beneficial in the training of novice nurse anesthesia students in the future with communication to the DNAP program at AHU for future cohorts.

Theoretical Framework

The theoretical framework for this project is rooted in the Dual Coding Theory (DCT) explored by Paivio (Hartland et al., 2008). This theory suggests our brain processes verbal and nonverbal input differently, with nonverbal input such as material presented visually amplifying cognition and leading to increased recall and understanding. This theory has been used to emphasize the benefits of input such as video-based or virtual reality in student nurse anesthetist training as this population necessitates a diverse and wide range of modalities during their education.

Additionally, self-efficacy is often associated with Bandura's (1977) research in the Social Learning Theory. Self-confidence, self-efficacy and confidence were used interchangeably within this theory to delineate a common thread suggesting when we perceive ourselves as knowledgeable and sure of our abilities, the more prepared and successful at the time of execution of the task with competence being tied directly to perceived self-efficacy.

Implications, Applicability to Practice and Contribution to Professional Growth

VR platforms offer a wider variety of clinical scenarios than traditional mannequins and HPS, require fewer staff to operate, and take up less overall space. These cost-efficient factors along with improvements in self-efficacy and maintenance of patient and trainee safety identified in the literature suggest a change in modality of airway intubation anatomy training is warranted within the AHU DNAP program. While feasibility may exist as a challenge for other nurse anesthesia programs to procure this level of technology for implementation, its use within the AHU DNAP program, where the Anatomage tables have already been purchased and are stored are highly achievable for use in the training of future cohorts.

Further research could be performed to analyze its effectiveness as a training modality in alternative anatomical training within the nurse anesthesia profession such as regional block or cadaver lab education. While our project was aimed at the analytics of self-efficacy or clinical preparedness the tables can provide students prior to clinical training, it could be advantageous to compare its use with the use of human cadaver training in the anatomy and physiology portion of the curriculum. This is especially prudent because the Anatomage tables, which are already procured, could provide an economical and sustainable alternative. Our scholarly project provided a safe additional learning modality incorporating the imaging of real-life cadaver anatomy in the training of airway anatomy for nurse anesthesia students, our target population. These students were able to successfully navigate the Anatomage tables while reporting higher rates of clinical preparedness compared to the control group. For this reason, our recommendation is the DNAP at AHU consider including the use of the Anatomage tables within their curriculum for future cohorts.

Limitations

Limitations included bias in sampling and comparison as well as potential for confounding variables. With only 14 to 15 students participating in each group, there is the possibility that too narrow a population makes it difficult to generalize results to a larger population. One of the anticipated limitations was that participants may not remain engaged in the study, but all participants remained engaged in the sessions and completed the post-test survey. There was also the potential for confounding variables depending on participants' backgrounds. Although all students within the study were essentially similar in terms of position in the DNAP program, their backgrounds may have varied considerably with regards to knowledge of the airway. However, this did not prove to be a concern.

Conclusion

Through utilization of a literature review, this scholarly project examined the use of virtual reality among graduate student learners and effectively determined research related to clinical preparedness among nurse anesthesia students specific to airway anatomy within intubation training to be lacking. This problem was the foundational basis and aided in the development of our two PICO questions and aims. Through the implementation of this project, it was found the innovation delineated within our PICO questions could be answered. With statistically significant results, Anatomage tables provide an effective modality at training novice nurse anesthesia students in the area of airway anatomy specific to intubation prior to entering clinical training. With these results, it is appropriate to recommend the use of the Anatomage tables within the DNAP program at AHU for future cohorts.

Dissemination Plan

This scholarly project's data will be disseminated at the AHU campus in Orlando, Florida during the spring of 2024. The plan for dissemination of data collected during the course of this scholarly project is to create a PowerPoint presentation and poster board. These materials will be presented to DNAP faculty and students, collaborating AHU staff, and key players at this time.

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Appendix A

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<tr><td>Purpose</td><td>Variables</td><td>Setting/Subjects</td><td>Measurement and Instruments</td><td>Results</td><td>Evidence Quality</td></tr>
<tr><td>Study One:
Assess impact on self-efficacy for pre-clinical physician assistant (PA) students through virtual reality (VR) operating room simulation.

Study Two:
Measure the speed, accuracy, and self-efficacy of medical students’ triage skills after exposing them to VR simulation.</td><td rowspan="2">Study One:
Self-efficacy

Study Two:
Triage score, Intervention score, Time to triage, and self-efficacy</td><td rowspan="2">Study One:
Subjects: 52 pre-clinical PA students
Setting: Surgical simulation suite, Shenandoah University

Study Two:
Subjects: 24 medical students
Setting: Medical school simulation center, University of Hawaii School of Medicine</td><td rowspan="2">Study One:
Schwarzer and Jerusalem’s General Self-Efficacy Scale (GSE)

Study Two:
Modification of the self-efficacy subscale of the learner evaluation questionnaire (LEQ) with the addition of two self-confidence questions.</td><td>Study One:
Statistically significant improvement in self-efficacy of VR group (M 31.92, SD 3.577) compared to traditional group (M 28.77, SD 4.092).

Study Two:
5 self-efficacy questions showed a statistically significant increase in scores over time. Q1 ΔM +0.2 p=0.034, Q2 ΔM+0.3 p=0.006, Q3 ΔM +1 p=0.001, Q4 ΔM +1.1 p=0.001, Q5 ΔM 0.8 p=0.008</td><td rowspan="3">Study One:
Methodological flaws:
Convenience sampling
Inconsistency:
None
Indirectness:
None
Imprecision:
Small sample size
Publication bias:
None

Study Two:
Methodological flaws:
Convenience sampling, subjects served as their own control group
Inconsistency:
None
Indirectness:
None
Imprecision:
Small sample size
Publication bias:
None</td></tr>
<tr><td>Design</td><td>Implications</td></tr>
<tr><td>Study One:
Randomized, double-blind, control trial

Study Two:
Repeated measures design</td><td>Study One:
VR simulation improved PA student self-efficacy in the operating room setting.

Study Two:
VR simulation improved medical student self-efficacy and self-confidence in triage skills.</td></tr>
</table>

<table>
<tr><td colspan="6">References
Pulijala, Y., Ma, M., Pears, M., Peebles, D. and Ayoub, A. (2018). Effectiveness of immersive virtual reality in surgical training - a randomized control trial. Journal of Oral and Maxillofacial Surgery, 76(5), 1065-1072. doi:10.1016/j.joms.2017.10.002
Schoeb, D. S., Schwarz, J., Hein, S., Schlager, D., Pohlmann, P. F., Frankenschmidt, A., Gratzke, C., & Miernik, A. (2020). Mixed reality for teaching catheter placement to medical students: A randomized single-blinded, prospective trial. BMC Medical Education, 20(1). https://doi.org/10.1186/s12909-020-02450-5</td></tr>
<tr><th>Purpose</th><th>Variables</th><th>Setting/Subjects</th><th>Measurement and Instruments</th><th>Results</th><th>Evidence Quality</th></tr>
<tr><td>Study One:
Evaluate impact of VR surgery on the self-confidence and knowledge of surgical residents.

Study Two:
Deliver an objective and subjective evaluation of learning outcomes applying a mixed reality (MR) system to train medical students to perform bladder catheter placement.</td><td rowspan="3">Study One:
Primary outcome: Self-confidence levels before and after the intervention

Secondary outcome: Knowledge level changes and impact of stage of training on perceived self-confidence scores

Study Two:
Primary outcome: learning outcomes

Secondary outcome: self-evaluation</td><td rowspan="3">Study One:
Subjects: 95 novice dental surgical residents
Setting: Virtual OR across seven dental schools across the UK

Study Two:
Subjects: 164 third- and fourth-year medical students on urology rotation
Setting: Department of Urology at the University of Freiburg Medical Center</td><td rowspan="3">Study One:
Primary outcome: Questionnaire was designed to accommodate various elements of confidence using a five-point Likert scale.

Secondary outcome: Two questionnaires developed including self-assessment and knowledge testing.

Study Two:
Primary outcome: Objective structured clinical examination (OSCE) with a total score of 24.

Secondary outcome: evaluation of their learning experience and ability using a 6-point Likert scale.</td><td>Study One:
Self-confidence: significant increase (f (1.85) =65.71, p=0.000) in both groups. Control group: d=0.234, power 0.906 (p=0.002). Study group: d=0.642, power 1.000, p=0.000.
Stage of training impact: significant difference between first- and third-year residents (p=0.001), no significant difference between second- and third-year residents (p=0.360).

Study Two:
Self-evaluation before training M=2.43 ± 1.4; Self-evaluation after training M=3.4 ±1.3, p<0.001, with no significant difference between the groups.</td><td rowspan="3">Study One and Study Two
Methodological flaws: Convenience sampling
Inconsistency: None
Indirectness: None
Imprecision: None
Publication bias: None</td></tr>
<tr><td>Design</td><td>Implications</td></tr>
<tr><td>Study One:
Multisite, single-blinded, randomized controlled trial

Study Two:
Randomized, single-blinded prospective trial</td><td>Study One:
Positive correlation between VR intervention and resident self-confidence. VR group performed better than control group. Highest improvement noted among first year residents.

Study Two:
Confidence levels in medical students placing a bladder catheter were the same whether the patient was trained with an instructor or mixed reality.</td></tr>
</table>

References

Ahlborg, L., Weurlander, M., Hedman, L., Nisel, H., Lindqvist, P. G., Felländer-Tsai, L., & Enochsson, L. (2015). Individualized feedback during simulated laparoscopic training:A mixed methods study. *International Journal of Medical Education, 6*, 93-100. https://doi.org/10.5116/ijme.55a2.218b

Fukuta, J., Gill, N., Rooney, R., Coombs, A., & Murphy, D. (2021). Use of 360° video for a virtual operating theatre orientation for medical students. *Journal of Surgical Education, 78*(2), 391-393. https://doi.org/10.1016/j.jsurg.2020.08.014

Purpose	Variables	Setting/Subjects	Measurement and Instruments	Results	Evidence Quality
Study One To assess whether individualized feedback among virtual reality laparoscopic surgical simulator training improves performance, self-efficacy and flow among medical students **Study Two** To assess whether a virtual reality simulation orientation improves knowledge and self-confidence among medical students	**Study One** Performance, self-efficacy, and flow **Study Two** Knowledge gain and change in self-reported confidence	**Study One** **Setting:** Center for Advanced Medical Simulation and Training (CAMST), Karolinska University Hospital, Stockholm, Sweden **Subjects:** Sixteen medical students equally distributed among gender (female n = 8, male n = 8). **Study Two** **Setting:** North Bristol Academy Medical School, University of Bristol, Southmead Hospital, Bristol, United Kingdom **Subjects:** 34 medical students	**Study One** Self-efficacy evaluated with a 3-item questionnaire using a 7-grade Likert-type scale, Mann-Whitney U, Wilcoxon, Qualitative Focus Group Interview **Study Two** 7-point Likert scale questionnaire	**Study One** Self-efficacy scores improved in both groups ($p < 0.05$), with males scoring higher than females on confidence of "success in future simulator tasks". **Study Two** Knowledge improved from 38.4% to 78.2% ($p < 0.01$), self-reported confidence improved from 4.3 to 6.1 ($p < 0.01$).	**Study One Methodological flaws:** Convenience sampling, no blinding **Inconsistency:** Not all participants participated in focus group interviews **Indirectness:** None **Imprecision:** Small sample **Publication bias:** None **Study Two Methodological flaws:** Convenience sampling, lack of a control group **Inconsistency:** None **Indirectness:** None **Imprecision:** Small sample size **Publication bias:** None
Design				**Implications**	
Study One Randomized mixed-method study. **Study Two** The design was not clearly stated, but appears to be a non-randomized controlled before-and-after study.				**Study One** Individualized feedback in a simulated training environment increases perception of self-efficacy, flow and performance **Study Two** VR simulation was found to be effective at improving knowledge and self-confidence	

References

Atuel, H. R., & Kintzle, S. (2021). Comparing the training effectiveness of virtual reality and role play among future mental health providers. Psychological Trauma, https://doi.org/10.1037/tra0000997

Lamblin, G., Thiberville, G., Druette, L., Moret, S., Couraud, S., Martin, X., Dubernard, G., & Chene, G. (2020). Virtual reality simulation to enhance laparoscopic salpingectomy skills. *Journal of Gynecology Obstetrics and Human Reproduction*, *49*(3), 101685. https://doi.org/10.1016/j.jogoh.2020.101685

Purpose	Variables	Setting/Subjects	Measurement and Instruments	Results	Evidence Quality
Study One: Assess if virtual reality simulation improves interviewing and clinical skills compared to peer role play **Study Two:** Assess skill enhancement and maintenance by virtual reality simulation of laparoscopic salpingectomy in gynecologic surgery fellows.	**Study One:** Self-efficacy scores and knowledge of: engagement, PTSD, suicide, military cultural competence and overall confidence scores. **Study Two:** Objective analysis of performance of surgery and subjective self-assessment	**Study One:** **Setting:** Large unknown university **Subjects:** 161 students enrolled in a Master of Social Work program **Study Two:** **Setting**: University of Lyon, France **Subjects:** 26 junior fellows specializing in gynecology-obstetrics with less than 4 semesters of internship with no experience performing laparoscopic salpingectomy	**Study One:** Military Objective Structured Clinical Examination scale (MOSCE), self-report online survey **Study Two:** Objective: total procedure time, blood loss, reserve volume, duration of ovarian diathermia insult, migration or lateral movement per instrument, number of times instrument left the camera's field of view. Subjective: Self-assessment of anxiety, efficacy, ease of using VR, and feeling of being at ease during the procedure.	**Study One:** Self-efficacy not statistically significantly altered by mode of simulation, with improvement in both pre-test ($p = 0.83$) and post-test ($p = 0.49$). **Study Two:** Subjective: Statistically significant increase in self-efficacy in both sessions as trials progressed. Session 1: Delta M +2 $p<0.0001$. Session 2: Delta M +1.6 $p<0.0001$	**Study One:** **Methodological flaws:** Convenience sampling, unclear if randomization present **Inconsistency:** None **Indirectness:** None **Imprecision:** Small sample size **Publication bias:** Undetected **Study Two:** **Methodological flaws:** Convenience sampling, lack of control group **Inconsistency:** None **Indirectness:** None **Imprecision:** Small sample size **Publication bias:** Undetected
Design				**Implications**	
Study One: Quasi-experimental non-equivalent groups study **Study Two:** Prospective study				**Study One:** Both VR and peer role playing are effective at improving self-efficacy among graduate level social work students **Study Two:** VR simulation of laparoscopic salpingectomy was associated with increased self-efficacy in junior fellows.	

References

Jiang, B., Ju, H., Zhao, Y., Yao, L., & Feng, Y. (2018). Comparison of the efficacy and efficiency of the use of virtual reality simulation with high-fidelity mannequins for simulation-based training of fiberoptic bronchoscope manipulation. *Simulation in Healthcare: Journal of the Society for Medical Simulation, 13*(2), 83.

Johnson, M. P., Hickey, K. T., Scopa-Goldman, J., Andrews, T., Boerem, P., Covec, M., & Larson, E. (2014). Manikin versus web-based simulation for advanced practice nursing students. *Clinical Simulation in Nursing, 10*(6), e317-e323. https://doi.org/10.1016/j.ecns.2014.02.004

Purpose	Variables	Setting/Subjects	Measurement and Instruments	Results	Evidence Quality
Study One To determine if virtual reality simulation training of fiberoptic microscope intubation is effective and efficient compared to a high-fidelity mannequin modality **Study Two** To assess the role of web-based simulation training and its impact on student's level of skills and knowledge compared to manikin-based training	**Study One** Primary Outcome: Training Efficacy, efficiency and self-confidence **Study Two** Primary Outcome: Knowledge, attitudes, and skills related to managing critically ill patients	**Study One** **Setting:** Peking University People's Hospital, Beijing, China **Subjects:** 46 anesthesia residents **Study Two** **Setting:** University school of nursing simulation laboratory. **Subjects:** 32 Advanced practice nursing students in either ACNP program (n = 27) or CRNA program (n = 5).	**Study One** Five-point Likert scale, five-point global rating scale (GRS), and length of procedure time **Study Two** Self-assessment Weller questionnaire, performance checklists (four) evaluating objectives of history taking and clinical management	**Study One** No significant differences between time effect, GRS score, mean procedure time or self-confidence between groups [Student's *t* test = 2.1 (1.2) vs. 2.0 (0.7), $t^1 = 0.454$, P = 0.653]. **Study Two** Manikin-based training showed higher self-assessment scores of ability after training (47% vs 75%; p = 0.001) and performance mean scores (70% vs. 63%; p = 0.02).	**Study One**: **Methodological flaws**: Convenience sampling **Inconsistency:** None **Indirectness:** None **Imprecision** Small sample size **Publication bias** None **Study Two**: **Methodological flaws:** Recruitment bias noted. Convenience sampling and varied level of experience among participants. **Inconsistency:** Unclear if improvement in skills examined are indicative of improvement in real clinical setting **Indirectness:** None **Imprecision:** Small sample size **Publication bias:** None
Design				**Implications**	
Study One Double-blind Randomized control trial **Study Two** Randomized quasi-experimental pre-post test design				**Both** Mannequin-based training does not significantly increase efficacy, efficiency or self-confidence (study one) compared to a virtual platform, but increases self-assessment and observed performance in clinical skills (study two).	

<table>
<tr><td colspan="6">References
Khundam, C., Sukkriang, N., & Noël, F. (2021). No difference in learning outcomes and usability between using controllers and hand tracking during a virtual reality endotracheal intubation training for medical students in Thailand. Journal of Educational Evaluation for Health Professions, 18, 22. https://doi.org/10.3352/jeehp.2021.18.22
Agasthya, N., Penfil, S., & Slamon, N. (2020). Virtual Reality Simulation for Pediatric Airway Intubation Readiness Education. Cureus, 12(12), e12059. https://doi.org/10.7759/cureus.12059</td></tr>
<tr><th>Purpose</th><th>Variables</th><th>Setting/Subjects</th><th>Measurement and Instruments</th><th>Results</th><th>Evidence Quality</th></tr>
<tr>
<td>Study One
Investigate the differences in usability between using video only, hand tracking and controllers during the VR intervention for intubation training for medical students

Study Two
Provide education to inexperienced trainees regarding preparation for airway intubation using VR tutorial and comparison of performance with that of experienced trainees without VR training
Design
Study One
Pre- and post-intervention comparative observational study, involving a comparison of 3 groups and interviews
Study Two
Prospective, randomized comparison study</td>
<td>Study One
Primary outcome: Learning outcomes
Secondary outcome: user satisfaction and system usability

Study Two: time to execute skills, cost and space requirements, recall vs. demonstration efficacy</td>
<td>Study One
Setting: Building B6 in the Laboratory Teaching Center of the School of Medicine, Walailak University, Nakhon Si Thammarat, Thailand, from February 17, 2021, to March 5, 2021
Subjects: 45 3rd year medical students

Study Two
Setting: Pediatric Intensive Care Unit (PICU) of a quaternary children’s hospital with Accreditation Council for Graduate Medical Education (ACGME)-accredited pediatric residency and subspecialty (fellowship) training programs from July 1st through 31st 2019.
Subjects: 7 pediatric and 1st year fellows & 8 upper-year fellows and emergency medicine residents</td>
<td>Study One
Pre-test and post-test scores for learning outcomes; usability for the System Usability Scale (SUS) tool; usefulness, ease of use, ease of learning, and satisfaction for the User Satisfaction Evaluation Questionnaire (USEQ) tool; and emotional, instrumental, and motivational experiences in the interviews.

Study Two: Oculus Rift S headset with hand controls, Alienware gaming laptop, Acadicus simulation platform for simulation development. 24-point timed checklist with the most common equipment and preparation required pre-intubation, evaluated by critical care attending.</td>
<td>Study One
Learning outcomes of VR groups were better than video only group. Post-test scores (P=0.581) and practice scores (P=0.168) of both VR groups were not significantly different. No significant differences in SUS or USEQ scores.

Study Two
No significant differences in the checklist scores. VR setup time = 6 min vs. non-VR group at 3.5 min (P= 0.005). Requesting advanced airways was higher in the non-VR group (73.6% vs 55.3%) (P=0.0009).
Implications
Study One: Virtual reality intubation simulation improves learning outcomes when compared to video only training.
Study Two: VR learners showed no statistical difference in accuracy when compared to experienced fellows after participation in the immersive tutorial. This suggests VR technology maybe utilized for this purpose.</td>
<td>Study One:
Methodological flaws: Convenience sampling, non-randomized trial (students chose which group to be in)
Inconsistency: None
Indirectness: None
Imprecision: Small sample size and small hospital center
Publication bias: None

Study Two:
Methodological flaws: unclear how groups were chosen for the study
Inconsistency: the non-VR group only had to recall, while the VR group had to recall and demonstrate
Indirectness: None
Imprecision:Small sample size
Publication bias: None</td>
</tr>
</table>

Appendix B

AdventHealth University Department of Nurse Anesthesia

Student Registered Nurse Anesthetist's perception of clinical preparedness and self-efficacy to identify airway anatomy during intubation after Anatomage training

Theresa Keegan, BSN, SRNA, Maribel Mueller, BSN, SRNA & Balee Winters, BSN, SRNA
Chair: Dr. Amanda Bracken, DNP, CRNA

About the study

We are conducting a survey and implementing an in-person training of airway anatomy with Anatomage tables to assess student registered nurse anesthetist's perception of clinical preparedness to intubate patients of the 2025 AHU DNAP cohort as we believe that you may benefit from the training. Your insight and data collected from participation may impact the future use of using Anatomage tables within the Department of Nurse Anesthesia in the future.

Participation:

- Participate in one in-person Anatomage table anatomy lesson specific to airway anatomy
- 8-item post-questionnaire

When: Fall 2022

Where: AHU Graduate Building

Other: Participation is completely voluntary and consent will be collected and completed surveys will be kept private. All results will be used only for the purpose of this study with data from this study being destroyed after 7 years

Email:
theresa.keegan@my.ahu.edu or
balee.winters@my.ahu.edu or
maribel.mueller@my.ahu.edu

Appendix C

Notice of Voluntary Consent

Dear Doctorate of Nurse Anesthesia Practice (DNAP) Class of 2026,

Hello, we are third-year student registered nurse anesthetists (SRNAs) at AdventHealth University in Orlando, Florida. We request a few minutes of your time, to allow us to explain your possible participation in our scholarly research project. A key component of airway management and successful intubations for the anesthesia provider is knowledge of anatomy. In the past, DNAP students have learned these skills with classroom learning, human-patient simulators, cadaver labs, and mannequins. A recent trend in education is the incorporation of virtual reality to enhance learning opportunities. Our project focuses on the use of a type of virtual learning known as Anatomage Tables. These tables are 3 Dimensional (3D) digital human models that can be used for various learning exercises. The goal is to determine if education on airway anatomy via Anatomage Tables increases confidence in the ability to intubate before entering clinical practice.

All voluntary participants will be randomly assigned to two distinct groups. The first group will engage in airway training via the intubation mannequins and McGrath video laryngoscopes during an in-person session requiring no more than 20 minutes of your time. The second group will engage in airway training during an in-person session with the tables in addition to the mannequins during an in-person session which should take no more than 30 minutes of your time. After completion of the educational sessions, computers will be available in the simulation room for completion of a brief, 8-item survey regarding your perception of the learning techniques presented. The survey should take no more than 10 minutes to complete, and all information provided will remain anonymous.

Survey responses will help determine if the use of Anatomage Tables increases feelings of confidence and self-efficacy before entering clinical practice, compared to traditional teaching methods that are currently implemented. You are being asked to be part of this research study because your participation may help improve the education of future nurse anesthetists if it is determined that Anatomage Tables can positively impact one's own confidence, knowledge, and ultimate ability to approach intubations in clinical settings.

Your participation is completely voluntary, and you can stop responding to the survey at any time. Your participation or lack of participation in this study will not affect your academic performance or relationship with AdventHealth University.

If you have any questions, concerns, or complaints regarding this study, you may contact us at our student-generated AHU email. If you have any questions, concerns, or complaints regarding rights as a study participant, you may contact the AdventHealth Orlando Institutional Review Board at Phone # 407-200-2677or email: ORL.IRB.General@adventhealth.com

Theresa Keegan, BSN, RN, SRNA
Maribel Mueller, BSN, RN, SRNA
Balee Winters, BSN, RN, SRNA
AdventHealth University, Orlando, FL

Appendix D

Domain/No.	Disagree <----------> agree					
	Item	1	2	3	4	5
Cognitive						
1	I can recall how to perform "the clinical skill".	1	2	3	4	5
2	I understand the content of "the clinical skill" and can demonstrate it to others.	1	2	3	4	5
3	I can verbally explain the purpose and principle of operating "the clinical skill".	1	2	3	4	5
4	I can verbally explain the sequence and interrelationship between each step.	1	2	3	4	5
Affective						
5	I think I spend more time on "this" course than on others.	1	2	3	4	5
6	I think I gain more in "this" course than in others.	1	2	3	4	5
7	I tend to pay more attention to information related to "this" course.	1	2	3	4	5
8	I tend to actively look for information related to "this" course.	1	2	3	4	5
Psychomotor						
9	I can precisely imitate the instructor's steps and actions of "the clinical skill".	1	2	3	4	5
10	I can smoothly complete the operation steps of "the clinical skill".	1	2	3	4	5
11	I try to monitor my "clinical skill" for improvements.	1	2	3	4	5
12	I try to monitor my "clinical" operations and make proper adjustments as needed.	1	2	3	4	5

Users can replace the quoted phrases with target clinical skills

https://doi.org/10.1371/journal.pone.0209155.t005

Appendix E

Fwd: Permission to use L-ESE Likert Scale

TK

Theresa Keegan <Theresa.Keegan@my.ahu.edu> Today at 2:38 PM

To: Balee Winters

self Learning efficac... 15.9 KB

Download All • Preview All

From: 吳建志(TMU) <ccwu@tmu.edu.tw>
Subject: **Re: Permission to use L-ESE Likert Scale**
Date: October 3, 2022 at 11:14:06 PM EDT
To: Theresa Keegan <Theresa.Keegan@my.ahu.edu>

Dear Theresa Keegan, Maribel Mueller, & Balee Winters:

Thank you for your E-mail, and sorry for the late reply.

Yes, it is our pleasure and happy to approve that you **use and modify** the learning self-efficacy scale (L-ESE) developed by our team for your doctoral research project.
And please cite our article in your reference. Thank you.
Attached please find the original version of the L-ESE scale.
By the way, both E-mial (ccwu@tmu.edu.tw, and ccwu@h.tmu.edu.tw) will be OK.

Regards

Chien-Chih Wu, MD, PhD.
Professor and Chair
School of Medicine, College of Medicine
Taipei Medical University
Taipei, TAIWAN

Theresa Keegan <Theresa.Keegan@my.ahu.edu> 於 2022年10月3日 週一 上午8:19寫道：

> Good Morning Professor Chien-Chih Wu,
>
> We are graduate students in the Department of Nurse Anesthesia Program at AdventHealth University in Orlando, FL. We are reaching out to you to gain permission to use the L-ESE scale developed by your team in our doctoral research project. Since we are not currently able to perform the psychomotor portion of the Likert scale, we would also like further permission to remove this section for the purpose of our project.
>
> Please let us know if this would be acceptable.
>
> Also, I apologize if you are getting this email for a second time. I found an email with a slight change in the address today and wanted to make sure you received it so am resending.
>
> Thank you,
> Theresa Keegan, SRNA, Maribel Mueller, SRNA & Balee Winters, SRNA

Appendix F

Doctor of Nurse Anesthesia Practice

DNAP Project Timeline Recommended Checklist for Class Of 2024
(Revised November 23, 2021 and Subject to Change as Necessary)

Task	**Recommended Target Trimester**	**Date Completed**
1. Determine topic for DNAP Project	**4th and 5th Trimester Summer/Fall 2022**	
1.1 Assignment of DNAP Scholarly Project Chair and the identification of one or two areas of focus	4th Trimester Summer 2022	2/4/22
1.2 Review the AHU Scholarly Repository to ensure your project of interest has not previously been completed.	3rd Trimester Spring 2022	2/6/22
1.3 Review relevant literature and evaluate feasibility	3rd Trimester Spring 2022	2/10/22
1.4 Discuss and refine best idea with 2023 cohort and DNAP faculty	3rd Trimester Spring 2022	3/16/22
1.5 Develop and Complete Scholarly Project Initial Presentation	3rd Trimester Spring 2022	4/29/22
2. Identify scholarly project site for DNAP Project	**4th and 5th Trimester Summer/Fall 2022**	
2.1 Discuss site options with DNAP Scholarly Project Chair	4th Trimester Summer 2022	6/17/22
2.2 Consult with key site personnel for the Analysis and Comparison of Key Players Assignment and gain preliminary approval from DNAP Scholarly Project Chair to continue with the proposed project	4th Trimester Summer 2022	6/29/22
2.3 Once assignment three has been graded, and faculty member and key player preliminary approval have been obtained:	4th Trimester Summer 2022	2.3 A-D: 7/22/22

A. ***Complete the Study Site Director Approval Letter Template*** (Under Academics > University Research > Guides and Forms) and have it signed by an authorized representative from the project site. This form must be completed if the scholarly project is to be conducted on students or at sites other than within the NAP (Ex. Nursing department, AdventHealth, USAP Anesthesia Group). B. Once signed, please submit the signed Study Site Director Approval Letter, via e-mail to the DNAP department chair (Dr. Devasher) to obtain approval. When completed submit to Canvas C. Submit to Canvas contact information for someone at the project site familiar with your proposed project. Preferably the individual signing the study site director's approval letter. D. Submit Study Site Director Approval Letter, when completed, to CANVAS DROPBOX **Note: This form must also be submitted with the IRB/SRC application**		
3. Form DNAP Scholarly Project Committee (SPC)	**4th and 5th Trimester Summer/Fall 2022**	
3.1 Review requirements for SPC composition In the Student Scholarly Project Guidelines	4th Trimester Summer 2022	7/12/22
3.2 Identify committee members, consider alternatives, select members in consultation with your assigned Scholarly Project Chair and obtain their approval.	4th Trimester Summer 2022	7/19/22
3.3 Obtain approval from the NAP Program Administrator for proposed project mentor(s) and reviewer	4th Trimester Summer 2022	8/5/22

3.4 Complete ***DNAP Scholarly Project Committee form*** by obtaining project chair, mentor and project reviewer signatures	4th Trimester Summer 2022	7/28/22
3.5 Submit completed form, scholarly project chair approval e-mail and department chair approval e-mail thread to CANVAS DROPBOX	4th Trimester Summer 2022	8/5/22
4. Develop DNAP Scholarly Project Proposal Paper	**4th and 5th Trimester Fall 2022**	
4.1 Prepare draft of DNAP scholarly project proposal paper	4th Trimester Summer 2022	6/29/22
4.2 Revise the draft until a score of 95% has been obtained and the student has been notified of their eligibility for SRC/IRB submission		
A. **Note: You may be required to submit multiple drafts and/or attend appointment(s) with the AHU writing center prior to obtaining approval**	A. 4th Trimester Summer 2022	A. 7/25/22
B. Determine instrumentation and obtain permission for use or complete face validation process. Note: Some revisions to the second PICOT statement may be required.	B. 4th Trimester Summer 2022	B. 5/20/22
C. Consult with available statistician to refine proposed analysis.	C. 4th Trimester Summer 2022	C. 6/10/22
D. Complete informed consent.	D. 5th Trimester Fall 2022	D. 9/23/22
E. **Obtain written verification of your Project Mentors' approval** of your proposal by having him/her sign the ***NAP Scholarly Project Proposal Approval Form*** prior to submission to the Scholarly Project Chair.	E. 4th Trimester Summer 2022	E. 7/28/22
F. Your Scholarly Project Chair will then submit the form to the NAP department chair (program administrator) for approval and signature	F. 4th Trimester Summer 2022	F. 7/28/22

4.3 Submit the completed and signed NAP Scholarly Project Concept/Plan Approval Form to CANVAS DROPBOX	5th Trimester Fall 2022	G. 7/28/22
5. Obtain AHU Institutional Review Board Approval	**5th and 6th Trimester Fall 2022-Spring 2023**	
5.1 Once the student group has received a 95% or greater on the Scholarly Project paper and have been notified of their eligibility for SRC/IRB submission, the ***Working Document for Web-Based Research Project Submission form*** and the ***Department Chair Certification Letter*** must be completed. A. A Scholarly Project Chair will then be assigned. B. A thumb drive containing multiple required documents (See DNAP 793 Syllabus for list) should be prepared and submitted to the Scholarly Project Chair C. The chair, will review the documents, sign the ***DNAP Scholarly Project Proposal Approval Form*** and will submit it to the Department Chair for his/her signature. It will then be returned once completed and uploaded to CANVAS by the students. D. In the application to SRC/IRB application, The Scholarly Project Chair will be designated as the Principal Investigator. Students will be designated as Co-Investigators		A. 1/23/22 B. 11/4/22 C. 11/5/22 D. 11/5/22
5.2 Once the working document is completed submit to Scholarly Project Chair for review and approval.		11/4/22
5.3 The Scholarly Project Chair will then complete and submit the IRB/SRC Web-based Scholarly Project Application		1/2/23

A. The Research Office will notify the investigators about the summary of the SRC review within 13 working days B. Following the SRC review, the Research Office will be responsible to submit the study proposal to **IRB** and will notify the investigators about the summary of the IRB review within **18 working days** C. The total time to complete the "AHU Web-based Research Project Submission Process" with Scientific Review Committee (SRC) and Institutional Review Board (IRB) approvals **is approximately 36 working days** D. IMPORTANT: this timeline is frequently exceeded. Please submit projects as soon as possible to prevent a delay in the scholarly project completion date and subsequent graduation		A. 1/25/23 B. 2/23/23 C. 3/3/23 D. 3/3/23
5.4 The student **MUST SUBMIT** the **AHU IRB NOTICE** of Exemption (at minimum) or Approval (if required) **TO** the designated **DROPBOX** in Canvas **BEFORE** proceeding with any aspect of project **IMPLEMENTATION**		3/3/23
6. Implement the DNAP Project Plan	**6th and 7th Trimester Spring and Summer 2023**	
6.1 Create database and data dictionary in Excel for project data entry and analysis. **Obtain the Scholarly Project Chair's approval for data dictionary via e-mail**		1/26/23
6.2 Implement your Project Proposal's plan per the SRC/IRB approved methodology		6/29/23 & 7/6/23
7. Develop final manuscript for professional dissemination	**8th and 9th Trimester Fall 2023-Spring 2024**	
7.1 Write results/findings, conclusion/limitations, and application to CRNA practice sections		11/5/23

7.2 Revise the wording in all prior sections of your proposal to now utilize past tense as appropriate		11/5/23
7.3 Complete your final Scholarly Project paper per the posted rubric		11/5/23
7.4 Submit the completed Scholarly Project final draft to your Project Mentors and Scholarly Project Chair for their review, recommendations for revision and editing. A. Obtain verification of your Project Mentor and Project Reviewer's approval of the Scholarly Project Final Manuscript by having him/her sign the ***NAP Scholarly Project Final Manuscript Approval Form.*** 1. Include all project components such as informed consent form, questionnaire/survey, power point presentation if applicable, analysis charts, etc. in the final manuscript after the reference section. Each component should be labeled as a separate appendix. B. Submit the NAP Scholarly Project Final Manuscript Approval Form (signed by mentor and reviewer), to the Scholarly Project Chair for his/her approval. C. If further revisions are not required the Scholarly Project Chair will submit the NAP Scholarly Project Final Manuscript Approval Form to the NAP Department Chair (Program Administrator) for approval and signature.		A. 3/10/24 B. 3/10/24 C. 3/10/24
7.5 Submit the completed and signed NAP Scholarly Project Concept/Plan Approval Form to CANVAS DROPBOX		3/10/24
7.6 Prepare a research status report and submit via e-mail to the Scholarly Project Chair. This should be a comprehensive report communicating information on the findings and dissemination, changes, and issues.		3/10/24

8. Develop and revise poster presentation	**8th and 9th Trimester Fall 2023-Spring 2024**	
8.1 **Develop an electronic PowerPoint version of your proposed poster** about your project, using the Scholarly Project Poster Guidelines. This PowerPoint slide must be submitted for review and feedback.		2/1/24
8.2 **Submit** the **FINAL (NOT Draft) electronic PowerPoint** slide of your Poster to your Scholarly Project Chair via AHU email and to DROPBOX. **A.** After the Scholarly Project Chair has given their approval for the electronic version of the final poster, it is the student's responsibility to **have the poster printed professionally, in compliance with the Scholarly Project Poster Guidelines** B. Final posters will be presented at the **AHU NAP Scholarship/Poster Presentation Day, which is tentatively planned for 4/3/2023 from 1-3pm (Monday afternoon)**. (May be online depending on COVID-19)		3/10/24 A. 3/15/24 B. 4/3/24
9. Submit final electronic copy of completed documents to library archive	**9th Trimester Spring 2024**	
9.1 Submit a complete electronic copy (including all appendices) of the final approved documents to the AHU library **(**Neal.Smith@ahu.edu**).**		3/28/24
10. Prepare for and complete professional Dissemination	**8th and 9th Trimester Fall 2023-Spring 2024**	
10.1 Prepare a faculty – approved manuscript for submission to a professional journal		N/A
10.2 In addition to professional journal submission, the following are considered appropriate methods of dissemination:		N/A

A. Submission of abstracts for oral presentation and poster presentations at professional meetings B. Executive summaries (as part of a business plan) C. Professional web page D. Guest editorials, news releases in print or on public radio/television		
10.3 Revise article or other appropriate method of dissemination as needed based on committee and other feedback		N/A
10.4 Obtain official submission/completion documentation and submit to DNAP Scholarly Project Chair and to Canvas DROPBOX		3/10/24
11. Prepare for Final Oral Presentation	**9th Trimester Spring 2024**	
11.1 Review guidelines and course schedule for conduct of presentation sessions A. Project Presentation (within DNAP 893) – Select AHU community members invited B. Clinical Site/Project site presentation		3/26/24 & 3/27/24
11.2 Obtain and complete the DNAP Final Project Presentation form with committee signatures and submit to DNAP Scholarly Project Chair		3/10/24
12. Complete final requirements for Scholarly Project Completion	**9th Trimester Spring 2024**	
12.1 Submit to CANVAS completed Scholarly Project documentation (All documents in one PDF) A. Completed Project Final presentation (date and time completed only) B. ***DNAP Project Final Presentation form*** completed C. DNAP Project Hours Log D. E-copy of final manuscript		A. 3/26/24 B. 3/10/24 C. 4/7/24 D. 4/7/24

E. Proof of journal submission or official completion document for project dissemination F. Student Data Declaration – where is your project data stored, when it will be destroyed and who will be responsible for it (i.e. at the clinical site or at AHU per IRB documents) G. IRB disposition-Students must close their projects with IRB after proof of submission or official completion documents are obtained		E. N/A F. 4/7/24 G. 4/7/24