1. Protocol Title

Development and Assessment of a 360° Video-Based Virtual Reality Application to Enhance Medical Students' Preparation for Initial Cadaver Dissection.

2. Research question

How effective is a 360° video-based virtual reality application in reducing anxiety, as measured by the State-Trait Anxiety Inventory, and influencing self-reported emotional preparedness among medical students before their initial cadaver dissection experience?

3. Objectives

- To develop a 360° video-based virtual reality application aimed at reducing anxiety levels among students before their first cadaver dissection experience.
- To compare the anxiety levels of students prepared for their first cadaver dissection using a 360° video-based virtual reality experience with those prepared through traditional anatomy lab methods.
- To assess the impact of a 360° video-based virtual reality experience, designed to prepare students for their first dissection class, on their anxiety levels during actual cadaver dissections.

4. Background

Cadaver dissection is a cornerstone of medical education, providing unique insights into human anatomy (Ghosh, 2017). However, this experience can also be a source of significant stress and anxiety for many students, potentially impacting their learning outcomes and emotional well-being. The emotional and psychological challenges associated with cadaver dissection have been well-documented in the literature, with studies reporting a range of reactions including anxiety, fear, disgust, and even symptoms of post-traumatic stress in some cases (Sándor et al., 2015, Romo-Barrientos et al., 2020). There is a notable gap in the literature regarding effective interventions to prepare students emotionally for their first cadaver dissection experience. Traditional methods of preparation tend to emphasize the technical and procedural elements of dissection, often neglecting to adequately prepare students for the complex emotions that may emerge (Lamdin et al., 2012).

Recent advances in educational technology and multimedia learning offer promising avenues for addressing this issue. Video-based interventions, in particular, have shown potential in various educational contexts for reducing anxiety and improving learning outcomes (Monteiro et al, 2022). Immersive media such as Virtual reality (VR) are emerging as effective tools in medical education, allowing students to experience clinical environments in a controlled and non-threatening manner However, the application of such interventions specifically to emotional preparation for cadaver dissection remains largely unexplored. 360° video-based virtual reality is a technology that immerses learners in a fully navigable digital environment using VR equipment. In medical education, this method offers a way to introduce learners to realistic clinical scenarios before they encounter them in person. The creation of a 360° video requires a specialized camera that captures footage from every angle simultaneously [Naef et al 2023]. Recently, this technology has been used to prepare students for their clinical clerkships, showing very positive results in enhancing their readiness and confidence [Pieterse et al 2023].

This study aims to address this gap by developing and evaluating a 360° video-based virtual reality application to enhance medical students' emotional preparedness for their first cadaver dissection experience. We hypothesize that this intervention will decrease anxiety levels and enhance overall preparedness among medical students compared to traditional preparation methods. By improving emotional preparedness, this study has the potential to positively impact not only the students' anatomy learning but also their overall well-being and professional development in medical education. The anticipated outcome of this research is a validated intervention that can be implemented broadly to reduce cadaver dissection-related anxiety in medical students.

5. Inclusion and Exclusion Criteria

This study will exclusively recruit incoming first-year medical students at Weill Cornell Medicine-Qatar for the 2025-26 academic year. Participants must be aged 18 years or older. Students who decline the invitation to participate in the survey will not be included in the survey.

6. Number of Subjects

The study will be powered at 90% with a significance level of 5%, requiring a total sample size of 42 (21 per arm) to detect a difference of 5 units between the intervention and control groups with a standard deviation of 5 (effect size =1).
Accounting for a 10% loss of participation, the final required sample size is estimated at 47 participants.

7. Study timelines.

The incoming first-year medical students at WCM-Q will join the program in August 2025. The anticipated timelines for the different phases of this study are as follows:
Recruitment and Data Collection - three weeks.
Data Analysis and Report Writing - ten weeks.

8. Recruitment Methods

First-year medical students joining in Fall 2025 will be invited to participate in the study through a recruitment email sent by Ms. Deema Al-Sheikhly at the beginning of orientation week on August 10, 2025. The email will explain the study and solicit their interest in participating. In the email, students will be informed that an in-person information session will follow on August 12 and will be held in Lecture Hall 2 at a specified time. The in-person information session will highlight the following:

1. That participation is unrelated to anatomy course requirements and will not impact academic performance or faculty relationships.
2. That participation in the study is completely voluntary, and students may withdraw at any time without any impact on their performance or grades.
3. The study design will be explained, detailing that participants will be randomly divided into a control group and an intervention group. The intervention group will experience a 360° video-based virtual reality session on the second day after the information session in Lecture Hall 2, while the control group will follow the current standard procedure of no exposure to any intervention.

The information session is expected to last approximately 15 minutes.

9. Procedures Involved

a. At the end of the information session, hard copies of written consent forms will be distributed by the co-investigators Deema Al-Sheikhly (DAS), Mohamed Ali Hammami (MAH), and Khadija Ahmed Elmagarmid (KAE) to interested students to read, complete, date, sign and return to the co-investigators.

b. Students who consent to participate in the study will be asked to create a unique code using the first three letters of their mother's first name and the last three digits of their phone number. In addition, students assigned to the intervention group will be asked to add the letter "A" at the end of their code, while those in the control group will be asked to add the letter "B". Students will be instructed to remember or securely save the code, as it will be used for all surveys. After completing the consent process, students may return to their regular activities.

c. The co-investigators will randomly assign participants to control and intervention groups using permuted block randomization with block sizes of 2 and 4. This method ensures balanced group allocation while minimizing selection bias through a computer-generated randomization sequence. Only the co-investigators will have access to group assignment information. After completing the grouping process, DAS will notify students in the intervention group via email to return to Lecture Hall 2 on the first day or second day at the designated time, where they will be handed the WCMQ-provided VR headsets. This is dependent on which day they are assigned to pick-up their VR headsets.

d. A link to the online baseline survey (Survey 1) will be shared with all participants through an email sent after the information session. The baseline survey and the two follow-up surveys (Surveys 2 and 3) will be identical, consisting of the State-Trait Anxiety Inventory (STAI), and will be administered to participants via Qualtrics at specified time points to assess changes in anxiety levels.
Below is a link to the Survey 1:
https://weillcornell.az1.qualtrics.com/jfe/form/SV_5i32PObt3X8km5U

STAI is a validated, self-reported tool used to measure anxiety in healthy adults, consisting of two scales: 'State Anxiety' (SA) and 'Trait Anxiety' (TA). TA reflects a person's usual emotional state, while SA measures temporary feelings of tension and fear in specific situations (e.g., before a dissection class) (Knowles & Olatunji, 2020). Each scale includes 20 items, providing a numerical score for anxiety levels. The tool has shown excellent reliability, with a Cronbach's alpha of 0.93 (Fonseca-Pedrero et al., 2012).

e. On the August 12, 2025 and August 13, 2025, students in the intervention group will participate in the 360° video-based VR sessions on the respective dates assigned to them. The sessions will be conducted in small groups simultaneously, with each participant's experience lasting no more than ten minutes. The VR sessions will be facilitated by co-investigators: DAS, MAH and KAE, who will be present in the Lecture hall 2 to provide guidance and ensure proper technical setup and privacy. WCMQ-provided VR headsets, assigned to each of the first-year medical students, will be used to experience the 360° video-based VR session. Each first-year medical student is assigned a VR headset by the Medical Education Division on the first and second day of orientation week for curricular use, which they retain until the end of the year. Headsets are returned by the students to the Medical education division at year's end; the research team will not collect them.

The virtual reality experience will be developed at WCMQ by the research team, featuring a custom-designed 360° video-based virtual reality application based on a structured script. The VR experience content will be organized into several sections, including an Introduction, a Virtual Tour of the Anatomy Lab, and a Simulated First Encounter-a step-by-step walkthrough of approaching and uncovering the body donor, with a focus on the initial visual experience.

At the end of the VR experience session, the 360° video-based content will be deleted from each headset by the co-investigators. Students may exit the session once they have completed their participation in the VR experience.

f. A link to online survey no. 2 will be emailed to the intervention group immediately after they complete the 360° video-based VR experience. This survey will evaluate the intervention's effectiveness in reducing anxiety. A reminder email will be sent three days after the initial invitation.
https://weillcornell.az1.qualtrics.com/jfe/form/SV_9Fi1fFReZTqnRL8

g. A link to online survey 3 will be emailed to all participants immediately after the first dissection session. The initial email invitation will be followed by one reminder sent five days after the first invitation. This survey will compare anxiety levels between the control and intervention groups after first dissection session.
https://weillcornell.az1.qualtrics.com/jfe/form/SV_8rijLg9DxMYPZrw

h. Finally, a follow-up online survey (survey 4) will be emailed to participants in the intervention group one week into the dissection sessions to evaluate their perspectives regarding the quality of the video intervention and its effectiveness in emotionally preparing students for their first cadaveric dissection. The initial email invitation will be followed by one reminder sent seven days later.
https://weillcornell.az1.qualtrics.com/jfe/form/SV_06fbWUA6KlOKcfA

Each of the online surveys will take no more than 10 minutes of the respondents' time. All emails inviting participants to complete online surveys will be sent by DAS.

Each participant will receive a gift voucher worth 180 QAR at the end of the second week of dissection sessions, which marks the conclusion of data collection.

10. Considerations for research involving students

A. *Faculty researchers on the study team*

1. *Do any researchers on this study have a role in assessing or evaluating the proposed student group? If yes, please specify the researchers and the nature of their institutional role.*
   The Principal Investigator Dr. Mange Manyama, is an Assistant Professor of Anatomy and the Course Director for Essential Principles of Medicine B (EPOM B), a required course taken by first-year medical students, which includes the proposed participant group. His responsibilities include delivering instruction, developing assessments, and evaluating student performance in this course.

2. *Do any of the researchers on this study have institutional positions that present potential for perceived coercion? If yes, please specify the researchers and the nature of their institutional role.*
   Dr. Manyama is an Assistant Professor of Anatomy and Course Director for EPOM B. His dual role as both researcher and instructor/evaluator creates a power differential where students may feel pressured to participate in the study due to concerns that non-participation could negatively affect their academic standing or relationship with Dr. Manyama in his teaching capacity.

3. *Please elaborate here the measures taken to minimize any potential for perceived coercion.*
   To minimize any potential for perceived coercion, Dr. Manyama, will have no role in the recruitment of participants, delivery of the study information session, or facilitation of the 360° video-based VR viewing session. These activities will be conducted by the co-investigators (DAS, MAH, and KAE), who do not hold any instructional or evaluative responsibilities for the proposed participant group. Dr. Manyama's involvement will be limited to the analysis of de-identified data only.
   The student co-investigator, KAE, does not have any authority or influence over participants' academic performance, grades, or course-related activities. In addition, recruitment will occur via standardized emails sent by Ms. DAS (a non-student researcher), ensuring consistency and minimizing direct peer pressure. The in-person information session will be conducted jointly by co-investigators (DAS, MAH and KAE), with all communication scripted to avoid undue influence.

B. *Use of student education records*

1. *Does the research involve access of student education records.*
   This study will not require access to any student academic records.

11. Data Management

A. Data Management

A. **Data Collection**

a. *What data types will be collected (e.g., personal, genomics, imaging, survey data)?*
Data to be collected include demographic data (gender, age), prior anatomy lab exposure, psychological assessment data (STAI anxiety inventory), and intervention evaluation data.

b. *Is the data collected with identifiers?*
No

c. *Who will be responsible for collecting the data?*
d. *How will the data be collected (e.g., applications, online tools, physical forms, instruments)?*
Participants will complete the State-Trait Anxiety Inventory (STAI) scale online via a Qualtrics survey at baseline and at specified time points, as well as the follow-up survey, as outlined in the "Procedures Involved" section, by accessing the provided links. Ms. Deema Al-Sheikhly will email participants with survey links included in the invitations. Collected data will be labeled with the unique code generated by each participant.

e. *What is the duration of the data collection? Will it occur all at once or over a specified period?*
Data will be collected over the course of three weeks.

f. *If the data or metadata was originally identifiable and has been code or de-identified, please* explain*: how was the data coded or de-identified?*
and who de-identified it?
Data will be collected using participant-generated codes known only to the individual participants. Although co-investigators will have access to the names of consented students, they will not be able to link survey responses to specific individuals, as the data collected through Qualtrics is associated only with the participant-generated codes rather than names or email addresses. Therefore, no additional coding or de-identification procedures are required.

B. **Data storage and Security**
a. *Where will the data be stored (e.g., on-premises servers, cloud storage, local devices)?*
b. *What measures will be in place to ensure data security and confidentiality (e.g., encryption, access controls, secure transfer protocols)?*
c. *Who will have access to the data, and what are their roles?*
d. *How will data access be managed and controlled (e.g., role-based permissions, audits, multi-factor authentication)?*

All collected data will be stored in a password protected computer in the PI's WCMQ office and uploaded in OneDrive folder which is also an encrypted, secure, and password protected data storage platform. The OneDrive folder will be accessible only to the Principal Investigator (MM) and co-investigators (DAS, MAH, and KAE). Both the computer and the OneDrive folder require multi-factor authentication for access.

C. **Data Usage and Sharing**

a. *Will the data be shared with external entities for analysis for the purpose of this study? If yes, specify the entities and the purpose of sharing.*
   - *State that institutional agreements will be attained prior to transferring data/samples*

What software or platform will be used for data sharing?

Data collected will not be shared with external entities.

D. **Data Backup and Retention**

a. *What is the backup strategy for the data?*
   All collected data will be stored in a password protected computer in the PI's WCMQ office and uploaded in OneDrive folder which is also an encrypted, secure, and password protected data storage platform.

b. *How long will the data be retained after the project is complete?*
   - *Add the following retention period requirement language: All research records will be retained for a minimum of 3 years, or longer if required by other applicable regulations or institutional policy.*
     Data retention will adhere to Weill Cornell Medicine-Qatar (WCM-Q) policies, including the secure storage of consent forms. All research records will be retained for a minimum of 3 years, or longer if required by other applicable regulations or institutional policy.

c. *What are the potential implications of data loss?*
   Since data is collected using participant-generated codes without any personally identifiable information that directly links data to individual participants, the risk to participants from potential data loss is minimal. The primary consequence of data loss would be the inability to analyze individual response changes over time, which would compromise the completeness of the study's findings.

d. *Will the data be deposited in a public repository at the end of the study or after publication?*

Data will not be deposited in a public repository at the end of the study or after publication.

B. Specimen Management

Describe how specimens will be handled study-wide:

a. *Where and how specimens will be stored?*
b. *How long will specimens be stored? If there are plans to store samples for secondary use, please complete section 13.*
c. *Who will have access to the specimens?*
d. *Who is responsible for receipt or transmission of specimens?*
e. *How will specimens be transported?*
f. *Will data samples be shared with external institutions for analyses for the purpose of this study?*

- *State that institutional agreements will be attained prior to transferring data/samples*

Not applicable

12. Data Analysis

Changes over time within the same cohort will be assessed only for participants who have completed the baseline survey and at least one follow-up survey. Paired t-tests and McNemar's tests will be used to evaluate changes over time. Comparisons between cohorts will be conducted using independent t-tests. A p-value of 0.05 or lower will be considered statistically significant. All statistical analyses will be performed using IBM SPSS (version 29, Armonk, NY, USA).

13. Withdrawal of Subjects

Participants may withdraw from the study at any stage, including during the viewing of the 360° video-based VR experience or by choosing not to submit the survey. However, due to the anonymous nature of data collection, once a survey has been submitted, it cannot be individually withdrawn or excluded from the study's dataset.

14. Risks to Subjects

Physical and Physiological Risks:

a. Virtual Reality Discomfort: Participants may experience virtual reality sickness, including symptoms such as nausea, eye strain, and disorientation (Chang et al. 2020). These symptoms are temporary and reversible. The 360° video-based VR session will be promptly discontinued if participants report experiencing any discomfort.
b. Emotional Response: The 360° video-based VR session may trigger emotional reactions in participants. *If a participant experiences discomfort, their 360° video-based VR encounter will be stopped immediately.*

The co-investigators will be present during every participant's experience with the 360° video-based VR session.

15. Potential Benefits to Subjects

There are no guaranteed direct benefits to participants in this research. However, potential benefits include reduced anxiety for participants in the intervention group who watch the 360° video-based virtual reality application. Additionally, Participation in this study will help explore how virtual reality preparation can reduce pre-dissection anxiety, potentially improving emotional readiness and shaping future medical education practices.

16. Confidentiality

Each participant will be asked to generate a unique code using the first three letters of their mother's first name and the last three digits of their phone number. Participants will use this code when completing the STAI scale surveys and the follow-up survey to allow data linkage while maintaining anonymity. No coding sheet linking the unique codes to identifiable information will be created, ensuring the survey data remains fully anonymous. Study data will be uploaded and kept securely on OneDrive folder which is an encrypted and password protected data storage platform.
The consent forms will be stored in a secure locked cabinet in Ms. Al-Sheikhly's office and the soft copy saved in OneDrive accessible only to her.

17. Provisions to Protect the Privacy Interests of Subjects

Student privacy will be protected through several measures during group VR sessions. The 360° VR sessions will be conducted in a controlled environment (Lecture Hall 2) with only designated research team members present, with no unauthorized access permitted. Each participant wears individual VR headsets creating a private, immersive experience where students cannot see each other's reactions or responses during the 10-minute 360° VR session. The lecture hall will be arranged to provide adequate personal space between participants, with research team members monitoring to ensure a respectful environment. All study procedures are conducted separately from regular anatomy coursework, ensuring participation remains private from faculty. Data will be collected exclusively through Qualtrics using self-generated codes, with no names or identifying information linked to individual participant data. All data will be stored securely with access limited to the research team. Results will be reported in aggregate.

18. Consent Process

We will use HRP-501, the consent form for low-risk studies provided by the IRB. The consent form will be in English, and since the study participants are first-year medical students at WCMQ, they are proficient in the language used for obtaining consent.
At the end of the information session, hard copies of written consent forms will be distributed to interested participants, who will be given sufficient time to read the forms and ask questions before completing them. Participants who agree to participate will sign the consent forms and return them to Ms. Al-Sheikhly, who will store the originals in a secure locked cabinet in her WCMQ office and upload soft copies to a secure OneDrive accessible only to her. Each participant will receive a signed and dated copy of their consent form from Ms. Al-Sheikhly.

19. Process to Document Consent in Writing

All participants in this study will be required to provide informed consent before taking part. At the conclusion of the information session, printed consent forms will be distributed to interested individuals. They will be given adequate time to review the forms and ask any questions prior to completion. Those who choose to participate will sign the forms and return them to Ms. Al-Sheikhly, who will securely store the original copies in a locked cabinet in her office at WCMQ. Digital copies will be uploaded to a secure OneDrive folder accessible only to her.

20. Setting

This research will be conducted in Weill Cornell Medical-Qatar. The 360° video-based VR session will be conducted in one of Lecture hall 2 at WCM-Q. Data analysis will be conducted at WCM-Q.

21. Vulnerable Populations

To prevent coercion, Dr. Mange Manyama (PI and Assistant Professor of Anatomy) will only analyze de-identified data and won't participate in recruitment, information sessions, or VR sessions. Co-investigators DAS, MAH, and KAE will manage these activities instead. Student co-investigator KAE has no authority over participants' grades or academic performance. Recruitment will occur through standardized emails sent by DAS (non-student researcher), and information sessions will follow scripted communication to avoid undue influence.

22. Compensation

Participants in both the control and intervention groups will receive a gift voucher worth 180 QAR as compensation upon completion and submission of baseline survey.

23. Qualifications to Conduct the Research and resources available.

Principal investigator:
Dr. Mange Manyama is an Assistant Professor of Anatomy in the Department of Radiology at WCM-Q. With more than 15 years of experience teaching anatomy to medical students, he has been actively involved in both medical education and birth defects research.

Co-Investigator:
Ms. Deema Al-Sheikhly is a Lecturer of Education in Medicine and the Director of Medical Education and Continuing Professional Development at the Weill Cornell Medicine - Qatar. She is an accomplished educator, having developed and taught in diverse educational programs. Her expertise extends to undergraduate, graduate, and continuing medical education, and her contributions have been acknowledged through presentations and publications in these domains.

Co-Investigator:

Mr. Mohamed Ali Hammami has over 16 years of experience and expertise in VR/AR/Edge AI. He has previous experience in the fields of Metaverse, AI, Drone technology, and Robotics.

Student Co-Investigator:
Khadija Ahmed Elmagarmid is a third-year medical student at WCM-Q with an interest in exploring how technology can enhance educational outcomes.

All the investigators have completed the required CITI trainings for this research which are the Group 2: Social and Behavioral Research Investigators and Group B - GCP - Social and Behavioral Research Best Practices for Clinical Research trainings.

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