

PROJECT PROPOSAL - 2112389

by Joshua Piecko

Submission date: 20-Oct-2023 11:38AM (UTC+0100)

Submission ID: 213763683

File name: 33382_Joshua_Piecko_PROJECT_PROPOSAL_-_2112389_508662_201504426.docx (226.27K)

Word count: 2316

Character count: 14589

Comparative Analysis of Engagement: VR-based Learning vs. Traditional Methods in Anatomical Exploration

Research Proposal

Joshua Piecko

James Williams, Gordon Dickers

1837 Words

Contents

Figures.....	3
1. Introduction	4
2. Background to the Proposed Research.....	5
2.1. Evolution of Anatomical Education.....	5
2.2. Integration of VR in Education	5
2.3. Benefits of VR-Based Learning in Anatomy	5
2.3.1. Enhanced Spatial Understanding.....	5
2.3.2. Increased Engagement and Motivation.....	5
2.3.3. Safe and Ethical Learning Environment	6
2.3.4. Current State of Comparative Studies	7
3. Aims & Objectives	7
3.1. Project Purpose.....	7
3.2. Objectives.....	7
4. Methodology.....	8
4.1 Research Methodology	8
4.1.1 Philosophy.....	8
4.1.2 Approach.....	8
4.1.3 Strategies	8
4.1.4 Risks & Limitations	9
4.1.5 Ethical Issues	9
4.1.6 Validity, Reliability & Generalisability	9
4.1.7 Data Evaluation Methods.....	9
4.2 Development Methodology	10
4.2.1 Software Development Methodology OR Other Relevant Major Methodology	10
5. Resources and Planning	11
5.1 Hardware Resources	11
5.2 Software Resources	11
5.3 (Optional) Information Resources	11
5.4 (Optional) Human Resources	11
5.5 Project Plan	12
6. Conclusion	13
7. References	14

Figures

Figure 1: Copy of Proposed Project GANTT from TeamGANTT.com

12

1. Introduction

This project lies at the intersection of education, technology, and human anatomy. The integration of Virtual Reality (VR) technology in education has gathered significant attention due to its potential to revolutionize the learning experience. Anatomy, being a subject that demands spatial understanding and visualization, provides a pertinent context for evaluating the effectiveness of VR-based learning.

The rationale for this project is rooted in the observed gap between traditional pedagogical methods and the opportunities presented by emerging technologies. While VR has shown promise in various educational domains, its application in anatomical education warrants systematic examination. This project addresses the pressing need for empirical evidence on the comparative effectiveness of VR-based learning in anatomical exploration.

2. Background to the Proposed Research

2.1. Evolution of Anatomical Education

Anatomical education, a cornerstone of medical training, has witnessed significant transformations over the years. Traditional pedagogical methods, including cadaveric dissections and two-dimensional illustrations, have long been the primary modalities for teaching anatomy [1]. While these methods provide invaluable insights, they have inherent limitations, particularly in conveying the intricate spatial relationships that characterize human anatomy.

By immersing learners in three-dimensional, interactive environments, VR technology has the potential to bridge the gap between theoretical knowledge and practical application in anatomy [2].

2.2. Integration of VR in Education

The integration of VR into educational practices signifies a significant advancement in pedagogy. VR creates simulated environments that allow learners to engage with complex concepts in an interactive and dynamic manner. This level of immersion has shown promise across various educational domains, including medical education [3]. Furthermore, the versatility of VR applications extends beyond traditional classroom settings. It opens avenues for remote and distance learning, allowing students to access high-quality anatomical education irrespective of geographical constraints [4].

2.3. Benefits of VR-Based Learning in Anatomy

2.3.1. Enhanced Spatial Understanding

The immersive nature of VR environments proceeds the limitations of traditional anatomical instruction methods. Traditional flat images and diagrams, while informative, fall short in providing an accurate representation of the complex three-dimensional structures of the human body. With VR, learners can interact with anatomical models in a dynamic, three-dimensional space. They can rotate, zoom, and dissect virtual anatomical structures, gaining a profound spatial comprehension that is challenging to achieve through traditional means [5].

Moreover, studies have shown that the kinesthetic aspect of VR-based learning significantly contributes to spatial understanding. By allowing learners to manipulate anatomical structures, VR leverages embodied cognition, a learning theory that posits that physical actions enhance cognitive processes [6].

2.3.2. Increased Engagement and Motivation

Engagement is undeniably pivotal to the learning process. In traditional anatomical education, maintaining high levels of engagement can be challenging, especially during prolonged lectures. This is where VR-based learning emerges as a transformative force.

2.3.2.1. *Immersive Experiences Captivating Learners*

The immersive nature of VR environments captivates learners by transporting them into virtual anatomical landscapes. Instead of passively absorbing information, students become active participants in the learning process. They can navigate anatomical structures, interact with physiological processes, and dissect virtual models with their own hands [3] [4].

2.3.2.2. *Personalized Learning Journeys*

VR allows for personalized learning experiences tailored to the individual style and pace of learners. Learners can explore anatomical structures at their own rhythm, revisiting concepts as needed. This autonomy empowers students, instilling a sense of ownership over their education [4].

2.3.2.3. *Gamification Elements and Incentive Systems*

Many VR applications incorporate gamification elements, such as quizzes, and interactive scenarios. These elements introduce an element of achievement, further fuelling learner motivation [7]. By earning points, or achieving milestones, students are incentivized to delve deeper into anatomical exploration.

2.3.2.4. *Real-World Clinical Scenarios*

VR can expose learners to situations they are likely to encounter in their medical careers. This practical relevance enhances engagement by demonstrating the direct applicability of anatomical knowledge in clinical practice [4] [8].

2.3.3. *Safe and Ethical Learning Environment*

In the realm of medical education, particularly in surgical disciplines, ethical considerations and patient safety are paramount. Traditional training methods present challenges in this regard. VR addresses this concern by providing a controlled and ethically sound learning environment. Students can practice intricate procedures and explore anatomical structures without any risk to patients [9]. This controlled environment allows learners to make mistakes, learn from them, and refine their skills without any potential harm.

Furthermore, VR enables the simulation of rare or complex cases that students may not encounter frequently in clinical settings. This exposure prepares them for a wider range of scenarios, enhancing readiness for real-world clinical practice [9].

2.3.4. Current State of Comparative Studies

While the advantages of VR-based learning in anatomy are increasingly recognized, a comprehensive comparative analysis between VR-based instruction and traditional methods remains a critical area of research [9] [10]. Existing studies primarily focus on the benefits of VR in isolation, often lacking direct comparisons with conventional instruction methods. A systematic evaluation is crucial in determining the superior approach for anatomical education, taking factors such as engagement levels, knowledge retention, and practical applicability into account.

3. Aims & Objectives

3.1. Project Purpose

The overarching aim of this project is to conduct a comparative analysis of engagement levels between VR-based learning and traditional methods in anatomical exploration.

3.2. Objectives

1. Analyse the existing landscape of VR technologies and platforms to determine the most suitable framework for anatomical visualization.
2. Design and develop a user-friendly VR application, ensuring intuitive navigation and interactive anatomical exploration.
3. Conduct rigorous user testing to assess the effectiveness of the VR application in enhancing engagement and understanding of anatomical structures.
4. Compare the learning outcomes and user satisfaction levels between traditional instructional methods and VR-based learning.

4. Methodology

4.1 Research Methodology

4.1.1 Philosophy

For this study, a constructivist research philosophy is adopted. This choice is driven by the aim to understand and interpret the nuanced experiences and perspectives of learners engaging with VR-based anatomical education. Constructivism aligns with the nature of the research, emphasizing the co-construction of knowledge between the learner and the educational environment. The advantages of constructivism lie in its capacity to uncover individualized learning processes and its applicability to dynamic, interactive learning environments. However, it is acknowledged that this philosophy may entail a more complex analysis of diverse perspectives, which will be addressed through systematic data categorization and thematic analysis.

4.1.2 Approach

An inductive approach will be employed, grounded in the constructivist philosophy. This approach is justified by the need to derive insights and meaning from the rich and diverse experiences of learners in the VR-based anatomical education context. Inductive reasoning allows for the emergence of themes and patterns from the data, facilitating a deeper understanding of the learners' perspectives. It is recognized that this approach may require careful attention to data saturation and iterative analysis to ensure comprehensive coverage of the diverse viewpoints.

4.1.3 Strategies

4.1.3.1 Literature Review

This strategy serves as the foundational step to establish the theoretical framework and contextualize the study within existing scholarly discourse.

4.1.3.2 Experiment

The experimental design will assess the comparative learning outcomes and engagement levels between VR-based learning and traditional instruction methods. This strategy allows for controlled testing and objective measurement of the variables under consideration.

4.1.3.3 Survey

A structured survey will be administered to gather quantitative data on participants' preferences, engagement levels, and perceived effectiveness of the VR-based learning approach. This strategy provides a quantitative complement to the qualitative insights gained from interviews.

4.1.4 Risks & Limitations

External factors that could impact the project's success include potential technical challenges in VR application development and participant recruitment constraints. Additionally, the study's sample size may be limited by resource constraints, potentially affecting the generalizability of the findings.

4.1.5 Ethical Issues

The research will adhere to ethical guidelines to ensure the well-being and confidentiality of participants. There is no foreseen physical harm to participants, and potential psychological discomfort will be minimized through informed consent, debriefing procedures, and optional participation.

4.1.6 Validity, Reliability & Generalisability

4.1.6.1 Validity

The research design, including triangulation of data collection methods, will enhance internal validity by corroborating findings across different sources.

4.1.6.2 Reliability

The use of standardized instruments and well-defined procedures will enhance the reliability of data collection and analysis.

4.1.6.3 Generalisability

While the study's findings will be context-specific, the insights gained from the comparative analysis can inform broader discussions on the effectiveness of VR-based learning methods.

4.1.7 Data Evaluation Methods

4.1.7.1 Data Collection

4.1.7.1.1 Types of Data

The study will collect both qualitative data from interviews and observational notes, as well as quantitative data from surveys.

4.1.7.1.2 Data Collection Methods

Interviews will be conducted in a controlled environment to ensure participant comfort, while surveys will be administered electronically to facilitate convenience and anonymity.

4.1.7.1.3 Sample Size Determination

A sample size of 20 participants is targeted for the survey, ensuring a robust dataset for quantitative analysis. Interviews will continue until data saturation is achieved.

4.1.7.1.4 *Minimum Data Threshold*

A minimum of 60 completed surveys is set as the threshold for data sufficiency.

4.1.7.1.5 *Contingency for Insufficient Data*

If the minimum data threshold is not met, additional recruitment channels will be explored, and the survey duration will be extended.

4.1.7.2 *Data Evaluation*

4.1.7.2.1 *Evaluation Techniques*

Quantitative data will be analysed using descriptive statistics, inferential statistics e.g., paired sample t-test, and correlation analysis. Qualitative data will undergo thematic analysis to identify recurring patterns and themes.

1.1.2.1.1 *Statistical Significance*

For experimental hypotheses, a significance level of $\alpha = 0.05$ will be used.

1.1.2.1.2 *Presentation of Data*

Findings will be presented through a combination of descriptive summaries, tables, charts, and thematic maps.

4.2 Development Methodology

4.2.1 Software Development Methodology OR Other Relevant Major Methodology

The project will employ an Agile development methodology, specifically Scrum. This iterative approach allows for flexibility in adapting to evolving requirements and ensures continuous stakeholder feedback. Bi-weekly sprints will facilitate progress tracking and timely issue resolution.

5. Resources and Planning

5.1 Hardware Resources

1. Virtual Reality Hardware

5.2 Software Resources

1. Blender 3.6.4
2. Unreal Engine 5.1
3. Visual Studio 22, C++, Python
4. Microsoft Office Suite
5. Survey Site

5.3 (Optional) Information Resources

1. BodyParts3D Anatomography Mesh Models

5.4 (Optional) Human Resources

The project's development phase primarily involves the researcher and the supervisor. However, during the user testing phase, a select group of participants will be engaged. This group will comprise students from the target demographic to ensure the VR application's effectiveness in enhancing anatomical understanding.

5.5 Project Plan



Figure 1: Copy of Proposed Project GANTT from TeamGANTT.com

This structured project plan ensures that each phase is allocated an appropriate timeframe, allowing for thorough execution and attention to detail. By adhering to this timeline, the project is positioned to achieve objectives effectively and yield valuable insights into the comparative effectiveness of VR-based learning.

6. Conclusion

By harnessing the immersive capabilities of virtual reality, this research aims to revolutionize the way students engage with anatomical concepts. The transition from traditional methods to VR-based learning is a paradigm shift, offering enhanced spatial understanding, increased engagement and motivation, a safe and ethical learning environment, and improved knowledge retention and recall. The comprehensive literature review underscores the advantages of VR-based learning and highlights the current gap in comparative studies, making this research relevant and timely.

7. References

- [1] B. C. Leung, M. Williams, C. Horton and T. D. Cosker, "Modernising Anatomy Teaching: Which Resources Do Students Rely On?," *J Med Educ Curric Dev*, 2020.
- [2] H. Jiang, S. Vimalasvaran, J. K. Wang, K. B. Lim, S. R. Mogali and L. T. Car, "Virtual Reality in Medical Students' Education: Scoping Review," *JMIR Med Educ*, 2022.
- [3] A. Maroukgas, C. Troussas, A. Krouska and C. Sgouropoulou, "Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade," *MDPI*, 2023.
- [4] J. Pottle, "Virtual reality and the transformation of medical education," *Future Healthc J*, 2019.
- [5] R. Boscolo-Berto, C. Tortorella, A. Porzionato, C. Stecco, P. E. E. Edgardo, V. Macchi and R. D. Caro, "The additional role of virtual to traditional dissection in teaching anatomy: a randomised controlled trial," *Surg Radiol Anat*, 2020.
- [6] M. C. Johnson-Glenberg, "Immersive VR and Education: Embodied Design Principles That Include Gesture and Hand Controls," *Front Robot AI*, 2018.
- [7] P.-H. Chen, "The Design of Applying Gamification in an Immersive Virtual Reality Virtual Laboratory for Powder-Bed Binder Jetting 3DP Training," *Education Sciences*, 2020.
- [8] Z. Karbasi and S. R. N. Kalhori, "Application and evaluation of virtual technologies for anatomy education to medical students: A review," *Med J Islam Repub Iran*, 2020.
- [9] N. E. Seymour, A. G. Gallagher, S. A. Roman, M. K. O'Brien, V. K. Bansal, D. K. Andersen and R. M. Satava, "Virtual Reality Training Improves Operating Room Performance," *ANNALS OF SURGERY*, 2002.
- [10] S. Patel, P. Binal, A. R. Patel and S. H. Ribadiya, "A Survey: Virtual, Augmented and Mixed Reality in Education," *International Journal of Engineering Research & Technology (IJERT)*, vol. 9, no. 5, pp. 1067-1072, 2020.

PROJECT PROPOSAL - 2112389

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

72/100

PROJECT PROPOSAL – ACCA6020 INDEPENDENT PROJECT

Student :Pieko, Joshua Mark: 72

Intro / A&O (400 words)		
Project title; Identification of a specific problem to be investigated; Well-defined aims and SMART objectives; Explaining why this project is worth doing; Discussion of what the project needs to do in order to be a success; Description any deliverables that will be produced at the end of the project	20	13
The title is a little clunky and could be simplified, eg An investigation of VR.....		
The aim is clear and placed in context with a good justification for the project supported by appropriate references. However, the aim is very, very ambitious and needs to be trimmed down		

significantly to be suitable for a 3rd year project. The comparison between VR based and traditional approaches is itself a separate project (or two). Focus instead on a small component of the technical aspect – eg the feasibility/development of a small part of a VR anatomical model leading on to either the implementation of the model/database/VR front end or on the user interaction/ UI aspect of the tool. The objectives are appropriate but one or two sentences giving some additional detail and linking them to the aims would help.		
Background to the Project / Literature Review (400 words)		
Description of how the work to be done by in the project relates to the work identified in the literature review; Discussion of any ethical issues raised by the project Identifying what has already been done within the field; Topic familiarity; Brief literature review using appropriate sources – 6-8 journal papers and book chapters rather than just websites; Selection of relevant models & concepts	20	17.5

Review of related work undertaken evidenced by some up to date, relevant and good quality references. Well done. Refs in general are used appropriately. Good. After reflecting on these I am a little surprised that the project scope remains so broad. Again, please revisit the title/aim to clearly emphasise the scope/focus of the project.		
Project Design (500 words)		
Clear statement of which development methods are to be used and why they are appropriate; Clear statement of which tools are to be used and why they are appropriate; Clear description of how data collected will be analysed You've identified important topics to consider and discuss methodologies that could be applied. Some detail is missing here – this will become evident as you progress and re-evaluate the scope and aim of the project.	30	21
Resources / Planning (200 words)		
List of any deliverables; Clear diagram showing both timing and resource use; Completed ethics form; Limited and relevant appendices	15	9.5

You provide a Gannt chart – you will need to revisit this in the new year to see how realistic it is. Resources, etc. identified and are generally relevant and well considered but you need to include a risk assessment regarding access to these. Have you access to VR kit and an existing anatomical assets database? The success of this project hangs on the answer to this question.		
Document Presentation		
Correct spelling, grammar and punctuation; Flow of narrative/fluency; Coherence; Word processed ; Correct use of referencing with bibliography; Strict word limit Well structured and generally well written. Referenced well used and appropriate.	15	11
TOTAL	100	72

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14
