International Journal of Science and Research Methodology (IJSRM)
Volume 28, Issue 11, November 2025 ijsrm.humanjournals.com ISSN: 2454-2008

Pre-Medical Readiness Outcomes in Undergraduate Anatomy Education: A Descriptive Evaluation of BIO 2100 and 2101 at Oakland University

Dr. Uma Pandalai[1], Mary Craig

Affiliation: Special Instructors in Anatomy, Department of Biological Sciences, Oakland University, Rochester, MI, USA.

Received: 24 September 2025 Revised: 10 October 2025 Accepted: 25 October 2025

ABSTRACT

Background: Foundational biomedical readiness requires undergraduate anatomy courses to foster structural knowledge, clinical contextualization, and early professional reasoning. However, limited empirical work qualitatively examines how these courses contribute to early medical preparedness. **Objective:** To examine perceived pre-medical readiness outcomes associated with BIO 2100 (Human Anatomy) and BIO 2101 (Human Anatomy Laboratory) using a qualitative descriptive methodology. **Methods:** A qualitative study was conducted across Fall 2024–Fall 2025 among ~300–400 students. Data sources included course artifacts, instructor reflections, informal student feedback, engagement analytics from Moodle, and interactions with micro-learning tools. A thematic coding process was applied to identify recurrent patterns of learning behavior, content challenges, and early professional development. **Results:** Students emphasized the value of clinically anchored examples, structured lecture organization, and multimodal micro-learning supports (short video explanations, visual boards, and podcasts). Recurrent difficulties included terminology acquisition, neuroanatomy comprehension, and managing dense content within a compressed time frame. Engagement analytics indicated frequent reuse of quiz banks and repeated viewing of digital learning media. Instructional changes, including expanded question banks and enhanced XR resources, were associated with improved confidence and conceptual clarity. **Conclusion:** Multimodal, clinically embedded instructional design in BIO 2100 and 2101 contributes to early pre-medical readiness by strengthening anatomical knowledge, enhancing spatial reasoning, and cultivating professional study habits. Such approaches offer a scalable model for undergraduate biomedical instruction.

Keywords: Anatomy education, pre-medical readiness, XR learning, multimodal pedagogy, qualitative evaluation.

1. Introduction

Human anatomy is a central pillar of pre-medical and allied health preparation, enabling students to build anatomical vocabulary, understand spatial body organization, and integrate physiological relationships.[1] As biomedical curricula evolve, undergraduate programs increasingly incorporate technological visualization, clinical framing, and blended learning approaches to enhance comprehension and long-term retention.[2–4]

Oakland University's BIO 2100 and 2101 courses incorporate structured lectures, imaging anatomy, XR visualization platforms (Visible Body, 3D Organon), and micro-learning strategies such as Instagram-based educational clips, curated anatomy boards, and supplemental audio explanations. These resources are intended to reinforce conceptual learning and support flexible review outside the classroom.

However, there is limited research describing how such multimodal instructional strategies contribute to pre-medical readiness at the undergraduate level.

The purpose of this study is to qualitatively evaluate how students experience these courses and how the instructional design supports early biomedical preparation.

2. Materials and Methods

2.1 Study Design

A qualitative descriptive approach was used to characterize student learning experiences and perceived readiness for further medical training.

2.2 Setting

BIO 2100 and 2101 are high-enrollment human anatomy courses at Oakland University that integrate lecture-based instruction, laboratory engagement, 3D/XR visualization, and digital reinforcement strategies.

2.3 Participants

Approximately 300–400 students were enrolled across the two semesters examined. No identifiable personal data were collected, and no individual-level academic information was accessed.

2.4 Data Sources

Data were derived from:

- syllabi and instructional documents
- instructor teaching reflections
- informal student feedback during academic interactions
- Moodle analytics (quiz access patterns, media engagement frequency)
- micro-learning engagement signals (link activity to reels, boards, podcasts)

2.5 Data Analysis

A multi-step coding process was applied:

1. Preliminary categorization of feedback into descriptive codes (e.g., “clinical relevance,” “terminology difficulty,” “micro-learning repetition”)
2. Collapsing codes into themes relating to perceptions, challenges, and readiness indicators
3. Triangulation across data sources to ensure convergence of interpretations
4. Theme refinement through iterative comparison and validation

Sample paraphrased student statements were incorporated to preserve qualitative authenticity (e.g., “the clinical examples helped me visualize real cases,” “the vocabulary was like learning a new language,” “the reels allowed me to review concepts quickly on my commute”).

2.6 Ethical Considerations

The analysis was exempted under IRB Category #1 for normal educational practices. All feedback included in the study was anonymous or inherently non-identifiable.

3. Results

3.1 Positive Learning Perceptions

Students consistently attributed improved conceptual understanding to the use of clinical correlations and structured weekly sequencing. Visual and micro-learning tools were described as efficient reinforcements that helped maintain regular content contact.

Paraphrased feedback: students expressed that clinical cases transformed abstract anatomy into medically relevant context (table 1 & figure 1). Micro-learning was described as:

- "Quick reinforcement"
- "easy to revisit before lab"
- "Helpful during exam preparation"

Table 1. Major Positive Perception Themes (Qualitative)

Theme	Description
Clinical Correlations	Made anatomy clinically relevant and helped understanding.
Organized Lectures	Sequenced structure reduced cognitive overload.
Micro-learning Tools	Reels, boards, and podcasts reinforced concepts.

Source: Author's Qualitative analysis, Oakland University.

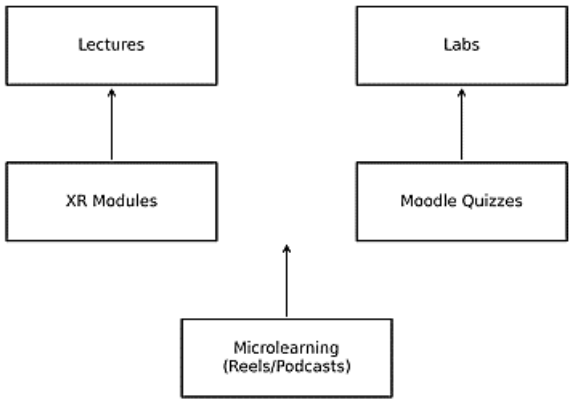

Figure 1. Conceptual Diagram of Learning Supports

Source: Conceptual Model developed by the authors based on instructional design structure.

3.2 Challenges

Students frequently described terminology acquisition as cognitively intensive. Neuroanatomy was persistently identified as difficult due to abstract conceptualization and limited prior exposure (figure 2).

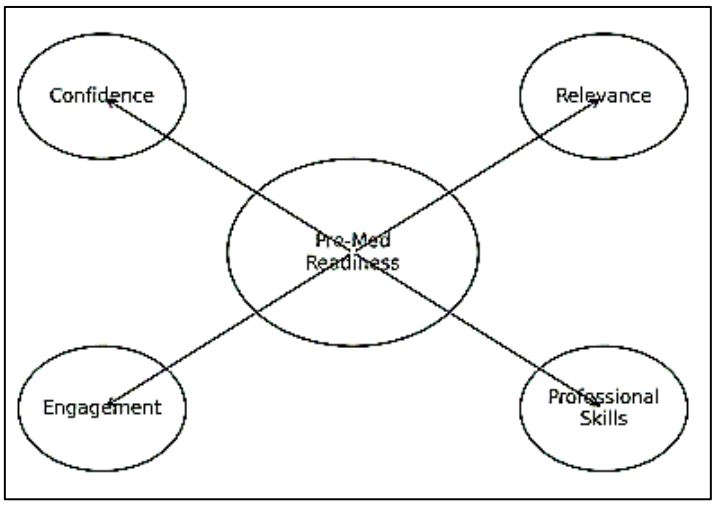

Figure 2. Thematic Map of Student Perceptions

Source: Visual synthesis derived from authors' coding of qualitative themes.

Several students commented that anatomy required constant review due to its "volatile," high-density memorization requirements (table 2).

Table 2. Common Learning Challenges Reported

Challenge	Description
Terminology Memorization	Students found large vocabulary requirements challenging.
Neuroanatomy	Abstract concepts required repeated exposure.
Fast Course Pace	Short semester made retention difficult.

Source: Authors' analysis of student reported difficulties and instructor reflections.

3.3 Professional Learning Behaviors

Instructor observations recorded notable improvement in:

- anatomical vocabulary usage
- spatial understanding through XR visualization
- disciplined study routines
- test preparation strategies aligned with pre-medical norms

3.4 Instructional Improvements and Their Effects

Curricular revisions—particularly the expanded question bank and explicit alignment with clinical application—were linked to improved student confidence and better performance in practical identification sessions.

Engagement analytics showed frequent re-entry into quizzes, especially during the week preceding summative assessments, suggesting active use of retrieval-based learning (table 3 & figure 3).

Table 3. Instructional Improvements Implemented

Improvement	Description
Redesigned Syllabus	Better alignment with pre-med competencies.
Expanded Moodle Quiz Bank	Provided repeated low-stakes practice.
Educational social media	Instagram reels, Pinterest boards, and podcasts.

Source: Authors' documentation of course redesign and engaged teaching practices.

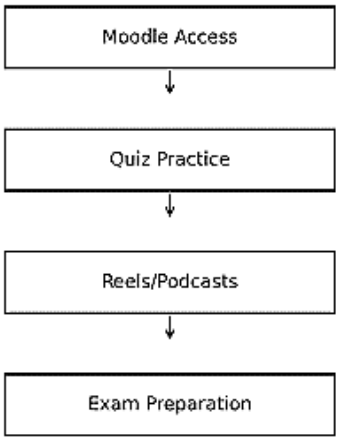

Figure 3. Engagement Flow Model

Source: Authors interpretation of Moodle interaction patterns and micro – learning engagement.

4. Discussion

This evaluation highlights the educational value of multimodal anatomy instruction in cultivating competencies relevant to early medical preparedness. Consistent with prior literature,[3–7] clinically framed learning enhanced conceptual significance and professional reasoning.

Strong engagement with digital resources demonstrates that contemporary learners benefit from distributed, portable, high-frequency review pathways. These tools may scaffold long-term retention and promote repetitive exposure to challenging terminology.

The findings also reflect the inherent difficulty of neuroanatomy and dense lexical acquisition, reinforcing prior research emphasizing the need for visualization-assisted and case-supported learning. Limitations include the single-institution context and reliance on naturally occurring reflections rather than controlled interview sampling.

5. Conclusions

BIO 2100 and 2101 contribute meaningfully to pre-medical development by:

- reinforcing anatomical knowledge
- strengthening spatial visualization
- supporting professional study habits
- establishing early clinical reasoning context

The multimodal instructional approach demonstrated in this study may serve as a scalable model for high-enrollment anatomy programs.

6. Limitations

This study has several limitations.

1. single-institution scope
2. informal feedback rather than structured interviews
3. absence of longitudinal tracking
4. qualitative rather than quantitative performance data

These limitations should be addressed in future work to strengthen the evidence base.

7. Recommendations

Based on the findings of this descriptive evaluation, the following recommendations are proposed:

1. expand XR-based neuroanatomy modules
2. increase structured clinical case application
3. widen low-stakes retrieval practice opportunities
4. incorporate formal end-of-semester qualitative surveys
5. consider follow-up studies linking this training to MCAT or medical school readiness

Acknowledgements

We are grateful to our colleagues for their assistance and insightful feedback.

References

1. Drake RL, Vogl AW, Mitchell A. Gray's Anatomy for Students. 4th ed. Elsevier; 2019.
2. Sugand K, Abrahams P, Khurana A. The anatomy of anatomy: A review for its modernization. Anat Sci Educ. 2010;3(2):83-93.
3. Peterson DC, Mlynarczyk GS. Analysis of traditional versus 3D anatomy teaching using Visible Body. Anat Sci Educ. 2016;9(6):529-37.
4. Estai M, Bunt S. Best teaching practices in anatomy education. Int J Med Educ. 2016;7:110-6.
5. Brown PM, Roediger HL, McDaniel MA. Make It Stick. Harvard University Press; 2014.
6. Nicholson DT et al. Can virtual reality improve anatomy education? J Surg Educ. 2006;63(2):114-20.
7. Mahdy MAK. Improving learning outcomes in anatomy education. Adv Med Educ Pract. 2020;11:117-22.
8. Ravi KS et al. Anatomy education: Current perspectives and future directions. Med Sci Educ. 2022;32:145-52.

How to cite this article:
Dr. Uma Pandalai et al. Ijsrm.Human, 2025; Vol. 28 (11): 31-36.

Conflict of Interest Statement: All authors have nothing else to disclose.