

# Evaluating Anatomy Learning of First-Year University Students: A Pilot Study

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**Abstract:** Many students find anatomy concepts overwhelming and difficult to grasp, therefore, understanding how anatomy is learned, and the influences thereon is important to ensure academic performance. To evaluate student diversity and anatomy learning, this study presents a pilot study on how first-year students at the University of the Western Cape (South Africa) learn anatomy. A mixed-methods approach was implemented using a Google Form questionnaire. Data was obtained from 20 first-year anatomy undergraduate students in 2022. The findings revealed participants preferred face-to-face practicals (60%) and specimens (55%). Face-to-face practicals, teaching slides and 3D models were identified as effective learning measures, with 3D models showing significant differences across academic degrees. Students perceived greater benefits from face-to-face practicals, 3D models and specimens. Students strongly preferred the visual modality and spaced practice strategy. Differences in aural and writing modalities were observed across degrees, where BSc in Medical Bioscience and BSc in Sports and Exercise Science had higher scores, respectively. Learning barriers included content overload, loadshedding, and less student-lecturer interaction. Overall, face-to-face teaching with teaching slides remains important, with online methods playing a supplementary role. Further research on anatomy learning in different degrees and the impact thereof on academic performance is needed.

**Keywords:** Anatomy, Pedagogy, Learning modalities, Learning strategies, Learning barriers

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## 1. Introduction

Human anatomy is fundamental in all undergraduate medical and health science degrees, requiring a robust understanding of complex anatomical structures and terminology. Teaching aims to simplify complex content while maintaining its integrity to encourage learning and enable students to solve simple and complex anatomical concepts (Abrahamson and Langston, 2017). However, challenges in the learning of anatomy include limited access to clinical hours, cadavers or 3D models (Moro et al, 2017); content overload, complex terminology, and grasping concepts (Lieu et al, 2018); as well as interactive engagement and emotional well-being (Abrahamson and Langston, 2017). Addressing these challenges and optimising the learning experience in anatomy education is important. Therefore, this study evaluated how first-year students at the University of the Western Cape (UWC) learn anatomy by determining their experience and preference for various pedagogies, learning modalities and strategies, and potential barriers to learning.

## 2. Literature Review

The need for improving anatomy education has motivated several studies on curriculum reform, learning modalities and strategies, students' perceptions, and innovative resources. For example, Johnston et al (2015) introduced interactive activities aimed at understanding learning modalities and promoting discussion and observed that most of the students found these activities helpful and learned best kinesthetically. Furthermore, an evaluation on how teaching strategies and external factors affect anatomy learning highlighted the effectiveness of practical lectures and the negative influence of strikes on memory retention (Phaswana, 2021). Determination of students' perception of teaching resources and learning outcomes have shown that cadaveric dissections paired with active learning clinical tutorials was helpful in achieving learning outcomes (Abdullah et al, 2021). Regarding the use of immersive technologies, an augmented reality (AR) educational application for the musculoskeletal system has shown that students expressed a willingness to integrate such an application into their studies and most students would recommend it (Boomgaard et al, 2022). To our knowledge, research

concurrently exploring these factors in SA is lacking, hence, to bridge the gap in existing literature this research is expected to provide a comprehensive understanding and improve educational anatomy practices at a tertiary-level.

### 3. Methodology

This pilot study, was conducted with ethical approval and informed consent, involved 20 first-year volunteer students enrolled for anatomy modules at UWC during 2022 when teaching and learning was predominantly conducted online. The sample size (n = 20) was calculated at ± 10% of the main study sample size (n = 243, projected population size = 660). A mixed-methods approach integrating both closed- and open-ended questions in a Google Form questionnaire was implemented to obtain quantitative and qualitative data, respectively (Zohrabi, 2013). Firstly, a Google Form questionnaire was developed using face and content validation, then shared via Ikamva (learning management system) to recruit participants. The questionnaire collected data on students’ demographics, and their experience and preference regarding pedagogies, learning modalities, and learning strategies. Lastly, the quantitative data was analysed with SPSS (version 28.0.0; Armonk, NY: IBM Corp) using descriptive statistics (all results), multiple response sets (most/least preferred pedagogies), chi-square statistics (effectiveness of pedagogies), and Kruskal-Wallis test (learning modalities and learning strategies). Qualitative data underwent thematic coding (adapted from Shead et al, 2019), with the findings reported based on number of responses per theme.

### 4. Results and Discussions

Participants were predominantly female (75%), 18-years-old (40%), and were English (home language; 55%) and Afrikaans (first additional language; 55%) speaking. Most participants represented the Bachelor of Nursing degree (30%), and 50% received bursaries. These demographic factors are known to affect how students assimilate anatomical concepts, academic performance, or enrolment to university (Mitchell, 2015; Mail & Guardian, 2014).

All students utilised live online lectures and YouTube/online videos to learn anatomy; face-to-face practicals (85%) and specimens (85%) were also widely used (Figure 1). This agrees with Kramer et al (2008) suggesting that many African tertiary institutions offer anatomy education comparable to western countries with similar hours and adequate resources (e.g. cadaveric dissection). Learning barriers related to the pedagogies used (40%) included challenges with online learning formats due to experiencing decreased cognition (4 responses) and lack of hands-on learning (2 responses). Other general influences included lecture content overload, less student-lecturer interaction, and loadshedding (13.2% each).

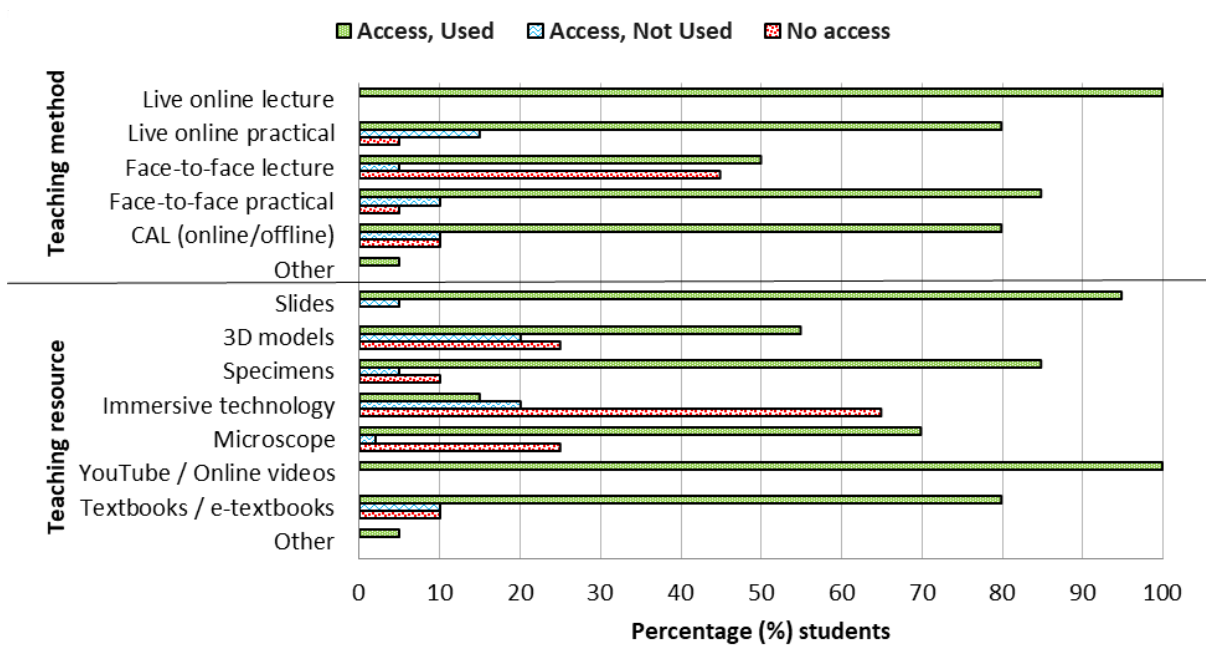


Figure 1: Accessibility/usability of pedagogies

Participants preferred face-to-face practicals (60%) and specimens (55%) (Figure 2). This agrees with Totlis et al, 2012 where students preferred traditional anatomy lectures to online alternatives like online lectures, pre-

recorded anatomy lectures and self-study using lecturer’s presentations. Live online lecture teaching methods (70%), textbook and e-textbook teaching resources (20%) were least preferred. Conversely, Yoo et al (2020) showed that students preferred online lectures as it increased autonomous time, accommodated studying/learning preferences, and allowed repeated viewing of recordings.

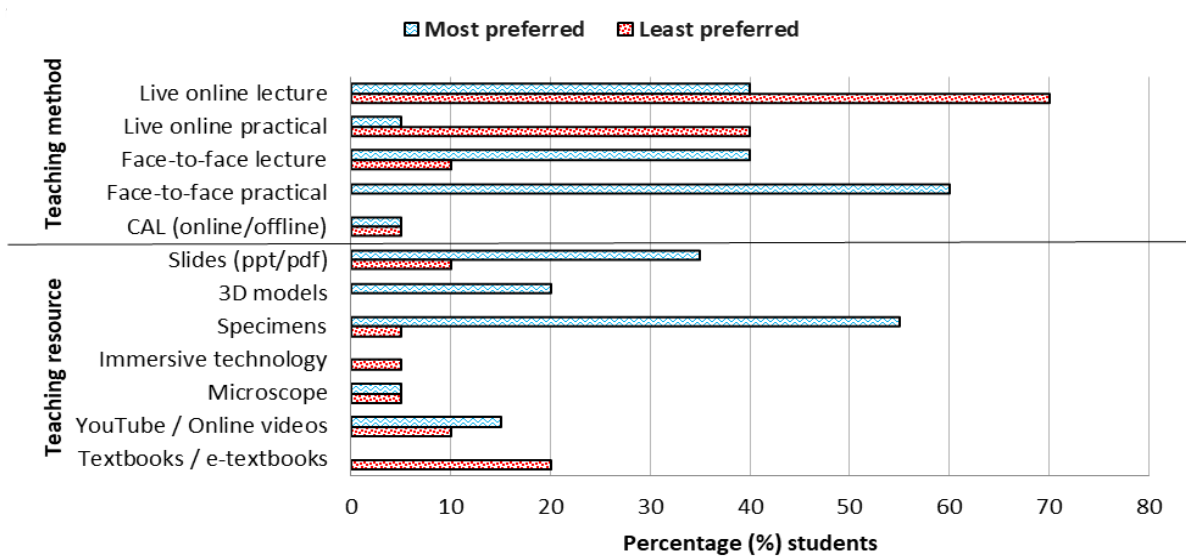


Figure 2: Most/least preferred pedagogies

This study identified effective teaching methods for anatomy learning including face-to-face practicals (95%), live online lectures (85%) and the associated resources like teaching slides (90%) and 3D models (90%) (Figure 3). Phaswana (2021) also highlighted practical lectures (93%) and YouTube videos (77%) as effective teaching and learning methods. A significant difference ( $p = 0.013$ ) was observed in effectiveness of 3D model resources across academic degrees, where Bachelor of Nursing students had the highest indications (33.3%,  $n = 6$ ).

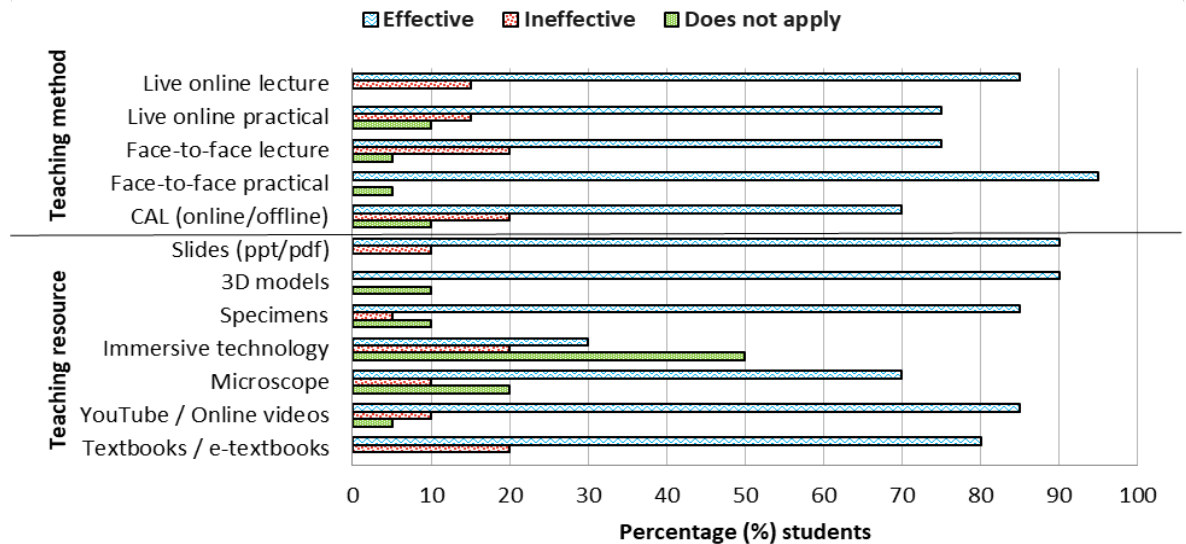


Figure 3: Rating effectiveness of pedagogies

Several learning benefits were associated with the various anatomy pedagogies (Figure 4). For example, the perceived benefits for face-to-face anatomy practicals (23.9%) included enhanced and increased interest in learning anatomy (27.5%,  $n = 14$ ), 2D/3D appreciation of the body (15.7%,  $n = 8$ ), and anatomical variation (15.7%,  $n = 8$ ). Students found 3D models and specimens (19.0% each) to be beneficial, with perceived benefits including enhanced and increased interest in learning anatomy (22.2%,  $n = 10$  each) and 2D/3D appreciation of the body (26.7%,  $n = 12$  and 22.2%,  $n = 10$ , respectively).

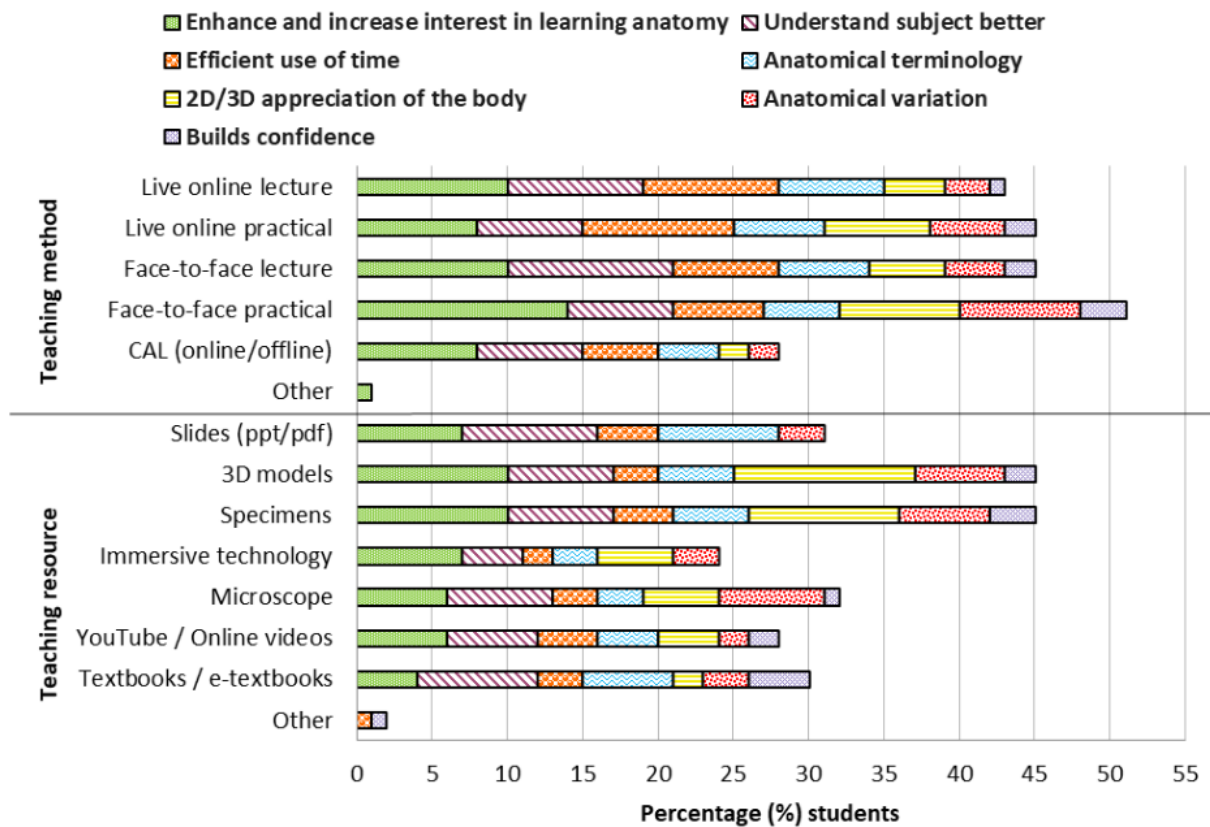


Figure 4: Benefits derived from pedagogies

According to the visual, aural, reading/writing, kinesthetic (VARK) inventory and students' perception thereof, the visuals (provided) (35%, 3.95±1.82) and writing (30%, 4.30±1.60) sensory learning modalities were strongly preferred (Figure 5). Contrary, Johnston et al (2015) showed kinesthetic/by doing (28%) to be the most preferred and visual/reading (9%) learning modalities to be the least preferred among students. Learning modalities can be influenced by sensory preferences (Johnston et al, 2015), cognitive processing (Kolb and Kolb, 2013), and personality/characteristics (McCardle, 2010).

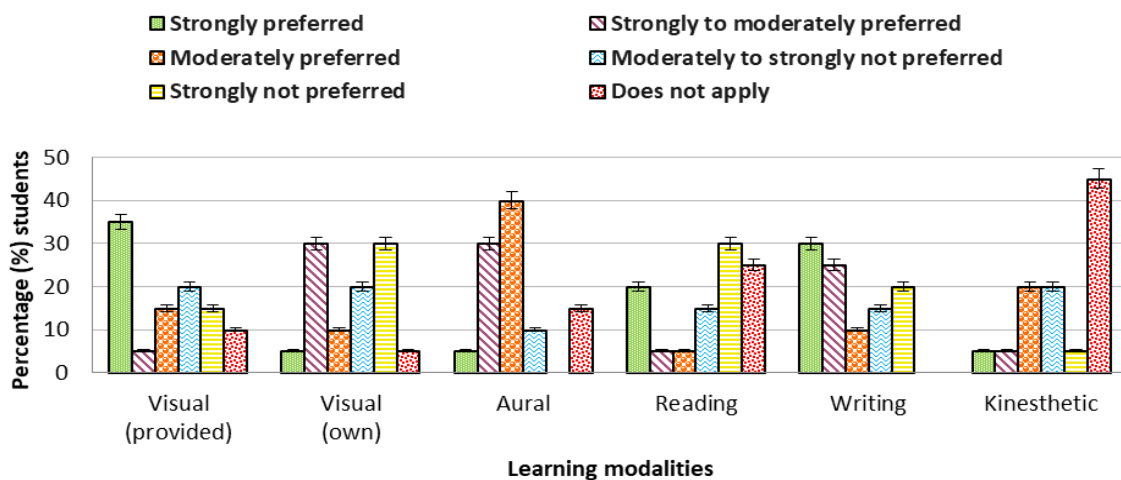


Figure 5: Students' perceived ratings of learning modalities

Significant differences across the degrees were observed for the aural ( $p = 0.017$ ) and writing ( $p = 0.020$ ) learning modalities. Bachelor of science (BSc) in Medical Bioscience ( $5.00 \pm 0.00$ ) and BSc in Sports and Exercise Science ( $5.00 \pm 1.00$ ) students had higher mean ranks for aural learning, while BSc in Sports and Exercise Science ( $5.67 \pm 0.58$ ) and Bachelor of Nursing ( $5.30 \pm 0.82$ ) students had higher scores for the writing learning modality.

Most students (70%) indicated that their learning modality preferences were accommodated through hybrid learning (3 responses) and availability of various pedagogies (3 responses).

Learning strategies refers to the way students go about organising and implementing their respective skills to learn content or complete activities (Weinstein et al, 2018). In this study, the spaced practice learning strategy (40%, 4.45±1.85) was strongly preferred (Figure 6). However, students predominantly used dual coding (28.2%) and elaboration (20.5%).

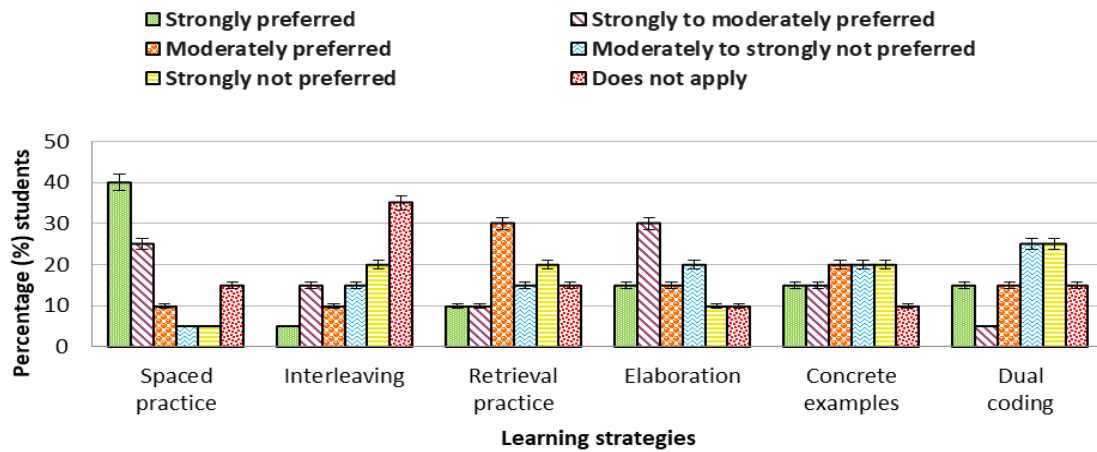


Figure 6: Students' perceived ratings of learning strategies

## 5. Conclusion

Overall, the study emphasises the complexity of anatomy education and the diverse needs of students when learning, particularly when considering different degrees. The preliminary findings indicated that face-to-face anatomy practicals are most preferred, effective and beneficial in teaching and learning, confirming its importance in anatomy education. The visual learning modality and spaced practice strategy were preferred, highlighting the significance of visual literacy and effective study schedules in anatomy education. Students were challenged with decreased cognition during online learning, lecture content overload, less student-lecturer interaction, and loadshedding. The results provide useful information for anatomy curricula development, enhancing the understanding of anatomy practices at UWC and potentially beyond. However, further research on anatomy learning in different degrees and the impact thereof on academic performance is needed. This study's main limitation was the COVID-19 related restrictions impacting the availability of certain face-to-face-teaching pedagogies, which hindered content delivery.

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