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Assessing Medical Students' Understanding Of Applied Anatomy: The Influence Of Visual Resources On Their Preparedness For Medical Practice

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ABSTRACT

Using visual aids such as cadavers, photos of cadavers, radiographs, and images of clinical findings, students were examined on timed tests that assessed their topographical and practical understanding of anatomy. When it came to combining written assessments with visual assistance like drawings, very little was known. But new developments in the concept of multimodal learning have helped us understand how people take in information visually and textually at the same time. Finding out how well medical students did with and without graphics on clinically-oriented, one-best-answer questions was the major motivation for this study. Moreover, a questionnaire was used to evaluate how students' unique attributes and preferred evaluation and teaching techniques affected their final grades. Participating were seventy-five second-year students from six different UK medical schools. The questions were arranged in a way that was consistent with whether the stimulus was graphic or text-only. Along with the image type and deep components, the question's emphasis on the picture's soft-tissue or bone composition was taken into account. The following studies mostly aimed to comprehend the subject's complexity and its regional anatomy. Before turning in their final exams, the students reviewed their questionnaire responses. Student comments lent credence to this argument. The study's findings showed that several factors were impacted, including the number of pictures included, the difficulty of the questions, the depth of the images, regional anatomy, and students' performance. The level of success that students achieve could be greatly affected by their own choices. When diagnosing or treating a patient, it is crucial to have access to high-quality radiological and anatomical images. Finding out how these pictures influence commonly used written assessments was the primary goal of this study.

Keywords*: Employed Medical Terminology, Medical Education, Visual Aids, Student Preparedness.*

1. INTRODUCTION

The impact of anatomy lessons on future doctors' attitudes and practices toward patient care is well-known. One must have a solid grasp of anatomy in order to make accurate diagnoses and administer different medications safely. Young doctors often depend on their anatomical expertise while interpreting radiological images and doing physical exams on patients. These results were "encapsulated" in treatment concepts and used more clandestinely as proficiency

increased. Doctors must have a solid grasp of anatomy for many reasons. Conti and Paternostro (2019) cover a wide range of subjects, including: how certain parts of the body lose feeling or control after a lesion or fracture; how neighboring structures can make a patient's symptoms worse; how to tell healthy ligaments and vessels apart from damaged ones; how to spot different kinds of haemorrhages on CT scans; and many more (Braun & Clarke, 2023).

Emerging medical specialties, including interventional radiology, increasingly need a thorough familiarity with human anatomy and physiology. Conversely, students in medical school have been seeing less time spent on anatomy in class. There were sufficient chances for the development and improvement of other relevant fields within the program. For decades, there has been passionate debate about its proper place in a curriculum that already contains several other subjects. Others have even pondered if, in later years of education, students may gain an advantage by revisiting it, since it could assist them in better integrating anatomy with clinical and other relevant fields. Many are worried that the undergraduate medical school curriculum in the UK has reduced the quality of entering doctors as no comprehensive study was conducted before the changes were put into place. According to the Medical Protection Survey, which investigated insurance claims against surgical procedures, over 50% of claims involving laparoscopic surgery were for inadvertent injury to surrounding tissues. This is likely due to a lack of adequate anatomical knowledge (Dempsey et al., 2024).

2. BACKGROUND OF THE STUDY

Despite the profusion of instruments, there is a dearth of documentation about their usage in anatomy research as evaluation tools. In place of the visual aids that are intrinsic to the numerous facets of anatomy, the limited coverage centered on more generalized ideas like validity, feasibility, and dependability. A viva, written (either digitally or on paper), or on-site examination is one option among several. Oral examinations were seldom utilized in the UK due to issues with bias, low reliability per testing hour, assessor unreliability, and the time they require. Nomenclature, function, and clinical/spatial links are highly valued in the US, ANZ, and AP systems, which is why they are still in use. Essays, free-response questions, short-answer questions (SBAs), extended-matching questions (EMQs), and key features are common types of written exams (Kalthur et al., 2022). A few examples of practical exams include the test-tank, the think-tank, tag, the steeplechase, the Objective Structured Practical Exams (OSPE), and the Integrated Anatomy Practical Papers (IAPP). These exams, which could or might not use visual aids, assess students' grasp of both theoretical and practical components of anatomy. Students of medicine who are thinking about pursuing a career in surgery also have the option of taking the MRCS, which assesses their practical knowledge of anatomy. Candidates aiming to finish their general surgery specialty training might have benefited from taking the MRCS membership exam. Members of surgical advisory committees deemed it necessary for students to transition to subspecialty surgical programs. There were a lot of sections to the exam, and some were more practical than others. Part A of the MRCS written test was two sections long and included Extended Matching Items and Single Best-answer questions to test applicants' understanding of basic scientific concepts and surgical procedures. These inquiries center on the patient's symptoms, medical background, and diagnostic data (such as imaging and blood test results) as outlined in the clinical case scenarios. Asking a question to get context was the next logical step. Approximately one-third of the forty to fifty questions in the magazine pertain to imaging, developmental, surgical, and topographical anatomy. The Objective Structured Clinical Examination (OSCE) in Part B covers a wide range of material, from theoretical principles to actual operating room experience. Using a collection of workstations that simulate different parts of normal medical procedures made this

feasible. Separately designed stations investigate topographical, functional, and surgical anatomy using x-rays and cadaveric specimens. Part B consists of three or four stations where participants will demonstrate their practical anatomy knowledge. At these stations, participants may put their knowledge of anatomy to the test by using medical images, skeletons, and protective eyewear. There has been a significant uptick in study on strategies for improving students' ability to apply their knowledge in undergraduate and graduate-level practical anatomy exams. Both Miller's pyramid and Bloom's taxonomy are well-known models for this kind of assessment (Punja & Punja, 2024). In theory, researchers may go up Miller's pyramid from "knows" to "knows how" and, using a modified version of Bloom's Taxonomy, strive for level 3 by providing contextual information and clinical case scenarios. Research has shown that measuring higher-level cognitive abilities, knowledge application, problem-solving skills, and critical thinking might benefit from contextual clinical information. According to Molyneux and Robson, clinical examination is an excellent method for learning and applying anatomy. All medical students, from first to fourth year, took the examinations online. Questions on clinical and functional imaging, as well as more traditional spotting questions, were all included in the tests. The clinically oriented anatomy questions were positively welcomed by both students (n=96) and clinical instructors (n=23), according to the results of the quantitative and qualitative assessments. This result provides support for the hypothesis that more practical, clinically oriented queries were more effective stimulation. The curriculum's spiraling, integrated, case-based approach is not well represented by multiple-choice questions (MCQs) on the exams because of their incapacity to portray the intricacy and reality of clinical anatomy (Hołda et al., 2019).

3. THE PURPOSE OF THE RESEARCH

The purpose of this study is to examine the efficacy of visual aids in helping medical students understand and retain anatomical concepts within the context of practical anatomy. This study set out to answer the following question: "How can visual aids influence students' readiness for clinical practice?" by looking at the transition from theoretical to practical medical knowledge. after class has ended for the day. By the conclusion of the day, the findings demonstrated that medical school instructors can maximize the classroom resources at their disposal.

4. LITERATURE REVIEW

The researcher had to read everything the researcher had given for the courses and the institutional-focused study (IFS). Search engines and databases including Google Scholar, ERIC, Medline, and Google were used in their pursuit of further information. The researcher used a variety of terms in the course of their investigation, including applied anatomy exams, online and practical anatomy tests, visuals in assessment, educational and anatomical evaluation, assessment psychometrics, and formative assessment. After then, the scholar came across papers that spoke about cognitive theories of visual processing and multimodal learning. The researcher aimed to gauge students' perceptions of the significance of anatomy lessons as well as their expectations for the course when they devised the questionnaire (Sagoo et al., 2021). After finding a few key individuals, the researcher used a snowball strategy to go further into the issue, thus these search engines were still rather useful. Investing considerable effort was needed to establish connections between visual learning psychology, anatomical assessments, and visual function. The assessment technique, which is briefly outlined in this chapter, is based on anatomy and other areas of medical education. the researcher then analyzed the students' ideas via the prisms of educational psychology and anatomy-based theories of

visual aids to see how well they performed. An essential component of any curriculum was assessment, which reveals the efficacy of educational institutions, students' knowledge acquisition, and their future study habits. The two main kinds of assessments employed were formative and summative. Summative exams aim to certify and hold students accountable, while formative assessments aim to give students agency and improve their capacity for autonomous learning via the provision of insightful feedback. In the opinion, the researcher would benefit from first defining "competence" before proceeding. The group in charge of gradmed programs established the six domains of competency and the criteria for evaluating them. All the following are part of this category: medical knowledge, systems-based practice competence, communication and interpersonal skills, practice competence for learning and growth, professionalism, and patient care. They seem to view anatomical competence as a subset of medical knowledge competence, as they are open to the notion of anatomy competence, which is defined as the ability to do a task by integrating the appropriate cognitive, psychomotor, and emotional abilities. A person's emotional, motor, and mental elements were often evaluated on a "knowledge/content dimension" and a "cognitive process/progress dimension" in traditional exams (Zhang et al., 2023). The content part of anatomy includes anatomical terminology and facts, conceptual comprehension, skill with techniques and processes, and metacognitive domains. How effectively individuals can classify, compare, translate, comprehend, and apply new information is what the "progress dimension" finds out while evaluating their capacity to learn. An online quiz was administered by the researcher to assess the participant's understanding of applied anatomy and their progress so far in the study. The emphasis in medical practice was moving from evaluation programs as independent tests to a more holistic view (Lochner et al., 2020).

5. RESEARCH QUESTION

- What is the impact of Simplified complex information on medical students' knowledge of applied anatomy in the medical profession?

6. METHODOLOGY

This study used a quasi-experimental design by recruiting from medical schools and depending on participants' voluntary involvement. The students were provided with uniform test conditions and were required to respond to questions using either anatomical or radiological images, or without any visual aids. The researcher first reached out to 10 different medical schools in the UK to request authorization to include their students in the study. The availability and use of visual aids in anatomy education were the determining criteria for the selection of these ten medical institutes. The anatomy homepage and relevant contacts of each medical school were meticulously examined for this material. These educational institutes use radiographic images, dissected cadavers, and pre-dissected anatomical specimens as resources. Only six of them, however, managed to authorize the request within the designated timeframe. Among the six medical schools, there was a judicious use of anatomy teaching resources: three institutions employed radiological images with prosections, two relied solely on radiological pictures, and one utilized all three methods. Medical students from six distinct institutions in the United Kingdom participated in the study. The students that participated in the study were in their last year of college. A complimentary review resource for students to assess their comprehension of applied anatomy, this assessment was sent around two months before to their final examinations. A multitude of students participated. It is logical to choose pre-clinical medical students, since the first two years of a medical degree focus specifically on anatomy.

As all students were slated to undertake their second-year final examination in about one to two months, it was presumed that the cohort had a comparable level of foundational knowledge. The anatomical and radiological images may be used to assess students at this stage of their medical education, since they are presumed to possess mental models to interpret the test's visuals. Moreover, the heads and professors of the anatomy departments from each medical school evaluated the questions and determined that the students were comparable in both the content (questions-context and visuals) and the presentation of the test. An administrative or anatomical department at each institution sent an introductory email and a brochure promoting the research to students to mitigate any semblance of pressure in their participation.

Participants

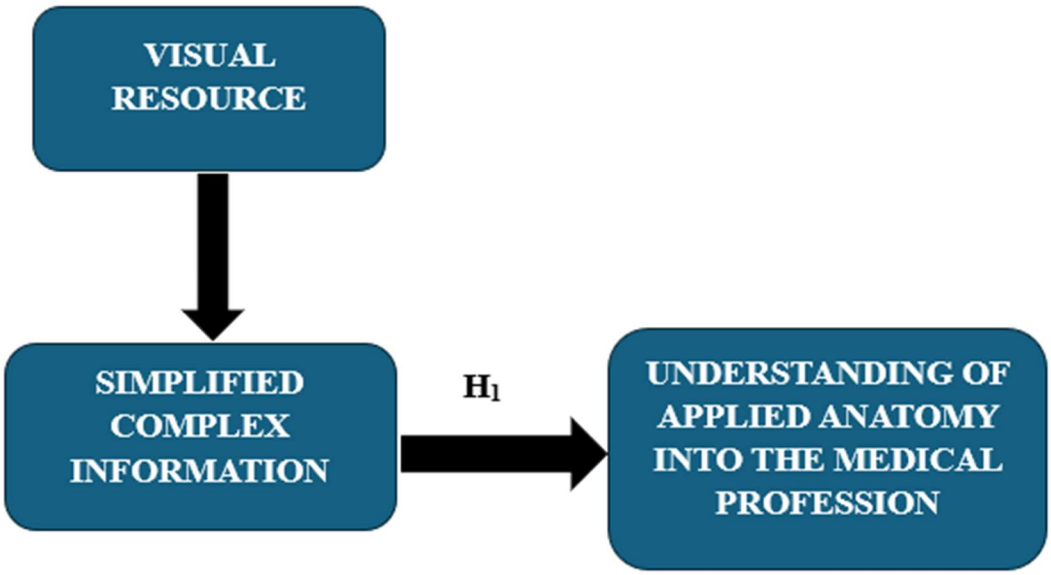
Utilizing identical pupils in both groups may enhance internal validity. This study deviates from the conventional methodology of randomized controlled trials due to the absence of an intervention to distinguish between the two groups. The researcher categorized them into three groups: controls, test 1 (including questions with images of human anatomy), and test 2 (with questions with images of radiography). This action addressed the possibility for group prejudice.The components referenced in the literature are as follows: When the researcher discuss changes in the learner's surroundings unrelated to the inquiry, the researcher refer to history. The phrase "testing" refers to alterations resulting from experimentation. The term "instrumentation" refers to the variability in measurements between different tests. Regression analysis necessitates the use of non-standard experimental groups. The death rate refers to the proportion of individuals who withdraw from a research. the researcher use the term "maturation" to describe learners' journey toward improvement over time. Establishing initial differences among groups is the first stage in selecting them for further analysis. Groups are susceptible to maturation interaction selection if they have a propensity to disband as individuals age. The causal relationship between A and B is unclear. The "diffusion of therapies" refers to the occurrence when components of a therapy intended for one demographic inadvertently transfer to another. It is essential to rectify uneven treatment to avert organizational pressures that may result from preferential treatment of one group over another. What the researcher refer to as "compensatory rivalry" is essentially internal process adjustments used to maintain competitiveness. The "history" and "testing" elements continue to pose challenges, irrespective of whether the study evaluated the same students' performance. Due to the exclusive use of a single quasi-experimental design, concerns such as "instrumentation," "mortality," "diffusion of treatments," "compensatory equalization of treatments," and "compensatory rivalry" were absent. The "Regression" group likely had students with varying abilities. Variations in "maturation" may stem from the influence of individuals' distinct life experiences on their development. Institutions of higher medical education were meticulously chosen for the "selection" phase based on the quality of instructional graphics used in anatomy courses. The investigator meticulously examined anatomy-related websites and relevant contact information for all medical schools.

Procedure

The study participants for "Anatomical Man" included both males and females. The typical duration of these anatomical blood pressure examinations was 18 to 24 hours, often occurring overnight. Precise results were obtained by rigorously following the BP approach. Images and anatomical atlases were used to precisely establish landmarks on the models initially. The landmarking procedure included precisely delineating several anatomical structures, including bones, muscles, organs, blood vessels, and nerves, using black whiteboard markers. This stage was significant as it provided a template for the subsequent phase. In some projects, the first

landmarking phase may need up to 10 hours for completion. Upon selecting a topic, the subsequent phase included painting and shading it. The need for long-term durability and fracture resistance necessitated the inclusion of superior grade paint and body coatings in every BP project. A variety of paintbrushes and cosmetic brushes were also used for this purpose. The student painters used reference materials, including Netter's Atlas of Human Anatomy, to produce precise representations of human anatomy. Upon completing the paintings, an ambitious photographer captured high-quality photos to complement them, which were subsequently published and used in advertising.

7. CONCEPTUAL FRAMEWORK

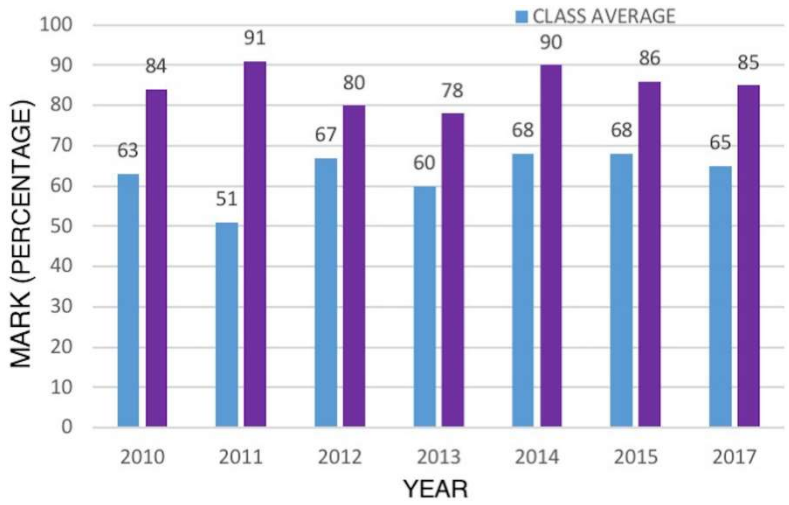


8. RESULT

Assumption of data point independence is fundamental to normal distribution-based parametric testing. Since the same cohort provided data on students' performance across many question types, a repeated measures approach was used. Consequently, information on the outcomes of different types of searches would be linked. Since the degree of dependence was almost same across groups, the researcher reasoned that other question categories may also have a similar link between performance. The object's nature is defined by its categorization as spherical. Researchers call a distribution spherical when the variances—the differences between any two scores in a given combination—are very close to being equal. Local circularity (sometimes called local sphericity) is a statistical phenomenon that occurs when two out of three treatments have similar variances. All sixteen of the BP projects that were completed outside of class are described in great detail below: Brain Man (covering the neurological and circulatory systems), Process Man (four sections showing how blood pressure works), Anatomical Man (four sections about muscles), Skeletal Man (two sections about bones), Anatomical Woman (two sections about muscles), Pregnant Woman (a monthly illustration of a pregnant woman until she gives birth), and Systems Man (visceral organs and anatomy). Land marking took roughly 8 to 10 hours, while painting took about 12 to 14 hours,

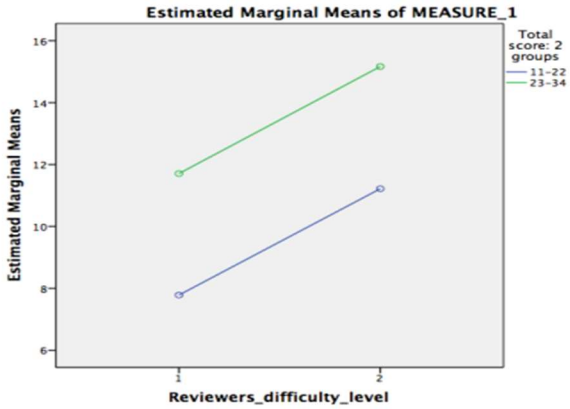
however most activities were accomplished within 24 hours. The procedure was open to a large number of invited guests, including members of the anatomy department, the dean of medicine, the head of school, and the deputy vice chancellor. These visits were essential in keeping employees motivated during the long hours of the project. Even more impressively, 87.1% of students felt that BP was applicable to class discussions, 93.6% said it was important for their success, and 80.7-87.1% stated it was valuable for their careers. Participation in the BP exercises improved students' short- and long-term recall of human anatomy by 93.3%. The majority of the kids had positive things to say about the event, and their comments were summarized.

Table: Inspiring Medical and Health Science Students to Learn Surface Anatomy



Mauchly's sphericity test is inapplicable due to the presence of just two independent factors un the dependent variable (question difficulty level). A substantial effect size (partial Eta Squared = .642) was shown by within-subjects effects and contrasts, indicating a significant difference in question difficulty ($F(1, 172) = 308.88$, $p < .001$). A significant difference is seen between students who attained high scores and those who did not ($F(1, 172) = 320.44$, $p<.001$), with a partial eta squared value of .651, indicating a big effect size. The relationship between question difficulty and student performance groups did not achieve statistical significance. Figure 12 illustrates the tiers of question difficulty: level 1 for scores of 56 or below, and level 2 for scores over 56.

Figure: High and low performers' scores on easy and difficult questions



9. DISCUSSION

The critical requirement of educating the next generation of healthcare professionals with effective teaching methodologies, particularly visual aids, is highlighted by an evaluation of medical students' understanding of applied anatomy. Studying the effects of new technologies on learning outcomes becomes extremely relevant as the use of technology and innovative teaching strategies in medical education continues to expand. Students may find it easier to understand complex anatomy with the use of visual aids such as anatomical models, interactive infographics, and computer simulations. These techniques enhance spatial awareness and recall, which might help students better appreciate the links between structures. This level of expertise is necessary for a complete understanding of both the theory and practice of healthcare. Moving from classroom theory to real-world clinical practice is fraught with challenges for pre-med students. Surgical procedures and the interpretation of diagnostic images are two examples of the more practical skills that students may acquire via the use of visual aids in the classroom. The ability to relate clinical scenarios to anatomical diagrams is crucial for providing excellent patient care, which requires the ability to think critically and solve problems. Additionally, some students may gain more than others from visual aids due to individual differences in how they learn. Different students may respond better to different teaching approaches; some may thrive with more traditional techniques and others with more contemporary approaches. Given this diversity, it is essential to provide students with a range of resources that may cater to their individual learning preferences. A potential takeaway for medical educators from this research might be a deeper understanding of the use of visual aids in the classroom. Recognizing the positive impacts of these technologies on knowledge retention and practical application might lead educational institutions to enhance their teaching techniques. As a result of students being more equipped to handle the challenges they would face in their future nursing and medical jobs, patient outcomes improved.

10. CONCLUSION

The study highlights the importance of students having a strong grasp of applied anatomy and the significant impact that visual aids have on medical students' learning and practical readiness. According to Menon (2022), students' understanding of complex anatomical concepts might be greatly enhanced by using current teaching methods like computer simulations, interactive visuals, and three-dimensional models (Menon, 2022). This could be a game-changer for the medical profession. The study found that students retained far more information about the human body when visual aids were used. In addition to improving their memorization abilities, students acquire practical skills that will be useful to them throughout their medical careers. Students need to develop their analytical and problem-solving abilities as they prepare to work as healthcare professionals; these resources help them bridge the gap between theory and practice. The use of visual aids should be prioritized by medical educators as a means to engage students and accommodate their various learning styles. This approach seeks to instill more self-confidence in medical professionals so that they can better meet the challenges of modern medicine and provide optimal treatment to their patients. Future research into medical education best practices might be informed by the findings of this study.

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