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EVALUATING MEDICAL STUDENTS' COMPREHENSION OF APPLIED ANATOMY: THE IMPACT OF VISUAL RESOURCES ON THEIR READINESS FOR MEDICAL PRACTICE

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ABSTRACT

Students' topographical and practical knowledge of anatomy were tested on timed exams that used visual aids such as cadavers, pictures of cadavers, radiographs, and images of clinical findings. Very little was known regarding the use of visual aids such as drawings in conjunction with textual evaluations. However, advances in the idea of multimodal learning have allowed us to get a better grasp of how individuals learn from visual and textual sources simultaneously. The primary goal of this research was to find out how medical students fared when given clinically-oriented, single-best-answer questions with or without pictures. Furthermore, the impact of students' individual traits and preferred assessment and instructional methods on their final grades was investigated via the use of a questionnaire. Six medical institutions in the United Kingdom sent 75 second-year students who volunteered to participate. Based on whether the stimulus was text alone or an image, the researcher organized the questions accordingly. The question's focus on the picture's soft-tissue or bone content was considered alongside the image type and deep components. The intricacy of the subject and its geographical anatomy were the primary foci of subsequent research. The students looked over their questionnaire answers as well as their exam results. Comments made by students provided more support for this claim. The research demonstrated that several parameters, such as picture inclusion, question complexity, regional anatomy, image depth, and students' performance, were affected. Students' personal preferences may have a significant impact on their performance. Radiological and anatomical pictures are essential in medicine for examining and evaluating a patient's anatomy. This research aimed to examine how these images affect routinely used written evaluations.

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

1. INTRODUCTION

As is well-known, medical students' approach to patient care is heavily influenced by what they learn in anatomy classes. Accurate diagnosis and the safe administration of various medicines need a firm understanding of anatomy. When interpreting radiological

images and doing physical tests on patients, it is usual for young physicians to rely on their anatomical knowledge. These findings were "encapsulated" in therapeutic ideas and used more covertly as competence grew. Anatomy knowledge is crucial for doctors for several reasons (Chytas et al., 2020). The mechanisms by which specific areas of the body lose sensation or control following a lesion or fracture; the ways in which nearby structures can amplify a patient's symptoms; the methods for identifying healthy and damaged ligaments and vessels; the presence of various types of hemorrhages on computed tomography (CT) scans; and many more. An in-depth understanding of human anatomy and physiology is now required for practice in many emerging medical fields, such as interventional radiology. On the other hand, anatomy classes at medical schools have been cutting down on the amount of time students spend on the subject. The program provided enough opportunities for the growth and advancement of other pertinent disciplines (Chase et al., 2018). Where exactly it belongs in a curriculum with so many other requirements have been the subject of heated controversy for decades. Some have even wondered if students might benefit from reviewing it in later years of school to help them better integrate anatomy with clinical and other pertinent disciplines. Since no thorough research was done prior to the implementation of the reforms, many are concerned that the undergraduate medical school curriculum in the UK has diminished the caliber of incoming physicians. More than half of the claims involving laparoscopic surgery were for accidental harm to adjacent tissues, most likely because of insufficient anatomical understanding, according to the Medical Protection Survey that looked into insurance claims against surgical treatments (Demirtaş, 2019).

2. BACKGROUND OF THE STUDY

Few assessment tools have been documented for use in anatomy research, despite the abundance of such instruments. The little coverage focused on more abstract concepts such as validity, feasibility, and reliability, rather than the visual resources inherent to anatomy and its many aspects. Examinations may be either oral (viva), written (online or on paper), or practical (on-site). Problems with bias, poor reliability per testing hour, assessor unreliability, and the time they demand meant that oral exams were seldom used in the UK. The United States, Australia, and New Zealand continue to utilize these systems because of how highly they regard nomenclature, function, and clinical/spatial linkages. Common forms of written examinations include essays, free-response questions, SBAs, extended matching questions (EMQs), and key features (Jones & Harris, 2020). The test-tank, the think-tank, tag, the steeplechase, the Objective Structured Practical tests (OSPE), the Integrated Anatomy Practical Papers (IAPP), and a few more are examples of practical tests. Students' understanding of both the academic and practical aspects of anatomy is tested on these tests, which may or may not use visual aids. An alternative option for medical students interested in surgery is the Membership Examination of the Surgical Royal Colleges of Great Britain (MRCS), which tests their practical understanding of anatomy. Taking the MRCS membership test would have been a good move for candidates hoping to complete their general surgery specialized training. Surgical specialized Advisory Committees declared that trainees were required to move to specialized surgical training. The test was divided into many parts, some of which were more theoretical and others more practical. Part A of the MRCS written exam consisted of two parts and examined candidates' knowledge of both fundamental scientific principles and surgical techniques via the use of Extended Matching Items and Single Best-answer questions. These questions, based on the clinical case scenarios,

mostly pertain to the patient's symptoms, medical history, and diagnostic data, such as imaging and blood test results. The next step was to ask a question that would serve as background information. Imaging, developmental, surgical, and topographical anatomy make about one-third of the forty to fifty questions in the publication. Topics covered in Part B's Objective Structured Clinical Examination (OSCE) include both theoretical concepts and practical experience in the operating room. This was made possible by using a set of workstations that mimic various aspects of typical medical operations (Guclu et al., 2021). Using radiological imaging and cadaveric specimens, each independently planned station explores topographical, applied, and surgical anatomy. In Part B, participants will put their practical knowledge of anatomy to the test at three or four stations. At these stations, participants tested their anatomical knowledge using medical graphics, bones, and safety glasses. Methods that help students apply what they've learned on practical anatomy exams at the undergraduate and graduate levels have recently been the focus of research. Popular models for this kind of evaluation include Bloom's taxonomy and Miller's pyramid. Researchers may theoretically go from "knows" to "knows how" and, according to modified Bloom's Taxonomy, aim for level 3 by supplying clinical case scenarios and other contextual knowledge, as seen in Miller's pyramid. The current findings suggest that contextual clinical information might be useful for evaluating higher-level cognitive powers, knowledge application, problem-solving skills, and critical thinking. Based on what Molyneux and Robson have said, clinical evaluation is a great way to learn and use anatomy. Online exams were administered to first- through fourth-year medical students. The exams included both classic spotting questions and more contemporary ones based on clinical and functional imaging. Results from both the quantitative and qualitative analyses revealed that the clinically focused anatomy questions were well-received by both students (n=96) and clinical instructors (n=23). This finding lends credence to the idea that realistic, clinically focused questions served as better stimulus. Because of their inability to capture the complexity and realism of clinical anatomy, multiple-choice questions (MCQs) on spotting examinations could never do justice to the curriculum's spiraling, integrative, case-based approach (Ozer O, Kılıç, 2018).

3. THE PURPOSE OF THE RESEARCH

In the framework of practical anatomy, this research aims to discover how students of medicine grasp and remember anatomical ideas via the use of visual aids. Through an examination of the change from theoretical to practical medical knowledge, this research aimed to address the following question: "How can visual aids influence students' readiness for clinical practice?" at the end of the classroom period. at the end, the results showed that teachers at medical schools can make the most of the resources available to them in the classroom.

4. LITERATURE REVIEW

The classes and the institutional-focused study (IFS) required the researcher to first read all The researcher had assigned. Their quest for further information led them to search engines and databases such as Google Scholar, ERIC, Medline, and Google. Formative assessment, assessment psychometrics, visuals in assessment, educational and anatomical evaluation, online and practical anatomy tests, and visuals in applied anatomy examinations were some of the terminologies employed by the researcher. The researcher then stumbled onto articles discussing multimodal learning and cognitive theories of

visual processing. The researcher's goals in developing the questionnaire were to get a sense of the students' perspectives on the importance of anatomy classes and their expectations for the course. The researcher used a snowball technique to study the ins and outs of the topic after locating a few important folks, thus these search engines were still fairly beneficial. Linking the links between visual learning psychology, anatomical evaluations, and visual function required significant time and energy (Samad et al., 2021). Anatomy and other branches of medical education provide the basis of the evaluation strategy, which is briefly described in this chapter. Next, The researcher looked at how well the students did by analyzing their thoughts through the lenses of educational psychology and visual aid theories based on anatomy. Because it shows how well educational institutions are doing, how much students have learned, and how they will study in the future, assessment was an integral part of every curriculum. There were primarily two types of evaluations used: formative and summative. The primary goals of summative examinations are certification and accountability, while the primary goals of formative assessments are to empower learners and enhance their ability to learn independently by providing them with useful feedback. The researcher think it would be helpful if the researcher defined "competence" before moving on. The six areas of competence and their measurement were defined by the organization that oversees graduate medical education. Included in this category are the following: medical knowledge, competence in systems-based practice, interpersonal and communication skills, competence in learning and development via practice, professionalism, and patient care. Their willingness to accept the idea of anatomy competence—the capacity to complete a task by combining the relevant cognitive, psychomotor, and affective skills—indicates that they see anatomical competence as a subset of medical knowledge competence. A "knowledge/content dimension" and a "cognitive process/progress dimension" were the typical ways in which tests assessed the emotional, motor, and mental aspects of a person. Metacognitive domains, conceptual understanding, technique and process competency, and anatomical language and facts make up the content component of anatomy. The "progress dimension" measures their ability to learn new material by measuring how well they can categorize, compare, translate, understand, and apply it. The researcher used an online quiz to gauge their level of knowledge in applied anatomy and the progress they had made so far in the project. A more comprehensive perspective was becoming more common in medical practice, shifting the focus away from assessment programs as standalone exams (Golenhofen et al., 2020).

5. RESEARCH QUESTION

- What is the impact of Improved understanding on medical students' knowledge of applied anatomy in the medical profession?

6. METHODOLOGY

This research used a quasi-experimental approach by recruiting from medical schools and relying on participants' voluntary participation. The students were given identical examination settings and had to answer questions using either anatomical or radiological pictures, or without visuals at all. At first, the researcher contacted ten different medical schools in the UK to ask for permission to use their students in the research. The accessibility and usage of visual aids in anatomy instruction were the deciding factors in the selection of these 10 medical institutions. Each medical school's anatomy homepage and pertinent contacts were combed through for this data. These educational institutions

make use of radiographic pictures, dissecting cadavers, and pre-dissected body parts as anatomical resources.

Only six of them, however, were able to approve the request within the allotted time. A good thing is that among those six medical schools, there was a reasonable distribution of the anatomy teaching resources: three schools used radiological images in addition to prosections, two schools used radiological images alone, and one school used all three. Medical students from six different schools in the United Kingdom took part in the research. The students who volunteered to take part in the research were in their last year of college. A free revision tool for students to test their understanding of applied anatomy, this test was issued around two months before their final exams. Many students took it. Since the first two years of a medical degree explicitly teach anatomy, picking pre-clinical medical students makes sense. Since all of the students were scheduled to take their second-year final test in around a month or two, it was assumed that the group had a similar level of background knowledge. Also, the anatomical and radiological pictures might be utilised to evaluate students at this point in their medical degree since they are thought to have mental models to handle the test's visuals. In addition, the anatomy department chairs and faculty from each medical school assessed the questions and found that the students were on par with one another in terms of both the substance (questions-context and visuals) and presentation of the examination. An administration or anatomical department at each school sent an introduction email and a leaflet advertising the study to students in an effort to avoid any appearance of coercion in their participation.

Participants

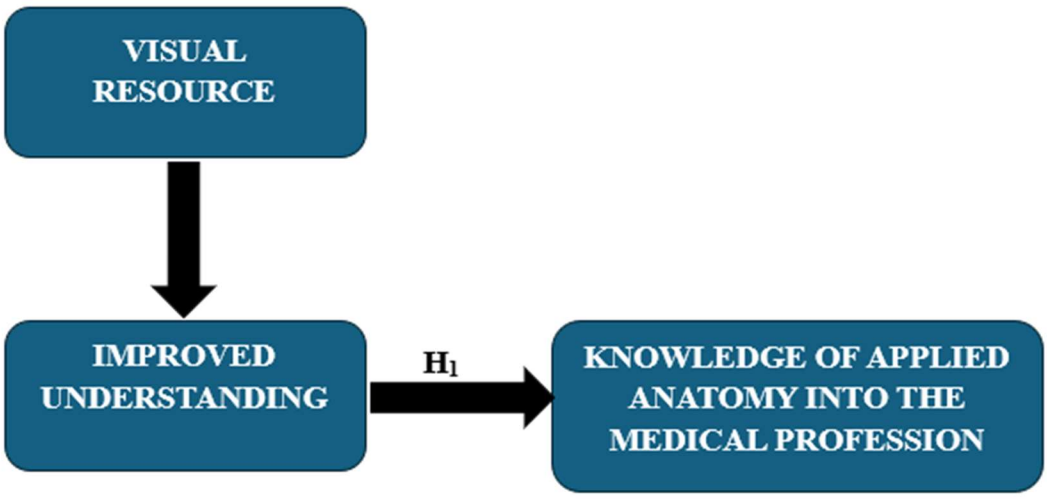
Having identical students participate in the two groups may help with group internal validity. Because no intervention was used to differentiate between the two groups, this research departs from the standard procedure of randomized controlled trials. This is when the researcher divided them into three groups: controls, test 1 (which had questions with pictures of the human body's anatomy), and test 2 (which had questions with pictures of its radiology). The potential for group discrimination was addressed by doing this.Here are the components that have been cited in the literature: When The researcher talk about the learner's environment changing for reasons unconnected to the inquiry, we're talking about history. The term "testing" is used to describe modifications that are the result of experimenting. Variation in measurements from one test to another is what the word "instrumentation" describes. Regression analysis requires the use of non-standard experimental groups. Death rate is the percentage of participants that drop out of a study. When The researcher talks about pupils' progress toward betterment over time, The researcher utilize the word "maturation" to express it. Making preliminary distinctions between groups is the first step in choosing them for further examination. The researcher say that groups are prone to maturation interaction selection if they have a tendency to split apart as people become older. In terms of the actual connection, it is not apparent whether A causes B or B causes A. The "diffusion of therapies" describes what happens when parts of a therapy that were meant for one group wind up in another. It is crucial to compensate for unequal treatment in order to prevent organizational pressures that might arise from favoring one group over another. What The researcher call "compensatory rivalry" is really just internal process adaptations made to stay competitive. The "history" and "testing" components remain problematic regardless of whether the research assessed the same students' performance. Because just one quasi-experimental design was utilized, issues including "instrumentation," "mortality," "diffusion of treatments," "compensatory

equalisation of treatments," and "compensatory rivalry" were not present. The "Regression" group presumably consisted of pupils with a range of talents. Individual differences in "maturation" may have resulted from the fact that people's growth was conditional on their unique set of life events. Institutions of higher medical education were hand-picked for the "selection" part according to the quality of the instructional visuals utilized in anatomy classes. This is why the investigator combed through the anatomy-related websites and pertinent contact information of all medical schools.

Procedure

Study subjects for "Anatomical Man" were male and female. The average period of these anatomical BP investigations was 18 to 24 hours, and they usually lasted overnight. Accurate findings were achieved by strictly adhering to the BP method. Images and anatomical atlases were used to accurately landmark the models initially. The landmarking process included meticulously outlining the many anatomical features, such as bones, muscles, organs, blood veins, and nerves, using black whiteboard markers. Important since it served as a blueprint for the next phase, this step was crucial. It may take up to ten hours to finish this first landmarking stage in certain projects. After deciding on a subject, the next stage was to paint and shade it. The need for long-term durability and crack-resistance meant that exceptional quality paint and body paints were an essential component of every BP project. Also used for this purpose were a variety of paintbrushes and cosmetic brushes. The student artists relied on reference materials such as Netter's Atlas of Human Anatomy to create accurate depictions of human anatomy. After finishing the paintings, an aspiring photographer shot high-quality images to accompany them, which were then published and used in advertising.

7. CONCEPTUAL FRAMEWORK

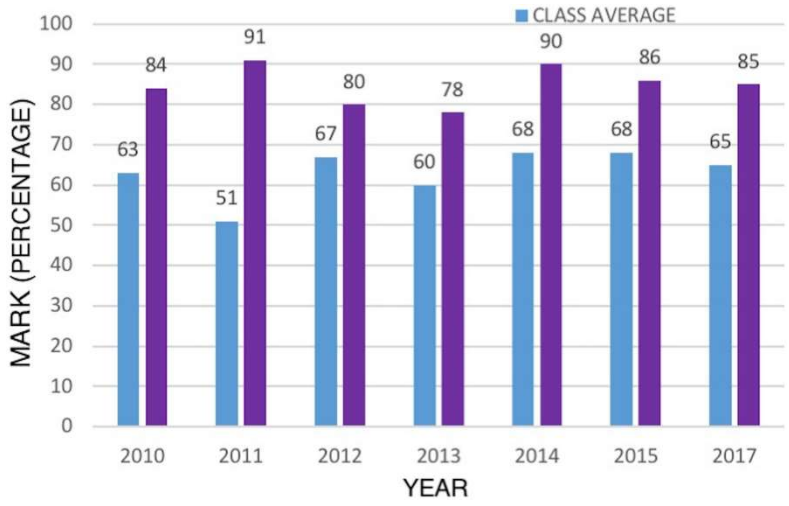


8. RESULT

Parametric tests based on the normal distribution assume the independence of data points. Data on student performance across several question types was obtained from the same cohort, hence a repeated measures technique was used. As a result, data on results from various forms of queries would be interconnected. The researcher found that, given the

almost same level of dependency across groups, it is reasonable to infer that the correlation between performance on other question types may likewise be comparable. The designation of this object as spherical delineates its nature. When these variances, indicating the disparities between any two scores in a certain combination, are almost identical, the researcher classifies the distribution as spherical. When the variances of two of three treatments are comparable, the researcher describes the data as exhibiting local circularity (sometimes referred to as local sphericity). The following is a detailed description of all sixteen extracurricular BP projects: Neurovascular Man (encompassing the nervous and cardiovascular systems), Multi-colored Man (muscles depicted in diverse hues; three projects), Process Man (four quadrants demonstrating blood pressure mechanisms), Anatomical Man (four projects pertaining to muscles), Skeletal Man (two projects regarding bones), Anatomical Woman (two projects centered on muscles), Pregnant Woman (a portrayal of a pregnant woman illustrated monthly until delivery), and Systems Man (visceral anatomy and organs). The majority of tasks were finished within 24 hours; land marking needed around 8 to 10 hours, but painting demanded about 12 to 14 hours. A multitude of attendees from various departments and programs, including anatomy, were there, alongside the dean of medicine, the head of school, and the deputy vice chancellor, all of whom were invited to see the surgery. These visits were crucial for sustaining employee enthusiasm over the prolonged project hours. Moreover, 87.1% of participants said that BP was relevant to their class discussions, 93.6% affirmed its importance to their success, and 80.7-87.1% recognized its value to their careers. Engagement in the BP activities led to a 93.3% improvement in students' memory of human anatomy, both in the short term and long term. The students' remarks were paraphrased, and they were mostly favorable about the experience.

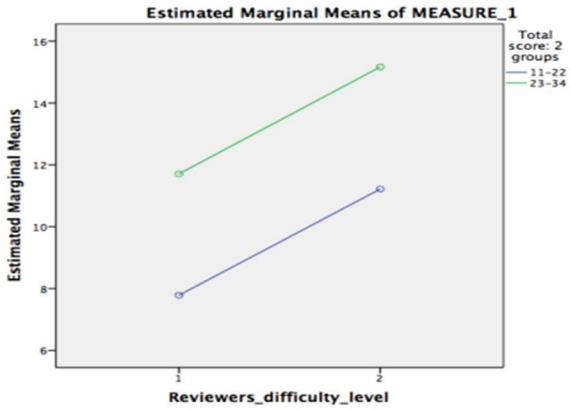
Table: Inspiring Medical and Health Science Students to Learn Surface Anatomy



Mauchly's sphericity test is not applicable since there are just two independent elements in the dependent variable (question difficulty level). A considerable 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 substantial disparity exists between students who achieved high scores and those who did not (F (1,

172) = 320.44, p<.001), with a partial eta squared value of .651, indicating a large effect size. The correlation between question difficulty and student performance groups did not reach statistical significance. Figure 12 delineates the levels of question difficulty: level 1 for scores of 56 or below, and level 2 for scores beyond 56.

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



9. DISCUSSION

An assessment of medical students' applied anatomy knowledge emphasizes the important need of using proper teaching strategies, especially visual aids, to educate the next generation of doctors and nurses. As the use of technology and creative teaching techniques continues to grow in medical education, it became critically important to study how new technologies affected learning outcomes. Visual tools like anatomical models, interactive infographics, and computer simulations may help students grasp complicated anatomy. Students may have an easier time understanding the interconnections between buildings if they use these tools, which improve spatial awareness and memory. To fully grasp both theoretical concepts and how to put them into practice in healthcare settings, one must have this in-depth knowledge. In addition, pre-med students face a multitude of obstacles while moving from theoretical study to hands-on clinical experience. Students may learn more practical skills, such how to execute surgical operations and interpret diagnostic photographs, with the use of visual aids used in the classroom. As a critical thinker and problem solver, the capacity to connect clinical situations to anatomical diagrams is essential for delivering top-notch patient care. Also, since every student has their own unique way of learning, some may benefit more than others from visual assistance. Traditional methods of instruction may work better for certain kids, while more modern methods may work better for others. Because of this variety, it is critical to provide students with various tools to accommodate their unique learning styles. One possible thing that medical educators might take away from this study is a better understanding of the use of visual aids while teaching. It is possible that educational institutions may improve their teaching methods if they acknowledged the beneficial effects of these technologies on information retention and practical application. Patient outcomes increased because students were more prepared for the difficulties they would encounter in their future careers as nurses and physicians.

10. CONCLUSION

The research emphasizes the significance of students having a solid understanding of applied anatomy and the profound effect that visual aids have on medical students' ability to learn and be clinically prepared. As the medical sector advances, Franchi argue that students' comprehension of complicated anatomical ideas might be substantially improved by the use of modern teaching tools such computer simulations, interactive graphics, and three-dimensional models (Franchi, 2020). Students learn anatomy far more well with visual aids, according to the research. They learn valuable skills that will aid them in their careers in medicine and also remember more of what they study. As they are ready to enter the healthcare industry as professionals, students must strengthen their critical thinking and problem-solving skills, and these materials assist them in making that leap from classroom theory to real-world practice. In order to engage students and cater to their individual learning styles, medical educators should make the use of visual aids a top priority. In order to tackle the problems of contemporary medicine and provide their patients with the best care possible, this method aims to teach doctors and nurses to believe in themselves more. The results of this study could serve as a foundation for future investigations into the best practices of medical education.

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