PORTABLE ANATOMY LEARNING AND PROTOTYPING WORKBENCH FOR ENHANCED SKILL TRAINING IN MEDICAL AND ALLIED HEALTH EDUCATION

Project Reference No.: *49S_MSC_0136*

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Keywords:

Anatomy, Systemic, Education, Medical, Undergraduate, Teaching Materials Models, Anatomic, Educational Technology.

Introduction:

Anatomy constitutes a fundamental discipline in medical and allied health education, providing the structural basis for understanding normal physiological function and clinical practice (Drake et al., 2009). Conventional methods of teaching anatomy predominantly rely on textbooks, cadaveric dissection, and static models. Although these approaches are essential, they are often limited in terms of accessibility, portability, and integration with evolving educational technologies (Estai and Bunt, 2016).

In recent years, there has been a paradigm shift toward competency-based medical education (CBME), which emphasizes the development of practical skills, clinical reasoning, and self-directed learning (Frank et al., 2010). However, the existing teaching-learning methods may not sufficiently facilitate the integration of theoretical knowledge with hands-on skill acquisition, particularly in resource-limited settings (Azer and Eizenberg, 2007).

Furthermore, the availability of cadaveric materials and advanced simulation tools is often restricted due to logistical, financial, and ethical constraints (Turney, 2007). This highlights the need for innovative, cost-effective, and portable educational solutions that can enhance student engagement and promote experiential learning (McMenamin et al., 2018).

In this context, the present project proposes the development of a portable anatomy learning and prototyping workbench. The system is designed to incorporate system-wise modular anatomical models along with measurement tools to support interactive learning. In addition, QR-based digital integration is utilized to provide access to supplementary educational resources, including videos, diagrams, and clinical correlations (Moro et al., 2017).

The proposed workbench aims to bridge the gap between theoretical knowledge and practical application by combining tactile and digital learning modalities. It is intended to serve as an effective teaching-learning aid for students in medical, physiotherapy, and allied health disciplines, thereby contributing to improved understanding, skill development, and academic performance (Nicholson et al., 2006).

Figure 1: 3D conceptual diagram of the portable anatomy learning workbench showing bones, joints and organs with integrated QR code

Objectives:

1. To design and develop a portable anatomy learning workbench for skill-based education.
2. To create system-wise modular anatomical learning units covering major body systems.
3. To integrate QR-based digital learning resources for enhanced understanding and self-learning.
4. To promote hands-on, interactive learning to improve student engagement and practical skills.
5. To evaluate the effectiveness of the workbench in improving knowledge and skill acquisition among students.

Methodology:

The project was carried out in multiple phases. Initially, the design of a portable anatomy learning workbench was conceptualized with emphasis on modularity and ease of use. A compact box structure with removable trays representing different anatomical systems was planned. System-wise modules including skeletal, joint, muscular, nervous, and cardio-respiratory systems were identified and designed.

In the prototype development phase, anatomical models such as bones, joints, brain, heart, and lungs were either procured or fabricated using low-cost materials. The workbench structure was assembled using foam boards, acrylic sheets, or suitable alternatives.

Subsequently, digital learning content was developed in the form of videos, labeled diagrams, and explanatory notes. The content was uploaded to platforms such as Google Drive or YouTube. QR codes linking to the respective learning materials were generated and affixed to each module for easy access.

In the implementation phase, the developed workbench will be demonstrated to students from medical and allied health backgrounds. Hands-on sessions will be conducted to allow students to interact with the modules.

For evaluation, a pre-test and post-test assessment method will be adopted. Student feedback will be collected using a structured questionnaire. The collected data will be analyzed using descriptive statistical methods to assess the effectiveness of the workbench in enhancing knowledge and skill acquisition.

Result and Conclusion:

The implementation of the portable anatomy learning workbench is expected to result in measurable improvements in students' knowledge and skill acquisition. Based on the pre-test and post-test assessments, a significant increase in scores is anticipated. For instance, the mean pre-test score is expected to be in the range of 45–55%, while the post-test score may improve to 70–80%, indicating an approximate 20–30% enhancement in learning outcomes.

During hands-on sessions, a higher level of student engagement is expected to be observed. It is anticipated that more than 80% of students will actively participate in identifying anatomical structures and performing assigned tasks. Additionally, around 75–85% of students are expected to demonstrate improved ability in correlating anatomical knowledge with basic clinical applications.

The integration of QR-based digital resources is expected to facilitate self-directed learning, with approximately 85–90% of students likely to report that the digital content helped in better understanding and revision of concepts. Feedback collected through structured questionnaires is anticipated to show that over 80% of students find the workbench easy to use, informative, and effective compared to conventional learning methods.

In conclusion, the portable anatomy learning and prototyping workbench is expected to function as an effective and low-cost educational tool. The observed improvement in test scores and positive student feedback will indicate that the combined use of physical models and digital learning resources enhances both comprehension and practical skills. This approach supports competency-based education and has the potential for wider implementation in medical and allied health training programs.

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Future Scope:

The future scope of this project includes:

1. The workbench can be enhanced by integrating advanced technologies such as augmented reality (AR) and virtual reality (VR) to provide immersive and interactive learning experiences.
2. Additional modules covering advanced anatomical systems and clinical procedures can be incorporated to expand its application in higher-level medical education.
3. A dedicated mobile application can be developed to organize QR-based content, enabling structured and easily accessible digital learning.
4. The prototype can be scaled for mass production and can be implemented across medical, physiotherapy, and allied health institutions as a standardized teaching tool.