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Original Research Article

Experimental Evaluation of Colorized Gross Anatomy Specimens as Teaching Aids in Laboratory and Museum Settings.

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Abstract:
Background: Traditional gross anatomy education relies on preserved specimens, which often lose their natural color and make it difficult for students to clearly identify structures. To address this, colorized specimens enhanced with dyes or pigments have been introduced to improve visual clarity and learning engagement. While visually appealing and increasingly used in labs and museums, there is limited experimental evidence on their actual educational effectiveness.
Objective: This study aims to evaluate the educational effectiveness of colorized gross anatomy specimens compared to non-colorized counterparts in enhancing anatomical understanding, student engagement, and information retention among medical and allied health science learners.
Methods: in their study six anatomically distortion-free specimens from arterial embalmed cadavers were chosen from the department of anatomy.
Results: Students in the colorized specimen group scored significantly higher on identification and retention tests ($p < 0.05$). They also reported improved clarity, greater engagement, and higher satisfaction. Qualitative feedback highlighted the specimens' usefulness in achieving core anatomical competencies, particularly in visually guided learning environments such as museums and static displays.

Keywords: Colorized Anatomy Specimens, Gross Anatomy Education, Competency-Based Medical Education (CBME), Anatomical Teaching Aids, Visual Learning, Student Engagement, Medical Museum Education, Cadaver-Based Learning, Anatomy Laboratory, Specimen-Based Teaching.

Introduction:

Human anatomy forms a foundational part of the medical curriculum during the first and second years of medical education in India. An anatomically rich and visually engaging museum can significantly enhance a medical student's interest and understanding of the subject. Once a specimen is preserved, it should be carefully colored and labeled to highlight relevant anatomical structures and ensure its effective display within the museum.[1]

To align medical education with technological advancements, modern tools such as digital projectors, 3D visualization, holographic displays, and anatomical mannequins should be integrated into the teaching of anatomy, catering to a generation immersed in digital learning. While the future of anatomy education is expected to be increasingly digital, traditional techniques like cadaveric dissection, plastination, and model making will continue to play an essential and irreplaceable role in anatomical museums.[2]

Color enhancement of specimens in anatomical museums plays a crucial role in distinguishing various structures such as arteries, veins, nerves, muscles, ligaments, tendons, and other anatomical components. In the case of preservative-fixed specimens stored in jars, tactile identification is not possible, making visual differentiation through color essential. To address this, various staining agents are employed, and ongoing efforts are focused on developing techniques that restore and maintain color with optimal longevity, cost-effectiveness, and resistance to aging.[3]

Anatomy can be most effectively studied through methods such as cadaveric dissection, preserved specimens, anatomical models, illustrations, computer-based simulations, and various imaging techniques. Among these, colored gross anatomy specimens serve as valuable educational tools for medical students. Their impact is significantly amplified when displayed in a well-designed,

modern, and visually engaging color anatomy museum.[4]

To enhance visualization and better understanding of the necessary structures after fixation, it is crucial to color and label the specimen for the teaching and learning process.[5]

Material and Methods:

Distortion-free gross wet anatomical specimens, derived from well-arterially embalmed cadavers, were collected from the Department of Anatomy at Rama Medical College, Kanpur, for the purpose of acrylic painting. A total of 6 specimens were included in this study.

The coloring materials used for the wet specimens were readily available commercial products, including acrylic paints, turpentine oil, and painting brushes of various sizes. Following the coloring process, the effectiveness of the colored specimens was evaluated based on several parameters: safety during handling, stability in formalin, visual clarity, viewer perception, distinction of anatomical structures through color, and overall comprehension.

Result:

The illustrates a gross anatomical specimen of the human heart, highlighting the major arteries and veins. The vascular structures are clearly visible, providing a detailed view of the heart's circulatory connections, which serves as an effective educational tool for understanding cardiovascular anatomy.

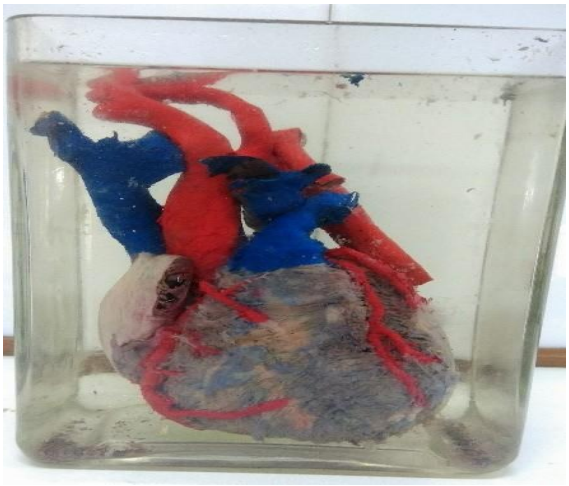

Fig 1 showing gross specimen of heart with its arteries and vein

Fig 2 showing acrylic paints with brushes

displays the materials used in the coloring process, including various shades of acrylic paints and fine brushes. This demonstrates the preparatory phase involved in enhancing anatomical specimens for improved visual differentiation of structures.

Figure 3 showing Bronchopulmonary segment of left lungs

presents the bronchopulmonary segments of the left lung. The segmental division is clearly demarcated using color, facilitating a better understanding of pulmonary anatomy and the spatial arrangement of bronchial and vascular components.

Fig 4 showing anterior and posterior relation of right & left kidney and mounted with nail inserted in wood.

shows the anterior and posterior aspects of both the right and left kidneys. The specimens are securely mounted onto a wooden base using nails, ensuring stability for display purposes. The orientation and relational anatomy of the kidneys are effectively visualized, offering learners a comprehensive view of renal structure and positioning.

	Parameter assessed	Non colored	Acrylic colored
1	Comfort in coloring	None	Excellent
2	Safety/ Handling	Good	Average
3	Acceptability of the method	Excellent	Good
4	Stability in 10% formalin	Yes	yes
5	Cost effectiveness	yes	No
6	Clarity of specimen	No	yes
7	Viewer's perception	Good	Excellent
8	Aesthetic look	Good	Excellent
9	Color distinction & 3D relations	Average	Excellent
10	Overall comprehension	Good	Excellent
11	Self-learning approach/ Educational value	Good	
12	Museum specimen	Good	Excellent

Discussion: This study found that colorized gross anatomy specimens significantly improved students' ability to identify structures and retain anatomical knowledge compared to non-colorized specimens. The enhanced visual contrast likely aided comprehension and memory, especially for visual learners and beginners.[6] Students also reported higher engagement and satisfaction, indicating that

colorized specimens not only improve learning outcomes but also enhance the overall educational experience. In museum settings, these specimens offered clearer, more accessible displays.[7]

Conclusion: Colorized anatomy specimens enhance visual clarity and support competency-based learning by improving students' ability to accurately identify structures, retain knowledge, and engage actively in the learning process. Their use in both lab and museum settings contributes meaningfully to achieving anatomical competency outcomes in modern medical and health sciences education.

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