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Original Research Article

Evaluating the Effectiveness of Model – Making as a Learning Tool in Physiology Education

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Abstract

Background: Physiology is foundational in medical education, yet many students find it abstract and challenging to master through traditional lectures alone. Active learning strategies, such as model making, have the potential to enhance understanding and engagement.

Objective: To evaluate the effectiveness of model making as a learning tool in improving the understanding and retention of physiological concepts in undergraduate physiology education.

Methods: A cross-sectional study was conducted among 150 first-year MBBS students at Akash Institute of Medical Sciences. Students were divided into 22 groups, each assigned a physiology topic to create cost-effective models, including working models where feasible. The models were presented in a competition judged by faculty. A self-administered feedback questionnaire using a 5-point Likert scale assessed students' perceptions. Data were analyzed descriptively.

Results: Feedback was obtained from 145 students (96.6% response rate). Most participants agreed that model making was helpful in understanding concepts (99.4%), promoted independent exploration (86%), and enhanced teamwork (94%). Additionally, 88% perceived this method as more effective than traditional teaching, and over 90% expressed interest in future sessions. However, about 30% reported that model preparation interfered with their routine activities.

Conclusion: Model making proved to be an effective and engaging strategy to facilitate deeper understanding and active learning in physiology. Incorporating structured model-making activities alongside traditional lectures may enhance conceptual clarity, teamwork, and independent learning. Further research should include objective measures of knowledge gain and explore broader applicability.

Keywords: model making, physiology, learning tool.

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Introduction

Physiology, a cornerstone subject in medical education, forms the basis for understanding the functional mechanisms of the human body. Despite its fundamental importance, students often perceive physiology as conceptually challenging due to the abstract nature of physiological processes and the need to integrate knowledge from multiple systems [1]. Traditional didactic teaching methods may not sufficiently engage students or cater to diverse learning preferences, thereby necessitating innovative and active learning strategies to enhance comprehension and retention [2].

Bloom's taxonomy states that students reach higher order learning in cognitive domain by learning by doing as the students analyze and perform whatever has been learned in the class [3] Learning pyramid displays that lecture and reading have retention rate of 10-20% compared to 75% by doing.[4] Model making, a form of kinesthetic and visual learning, has gained attention as an effective pedagogical tool that encourages active participation, critical thinking, and creativity. By constructing three-dimensional representations of physiological structures and functions, students can transform abstract ideas into tangible forms, facilitating deeper understanding and long-term memory retention [5]. This hands-on approach not only promotes engagement but also fosters collaborative learning and problem-solving skills, which are crucial competencies for future healthcare professionals.

Previous studies have demonstrated the utility of model-based learning in anatomy and microbiology; however, its application in

physiology education remains relatively underexplored [6,7]. Given the complex dynamic interactions inherent in physiology, the use of model making may offer unique advantages in helping students visualize processes such as neuronal transmission, hormonal regulation, or cardiovascular dynamics.

This study aims to evaluate the effectiveness of model making as a learning tool in undergraduate physiology education. By assessing student engagement and conceptual understanding, the study seeks to determine whether model making can serve as a valuable complement or alternative to traditional lecture-based teaching.

Objective: To evaluate the effectiveness of model making as a learning tool in improving the understanding and retention of physiological concepts among students.

Methodology

A cross- sectional study was conducted at the department of Physiology, Akash institute of medical sciences and research center, involving 150 medical students of MBBS phase 1 of 2024-25 batch. The study was conducted when 80% syllabus were already completed in theory classes. The students were divided into groups of 6 to 8 members. Total of 22 groups were made and each group was allotted a topic in physiology. Each group had a group representative. Moderators who are faculty in the department were assigned to all the group, who guided the groups about the concepts and usage of materials. Thereafter, every group representative or the team members were asked to consult with the faculty in the department and discuss and clarify the doubts for model preparation. Every group had equal opportunity to discuss with their moderators. The topics were ECG leads, Sodium Potassium pump, Corticospinal tract, Mechanics of breathing, Phagocytosis, Pacinian Corpuscle and Receptor potential, Renin Angiotensin Aldosterone system, Pressure volume loop of left ventricle, Skeletal muscle contraction, Micturition reflex, Hemodialysis, GIT peristalsis and segmentation contraction, Facilitated diffusion, Pain pathway, Deglutition, Visual pathway, Parturition reflex, Dorsal column pathway, Hemostasis, Gastric Juice regulation- phases, Baroreceptor reflex, Venous return- skeletal muscle pump. One month time was given for the model preparation.

Cost effective materials like cardboards, clay, thermocol, plywood, plastic bottles, wires and LED lights were used to prepare the models. Groups were instructed to prepare a working model if possible. One month time was given for the model preparation. Out of 22 models, 9 models were working models.

List of working models:

1. Skeletal muscle contraction
2. Micturition reflex
3. Hemodialysis
4. GIT peristalsis and segmentation contraction
5. Pain pathway
6. Deglutition
7. Visual pathway
8. Baroreceptor reflex
9. Venous return- skeletal muscle pump.

To further motivate the students, a competition was held as PHYSIOSCULPT: Innovative learning in physiology where representee from each group explained the model to the judges who were three Professors from other departments. Judging criteria included innovation, working model, creativity, presentation, physiological concept of the model and ability to answer the questions asked by the judges. Best three models were selected and all the group members awarded the prizes and certificates. To explain all the models for the entire batch of students, small group discussions were conducted using these models.

A self-administered feedback questionnaire with 5-point Likert scale was sent to all the students of the batch through google form.

Statistical Analysis: A self-developed questionnaire survey using Likert scale (response scale 1–5) was used in the present study (5 strongly agree; 4– Agree; 3– Neutral; 2– Disagree; 1 strongly disagree). Data were analyzed using Microsoft Excel. Statistical tool such as Likert scale and percentages was used for analysis.

Results

Total of 22 topics were allotted to 22 groups of 6 to 8 members in each group. Google feedback form was sent to all 150 students out of which response was obtained from 145 students. The results showed that 57% strongly agreed and 42% agreed that the model making was helpful in understanding the concept in topics of Physiology. 50% strongly agreed and 48% agreed that it help in building logical thinking of the mechanism of the given topic. 52% strongly agreed and 44% agreed that model making was useful and interesting. 86% strongly agreed that this method encouraged me to explore the topic more independently. 55% strongly agreed and 39% agreed that it gave them the ability to work in groups. 53% strongly agreed and 44% agreed that listening to peer presentation deepened their knowledge about the topic. 45% strongly agreed and 44% agreed that Model making method is effective than traditional teaching methods. 44% strongly agreed and 46% agreed that they would like to have more session using this method in the future. 58% strongly agreed and 39% agreed that sufficient time was allotted for model

making. 47% strongly agreed and 46% agreed that they will recommend their friends studying in other colleges to participate in such activities. 23.4 strongly agreed, 30% agreed, 21% neutral ,15% disagreed and 9% strongly disagreed that their routine activity was disturbed during the process of model making. 47% strongly agreed and 46% agreed that they will recommend to their friends studying in other colleges to participate in such activities.

Table 1: Feedback survey from students

	Strongly agree %	Agree %	Neutral %	Disagree %	Strongly disagree %
1.Was the model making helpful in understanding the concept in topics of Physiology	56.6	42.8	0.6	0	0
2.Did it help in building logical thinking of the mechanism of the given topic	50.3	48.3	1.38	0	0
3.Did you find model making useful and interesting	52.4	44.1	2.76	0.69	0
4.This method encouraged me to explore the topic more independently	86.21	0	11.03	0	2.76
5.Did it give ability to work in groups	55.17	38.6	5.52	0.69	0
6.Did all the members of group contribute to model making	57.24	35.17	6.21	0.69	0
7.Listening to peer presentation deepened my knowledge about the topic	53.1	44.14	2.76	0	0
8.Model making method is effective than traditional teaching methods	44.83	44.13	9.66	1.38	0
9.Sufficient time was allotted for model making	58.6	39.31	2.07	0	0
10.Would you like to upload pictures/videos of model making prepared by you in social media	31.72	36.55	23.45	6.9	1.38
11.I would like to have more session using this method in the future	44.14	46.21	6.9	2.07	0.69
12.Was your routine activity disturbed during the process of model making	23.4	30.3	21.38	15.17	9.6
13.Will you recommend your friends studying in other colleges to participate in such activities	46.53	45.8	7.64	0	0

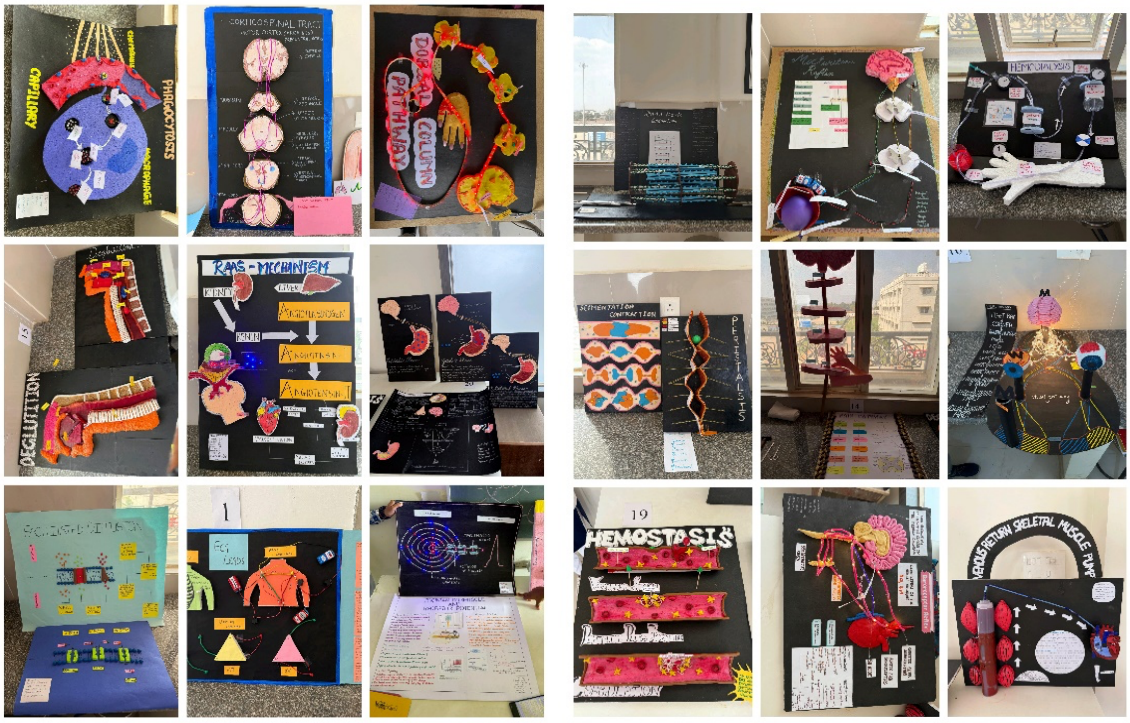

Figure 1: Various models prepared by the students

Discussion

The findings of this study highlight that model making is an effective, engaging, and well-received active learning strategy in physiology education among undergraduate medical students. A significant majority of students agreed that model making is beneficial in deepening conceptual understanding, enhancing logical thinking, and promoting independent exploration of physiological topics.

Almost all students (99.4%) said model making improved their understanding. This supports earlier studies showing that active learning methods, like building models, help students connect theory with real-life examples [1,2,5]. According to Bloom's taxonomy, learning by doing helps students reach higher levels of thinking, like analysing and creating. [3] The Learning Pyramid also shows that hands-on activities have much higher retention rates compared to lectures [4].

In this study, over 90% of students felt model making encouraged them to explore topics independently. This is important because self-directed learning is a key part of the Competency-Based Medical Education (CBME) guidelines from the National Medical Commission of India [8]. Model making also improved teamwork skills. About 94% of students agreed it helped them work better in groups, and 99% said listening to their classmates' presentations increased their understanding. This matches findings from other research showing that group activities improve learning, communication, and collaboration [6,9].

When comparing model making to traditional lectures, most students (88%) said this method was more effective, and more than 90% wanted to have more such sessions in the future. This suggests that while lectures are still necessary, adding innovative, student-centred activities makes learning more interesting and effective [10,11].

However, about 30% of students felt that preparing models disturbed their routine activities. This shows that although model making is beneficial, it also requires extra time and planning.

Conclusion

Overall, the results suggest that model making is a helpful and engaging tool to teach physiology. It supports the move towards CBME and active learning recommended by education experts in India and worldwide. Adding structured model-making sessions could help students better understand concepts, work well in teams, and become more independent learners.

Future studies should measure knowledge gains, see how long students remember the material, and explore whether this method works in other colleges with different resources.

Limitations of the study: This study had some limitations. First, it relied on students' opinions instead of measuring actual improvement in test scores. Future research could use pre- and post-tests to see if knowledge improved objectively. Second, the study was done in one college, so the results may not apply everywhere.

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