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Original Research Article

Perception of 2nd Year Medical Students Regarding Model Making as an Innovative Learning Tool in Pharmacology: A Cross Sectional Study at a Tertiary Care Teaching Hospital

Gaurav G Kakasaniya[1], Sunita B Chhaiya[2], Tejas A Acharya[3], Madhav D Trivedi[4]

[1]Assistant Professor, Department of Pharmacology, C. U. Shah Medical College & Hospital, Surendranagar, Gujarat, India

[2,3,4]Professor, Department of Pharmacology, C. U. Shah Medical College & Hospital, Surendranagar, Gujarat, India

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Corresponding Author: Dr. Gaurav G Kakasaniya

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Abstract:

Introduction: Medical education is evolving from traditional lecture-based methods to more innovative, active learning strategies. One such approach is model making, which allows students to create tangible representations of pharmacological concepts.

Aim and Objective: The study aimed to assess the perception of 2nd-year medical students regarding model making as a tool for enhanced learning in Pharmacology

Methodology: A cross-sectional study was conducted among 97 voluntarily participating 2nd-year MBBS students at a tertiary care teaching hospital. Students were divided into ten groups and tasked with creating models on pharmacology-related topics. A structured questionnaire was administered after a model-making competition to assess student perceptions. Data were analyzed as frequencies and percentages.

Results: Ninety-four percent of student's perceived model making as an innovative method of learning pharmacology. A total of 90.7% agreed that it significantly improved their understanding of pharmacological concepts. Around 91.8% stated that model making enhanced their retention of knowledge, and 87.6% felt more confident in applying the concepts learned. Additionally, 89.7% of students found the learning method enjoyable, and 87.6% recommended its application in other medical subjects.

Conclusion: Model making as a learning tool in pharmacology was well-received by students, who reported improvements in understanding, knowledge retention, confidence, and enjoyment. The findings suggest that integrating model-making into the pharmacology curriculum could enhance the overall learning experience and foster a more interactive, student-centered educational approach.

Keywords: Model Making, Pharmacology, Innovative Teaching, and Student Perceptions.

Introduction

Universities are hubs of knowledge, creativity, and innovation, serving as the breeding grounds for new ideas and advancements. Medical education, in particular, thrives on a dynamic integration of knowledge and learning.1] This relationship is much like how fingers work in harmony with the thumb – one cannot function effectively without the other.

In recent years, a growing recognition has emerged worldwide about the need to shift medical education from passive, lecture-based teaching to more active, student-centered learning methods. [2] This shift aims to promote problem-solving, critical thinking, and deeper engagement with complex medical concepts, equipping students with essential skills for their future medical practice. [2] In India, the National Medical Commission (NMC) has spearheaded educational reforms aimed at encouraging more interactive, self-directed learning. [3]These reforms acknowledge that while traditional didactic teaching methods have their merits in conveying essential knowledge, they often fall short in stimulating student engagement, creativity, and critical thinking.

Medical schools globally, and increasingly in India, are now focusing on introducing innovative teaching methods such as problem-based learning (PBL), role-playing, case-based learning, and mind mapping. These methods aim to provide students with the tools to not only absorb information but also apply it in practical, clinical settings. [4] Pharmacology, a core subject in medical education, is a field that deals with the detailed study of drug actions, mechanisms, therapeutic uses, and side

effects. Mastery of this subject requires more than rote memorization—it demands a deep understanding of how drugs interact with biological systems and their clinical applications. However, traditional teaching methods in pharmacology often rely heavily on lectures and memorization of drug names, mechanisms, and effects. While foundational, these approaches often do not provide students with the opportunity to critically engage with the material, leading to gaps in understanding and application. [5]

To address these challenges, innovative learning tools, such as model making, have been introduced in pharmacology education. Model making allows students to create three-dimensional representations of pharmacological processes, such as drug mechanisms, receptor interactions, or organ-specific effects. [6] This approach offers a hands-on, visual learning experience, making abstract and complex concepts more tangible and understandable. By engaging students in the model-making process, they are encouraged to think creatively, apply their theoretical knowledge, and work collaboratively with peers. This active learning strategy not only enhances retention of information but also improves students' ability to apply their knowledge in practical and clinical scenarios. [7]

The benefits of model making in education go beyond just improving understanding of complex concepts. It also fosters essential skills such as teamwork, leadership, and communication. In creating models, students often work in groups, which promotes collaboration and the exchange of ideas. [8] Through these collaborative efforts, students learn to communicate complex concepts more effectively, develop leadership abilities, and manage resources—all critical skills in the medical profession. Furthermore, model making transforms the learning process into a more enjoyable and memorable experience, moving away from passive learning to an interactive, engaging approach. [9] Given the promising outcomes of active learning tools like model making, this study seeks to explore the perceptions of 2nd-year medical students regarding the use of model making as an innovative learning tool in pharmacology. By assessing student feedback and evaluating the impact of this method on their learning experience, the study aims to determine whether model making can serve as a valuable addition to traditional teaching methods in pharmacology.

Methodology

This cross-sectional study was conducted among 2nd-year MBBS students at a tertiary care teaching hospital to evaluate their perceptions of model making as a tool for learning pharmacology. The study time period spanned from September 2024 to October 2024. The study received approval from the Institutional Ethics Committee (IEC) (CUS MC/IEC(HR)/Pro.Approval-RP-46/2024/OUT-244/2024).

Model-making competition was organized by the Pharmacology Department, where students were divided into ten groups and assigned pharmacology-related topics. These topics included G-protein coupled receptors, protein synthesis inhibitors and other relevant pharmacological concepts. Each group was given 3 weeks to prepare their models, during which they were allotted a faculty guide to provide support and mentorship.

The competition took place on September 6, 2024, with each group presenting their models. On the day of assessment, each group was allotted 15 minutes to present and explain their models. The event was evaluated by two external faculty members and the dean of the medical college, who served as judges. Rankings were awarded to the top three groups based on the quality and accuracy of their models and presentations. The competition aimed to encourage active participation, collaboration, and a deeper understanding of the subject matter through hands-on learning.

The questionnaire for this study was developed by referencing relevant articles[10] and incorporating self-designed items. For validation, it was sent to four experts from different departments. The scale-level content validity index (S-CVI) was calculated and found to be 1, indicating that all items on the scale were universally rated as valid (scored 3 or 4) by the expert panel, thus demonstrating a high level of content validity across the scale.[11]

The structured questionnaire was distributed to participants through Google Forms 2-3 weeks after the event (ethical permission was obtained during this period). Informed consent was included in the Google Form questionnaire, with voluntary participation.

The questionnaire included two types of multiple-choice questions. The first type consisted of six Likert scale-based questions, allowing students to express their perceptions on a five-point scale (Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree). These questions focused on the educational value of model making in pharmacology. The second type comprised seven questions, evaluating the practical aspects of the model-making process, such as its relevance to the syllabus, the adequacy of time provided, and the availability of resources for creating the models.

The questionnaire was pre-validated by circulating it among faculty members from different departments. Data was collected and analyzed as frequencies and percentages.

Results

Out of a total of 103 students, 97 voluntarily participated in the study.

Questions regarding model making process: Innovative Method: A substantial 94% of students felt that model-making is an innovative method of learning pharmacology, while only 3% disagreed and another 3% were uncertain, as illustrated in Figure 1.

Relevance to Syllabus: Almost all respondents (99%) confirmed that the topics allotted were relevant to their syllabus, with just 1% showing uncertainty.

Sufficient Time: About 95.9% of students agreed that sufficient time was provided for model preparation, though 2.1% disagreed or were neutral on this aspect.

Team Participation: Regarding team dynamics, 77.3% of students stated that all team members actively participated in model preparation, while 9.3% disagreed and 13.4% were neutral.

Resource Availability: Most students (87.6%) were able to find the resources needed for model making with ease, though 3.1% disagreed, and 9.3% were neutral.

Recommendation for Other Subjects: Notably, 87.6% of respondents would recommend model-making for other subjects in medical education, with 10.3% remaining neutral and only 2.1% opposing the idea, as seen in Figure 2.

Sources of Ideas: For sourcing ideas, 61% of students used a combination of online and personal (own) resources, 31% relied solely on their own ideas, and 8% used exclusively online resources, demonstrating a balanced approach to creative sourcing, as seen in Figure 3.

Questions regarding model making as an educational tool (Table -1): Understanding of Pharmacological Concepts: A significant majority of the participants (43.3%) strongly agreed that model-making helped them better understand pharmacological concepts, while 47.4% agreed. Only 9.3% of respondents were neutral, and there were no responses in the disagree or strongly disagree categories, indicating overwhelming support for model-making in aiding comprehension.

Knowledge Retention: Similarly, 43.3% of students strongly agreed that creating models enhanced their ability to retain pharmacological knowledge, with 48.5% agreeing. A small portion (6.2%) remained neutral, and 2.1% strongly disagreed, suggesting that while most students found value in this approach, a few may not have experienced the same benefit.

Confidence in Applying Concepts: When asked whether they felt more confident applying pharmacology concepts after model-making activities, 43.3% strongly agreed, and 44.3% agreed, with 9.3% neutral and 2.1% strongly disagreeing. These responses reflect that the majority found the activities beneficial for practical application, though a small fraction did not perceive the same level of confidence improvement.

Encouraging Creativity: Model-making was also seen as a stimulant for creative thinking in pharmacology, with 42.3% strongly agreeing and 45.4% agreeing. About 12.4% remained neutral, and no respondents disagreed, showing broad support for the inclusion of creative thinking exercises in the curriculum.

Curriculum Inclusion: Interestingly, 38.1% of respondents strongly agreed that model-making should be included as a regular part of the pharmacology curriculum, and 44.3% agreed. However, 15.5% were neutral, and 2.1% disagreed, suggesting that while many students are in favor, some may not view it as essential for regular inclusion. Enjoyment of Learning: When evaluating the enjoyment factor, 48.5% strongly agreed that model-making made learning pharmacology more enjoyable, and 41.2% agreed. Only 10.3% were neutral, and none disagreed, emphasizing that the majority found this method engaging and enjoyable.

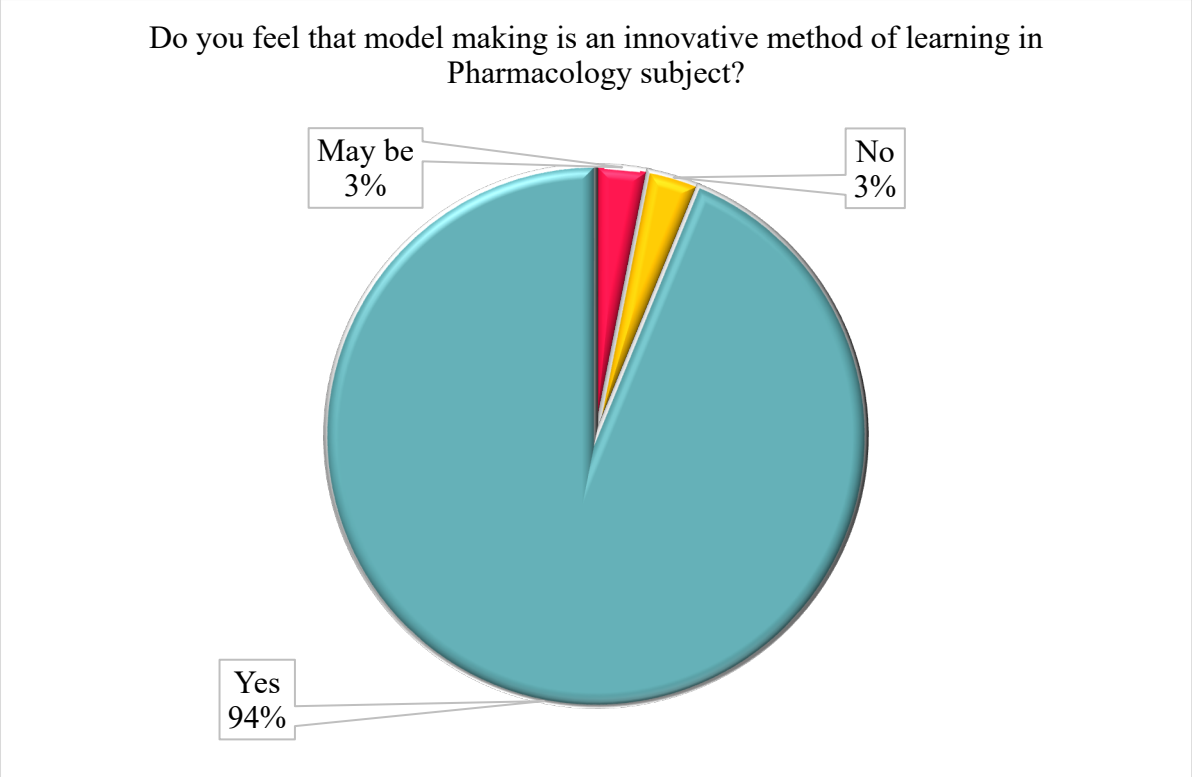

Figure 1: Student Perception on Model Making as an Innovative Method of Learning in Pharmacology

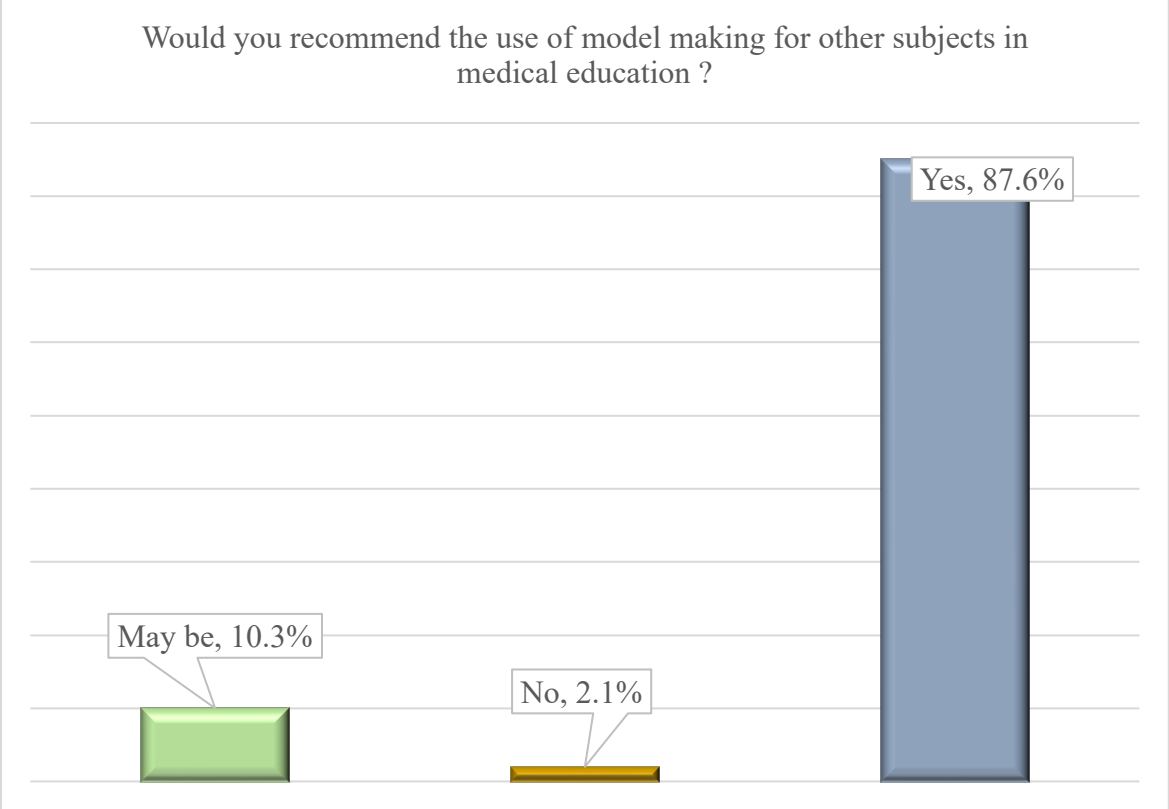

Figure 2: Student Recommendations for Using Model Making in Other Medical Subjects

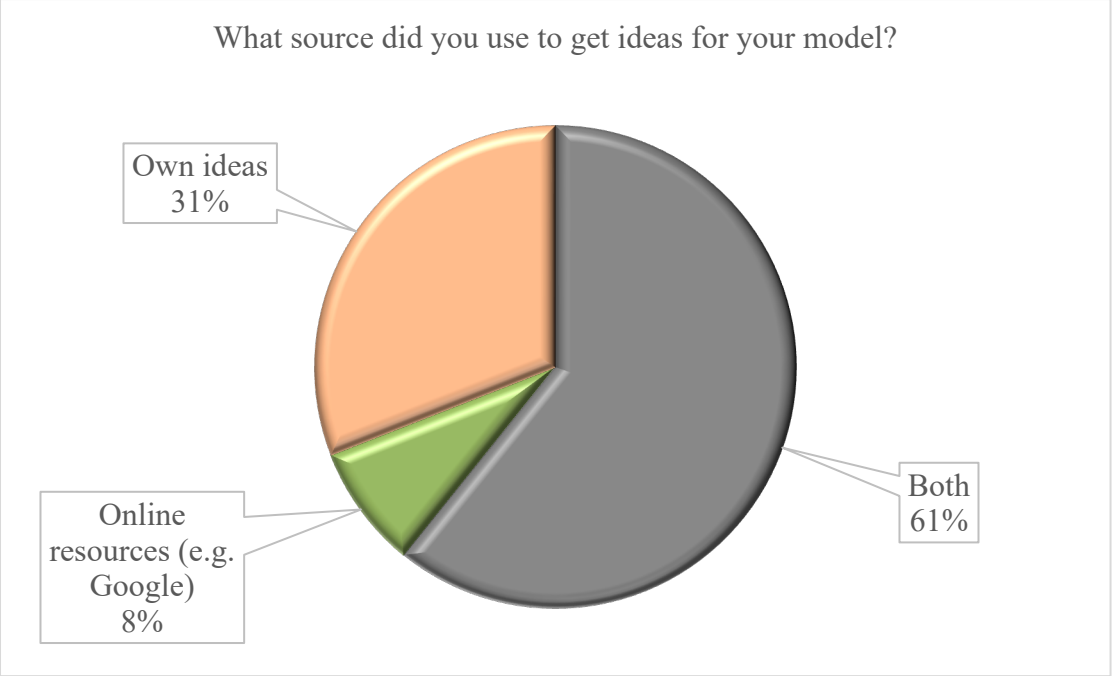

Figure 3: Sources Used by Students to Get Ideas for Their Models

Table 1: Questions regarding model making as an educational tool

Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Model making helped me better understand pharmacological concepts.	43.30%	47.40%	9.30%	0%	0%
Creating models enhanced my ability to retain pharmacological knowledge.	43.30%	48.50%	6.20%	0%	2.10%
I feel more confident in applying pharmacology concepts after participating in model-making activities.	43.30%	44.30%	9.30%	0%	2.10%
Model making encouraged creative thinking in approaching pharmacology topics.	42.30%	45.40%	12.40%	0%	0%
Model making should be included as a regular part of the pharmacology curriculum.	38.10%	44.30%	15.50%	2.10%	0%
Model making made learning pharmacology more enjoyable.	48.50%	41.20%	10.30%	0%	0%

Discussion

Education should help students develop self-discipline and commitment while making learning enjoyable and engaging. When learning becomes an exciting journey rather than a tedious task, students are more motivated to achieve their goals. Effective education equips students with scientific knowledge, practical skills, and a positive mindset, all of which guide them in the right direction. This philosophy aligns with the idea of "learning by doing," where hands-on activities like creating 3D models help deepen the understanding of complex topics. Even with advanced teaching methods, there can still be gaps in student engagement, but interactive approaches help bridge those disconnects, making learning more comprehensive and meaningful. [10] Model making is a practical and engaging way to help students understand complex medical concepts by turning ideas into physical, visual models. This method allows students to better understand topics, like drug actions or body processes, in a hands-on manner. [12] It makes learning more interactive and fun, helping students to remember the information more easily. In addition, model making encourages teamwork, creativity, and problem-solving, as students work together to create their models. This approach also gives students the chance to learn at their own speed and in ways that suit their individual learning styles. Overall, model making adds variety to traditional teaching methods, making the learning process more enjoyable and effective. [10]

In this study, 94% of students acknowledged model-making as an innovative method of learning pharmacology, a result closely aligning with

Ramachandra et al.'s findings, where 92% of students recognized the innovativeness of 3D model-making in medical education. [10] This emphasizes the growing appreciation for creative, hands-on approaches in enhancing traditional learning methods. Regarding resource accessibility, 87.6% of students in this study found it easy to access resources for model-making, which is consistent with Ramachandra et al.'s findings, where 74.1% of students had no difficulty locating materials for their 3D models. [10] The availability of resources plays a critical role in the feasibility and success of such interactive learning activities.

Topic relevance was also a key factor, with an overwhelming 99% of students affirming that the topics assigned for model-making were directly aligned with their pharmacology syllabus. This result closely mirrors Ramachandra et al.'s findings, where 96.3% of students agreed that their 3D model topics were syllabus-relevant. [10] Ensuring topic alignment reinforces the academic value of these activities, making them not only engaging but also educationally pertinent.

In terms of understanding, 43.3% of students strongly agreed and 47.4% agreed that model-making significantly improved their grasp of pharmacological concepts, totalling 90.7% with a positive impact. This result is comparable to Richardson et al.'s study, where 81% of students believed that participating in a 3D virtual environment enhanced their understanding of drug-receptor interactions, demonstrating the efficacy of both physical and virtual models in deepening conceptual understanding. [6]

Regarding confidence, 87.6% of students in this study felt more confident applying pharmacology concepts after the model-making activity, slightly higher than Richardson et al.'s result, where a combined 87% of students reported confidence in applying concepts learned through virtual simulations. [6] This suggests that tactile, hands-on learning may further enhance student confidence in practical applications of theoretical knowledge. In terms of knowledge retention, 91.8% of students in this study reported that model-making improved their ability to retain pharmacological information. This result is closely in line with the findings of Joshi and Ganjiwale, where 92% of students felt that innovative teaching methods similarly improved their foundational knowledge, underscoring the effectiveness of active learning strategies. [13]

Finally, 89.7% of students in this study found model-making to be an enjoyable method of learning, which aligns with the 92% of students in Joshi and Ganjiwale's study who also reported that innovative methods made learning more fun and engaging. [13] Enjoyment in learning plays an important role in sustaining student interest and motivation, making it a critical outcome of innovative educational approaches.

Conclusion

The findings of this study strongly suggest that model-making is an impactful and interactive teaching tool in pharmacology, promoting deeper understanding, improved retention of knowledge, increased confidence, and greater enjoyment among students. Based on these encouraging results, integrating model-making into the routine pharmacology curriculum, and expanding its application to other medical subjects, could greatly enrich the learning experience for students in medical education.

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References

1. Husain M, Khan S, Badyal D. Integration in medical education. Indian Pediatr. 2020 Sep 15; 57(9):842–7.
2. Fakoya AOJ, Ndrio M, McCarthy KJ. Facilitating active collaborative learning in medical education: a literature review of peer instruction method. Adv Med Educ Pract. 2023 Oct 3; 14:1087–99.
3. National Medical Commission [Internet]. [Cited 2024 Sep 20]. Available from: https://www. nmc.org.in/
4. Nanda B, Manjunatha S. Indian medical students' perspectives on problem-based learning experiences in the undergraduate curriculum: one size does not fit all. J Educ Eval Health Prof. 2013; 10(1):11.
5. Fasinu PS, Wilborn TW. Pharmacology education in the medical curriculum: challenges and opportunities for improvement. Pharmacol Res Perspect. 2024 Feb 15; 12(1).
6. Richardson A, Bracegirdle L, McLachlan SIH, Chapman SR. Use of a three-dimensional virtual environment to teach drug-receptor interactions. Am J Pharm Educ. 2013 Feb 12; 77(1):11.
7. Saunders L, Wong MA. Active learning: engaging people in the learning process. 2020 Aug 1 [cited 2024 Sep 20]. Available from: https://iopn.library.illinois.edu/pressbooks/instructioninlibraries/chapter/active-learning-engaging-people-in-the-learning-process/
8. Thornhill-Miller B, Camarda A, Mercier M, Burkhardt JM, Morisseau T, Bourgeois-Bougrine S, et al. Creativity, critical thinking, communication, and collaboration: assessment, certification, and promotion of 21st century

skills for the future of work and education. J Intell. 2023 Mar 15; 11(3):54.
9. Experiential learning model, methods, practices & principles [Internet]. Outlife. Outbound Training. Team Building Activities. Employee Engagement. [Cited 2024 Sep 20]. Available from: https://www.outlife.in/experiential-learning.html
10. Ramachandra SC, Ojha VA, Devegowda D, Nataraj SM, Vishwanath P, Prashant A. 3-dimensional model making as an innovative tool for enhanced learning through student engagement among early professional medical graduates. Int J Health Allied Sci [Internet]. 2022 Sep 14 [cited 2024 Sep 23]; 11(1). Available from: https://rescon.jssuni.edu.in/ijhas/vol 11/iss1/4
11. Halek M, Holle D, Bartholomeyczik S. Development and evaluation of the content validity, practicability and feasibility of the Innovative Dementia-Oriented Assessment System for challenging behaviour in residents with dementia. BMC Health Serv Res. 2017 Aug 14; 17:554.
12. Newman DL, Stefkovich M, Clasen C, Franzen MA, Wright LK. Physical models can provide superior learning opportunities beyond the benefits of active engagements. Biochem Mol Biol Educ. 2018; 46(5):435–44.
13. Joshi A. Evaluation of students' perceptions towards an innovative teaching-learning method during pharmacology revision classes: autobiography of drugs. J Clin Diagn Res [Internet]. 2015 [cited 2024 Sep 30]. Available from: http://jcdr.net/article_fulltext.asp?issn=0973-709x&year=2015&volume=9&issue=7&page=FC01&issn=0973-709x&id=6153