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Original Research Article

Model preparation-an effective teaching-learning tool in microbiology

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ABSTRACT

Background: Learning by doing has retention rate of 75%. Working model preparation helps in better understanding of concepts by the students and improves their confidence. They will have a prolonged retention of the topic and its concept thus developing a scientific approach and attitude. The aims were to study the perception of the students for model making, to create students understanding of three-dimensional view of microbiology and to motivate the students to learn microbiology in a better and easy way.
Methods: The study was conducted at the department of microbiology, CIMS, Chhindwara. Study participants were second phase MBBS student's of 2019 batch. 20 Topics were allotted for model preparation. 100 students were divided in 5 different batches. Guidance for model preparation was provided by a mentor of the department. Cost-effective materials such as cardboard, thermocol, paper was used by the students. One week time was given to the students for model preparation. Fifteen days after submission of model a competition was held to motivate students.
Results: Most of the students enjoyed the activity, found it useful, interesting, helpful in understanding the concept of the subject, helpful in building logical thinking and gained confidence about the subject.
Conclusions: This activity helped the students to showcase their cognitive, psychomotor and communication skills. Constant motivation by teachers to the students shows that slow learners could try to perform well after looking at the other team members.

Keywords: Working model, Medical education, Scientific approach

INTRODUCTION

Teaching and learning method play an important role in making learning fruitful and easy to remember topics. At present various teaching learning methods adopted to teach microbiology in different medical colleges in India include didactic lectures, demonstrations, practical, tutorials and small group discussions. The present generation of students is technology friendly and with the availability of internet is well aware of the various teaching technologies. The skills and concepts taught to the students with use of friendly teaching learning methods so that the student can implement these in future in patient care and management. 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.[1,2]

Learning pyramid displays that lecture and reading have retention rate of 10-20% compared to 75% by doing.[3] Curriculum-driven medical education stresses the focus of problem-based learning for teaching clinical cases. Working model preparation helps in better understanding of concepts by the students.[4] 3D models can be used to teach various aspects of virology and microbiology to the students. These models will not only help students in gaining better knowledge of the topic but also improve

their understanding. They will have a prolonged retention of the topic and its concept thus developing a scientific approach and attitude.

Model preparation activity requires motivated teachers and students. Second phase MBBS curriculum does not include this activity as a mandatory part of their curriculum. However, this activity was allotted to the students by Microbiology Department. They had to prepare three dimensional models on the various topics allotted to them. Thus, this study was conducted with the aims and objectives of to study the perception of the students for model preparation, to create students understanding of three-dimensional view of microbiology and to motivate the students to learn microbiology in a better and easy way.

METHODS

This cross-sectional study was conducted at the department of microbiology, CIMS, Chhindwara, M.P. after approval from the institutional ethical committee, CIMS, Chhindwara (No. CIMS/ethics committee/2022/6395 dated 31/08/2022). The study participants were students of second phase MBBS of 2019 batch whose 80% syllabus is already completed in the theory classes. 20 Topics were allotted for model preparation. The topics were-herpes virus, adeno virus, orthomyxovirus, rhabdovirus, SARS CoV-2, shapes of bacteria (Morphology), hepatitis B virus, retrovirus (HIV), bacteriophage, embryonated egg (Different routes of inoculation), eggs and cysts of parasites found in stool, structure of *Aspergillus*, bacterial cell wall, Zygomycetes-mucor, *Rhizopus*, flagella and its types, immune response (Monoclonal antibodies), bacterial spore, ELISA, polio virus and *Plasmodium falciparum* life cycle. Inclusion criteria included all the 2019 batch second phase MBBS students and with no exclusion criteria.

All the students (100) were divided in 5 different batches for model preparation activity. Students were advised to use textbooks, internet and other source of information. The mentor of the department guided the student for model preparation related to cost-effective materials such as cardboard, thermocol, paper, etc. One week time was given to the students for model preparation. After submission of model, they were given 15 days' time to study the related topic and informed that a competition will be held for same to motivate students.

Competition for model making was held after 15 days and two faculties from another department were invited as judge. Judgment was based on knowledge of the students related to the topic allotted to them. Assessment scheme included idea & relevance, creativity, neatness of the model, presentation of the model and their ability to answer the questions asked by the judges.

A self-administered, pre-validated feedback questionnaire was used for perception of students in 5-point Likert scale. Pre-validation was done by two external subject experts. Models were donated to the department of microbiology. These models were kept in the departmental museum and were made accessible to other medical and paramedical students. These models were used as a teaching tool during small group discussions for the other batches also.

Statistical analyses

All data was maintained in Microsoft office excel. The statistical analysis was carried out using Microsoft office excel. Statistical tool such as Likert scale and percentages was used for analysis.

RESULTS

Total twenty models were prepared by the students on the twenty different topics allotted to the students. Main reason for uploading pictures of model in social media was to share knowledge (71%) and to get publicity (64%). In the present study, an anonymous feedback survey was done (Table 1). Out of all 100 students, 64 (64%) students were males and 46 (46%) were females. Out of all the students, 67% students strongly agreed and 26% agreed that they enjoyed the activity. Fifty four percent strongly agreed and 31% agreed that the activity was useful. Around 56% strongly agreed and 25% agreed that the topic allotted for model preparation was interesting. Fifty percent strongly agreed and 28% agreed that activity was helpful in understanding the topics of microbiology along with 48% who strongly agreed and 32% who agreed that the activity was helpful in understanding the concepts better than earlier. Out of all the students, 40% strongly agreed and 41% agreed that the activity was helpful in building logical thinking about the given topic. Sixty one percent have strongly agreed and 28% have agreed to the fact that they have gained confidence about the subject during model making activity. Out of all the students, 32% strongly agreed and forty-seven agreed that the activity gave them the ability to work in group. Sixty two percent strongly agreed and 15% agreed that the activity had a positive impact on their attitude towards learning. Sixty six percent strongly agreed and 20% agreed to the fact that they were motivated by the model preparation competition.

Table 1: Feedback survey from students.

Parameters	Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
Enjoyed the activity	67	26	0	4	3
Found the activity useful	54	31	2	8	5

Continued.

Parameters	Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
Found the topic allotted for model preparation interesting	56	25	7	7	5
Found the activity helpful in understanding the topics of microbiology	50	28	6	10	6
Found the activity helpful in understanding the concepts better than earlier	48	32	7	9	4
Activity was helpful in building logical thinking about the given topic	40	41	5	12	2
I have gained confidence about the subject during model making activity	61	28	0	4	7
Activity gave you the ability to work in group	32	47	2	9	10
All the members in your group contribute in model making activity	46	50	0	2	2
Got support from all the members of your group	31	50	3	11	5
Have a positive approach working with peer	44	51	0	3	2
Viewpoint of each group member was well heard and appreciated during model preparation	55	21	10	11	3
Did you get an opportunity to show your creativity in model preparation	49	25	7	13	6
Activity had a positive impact on your attitude towards learning	62	15	9	7	7
The competition has a positive impact on my knowledge about the topic	60	19	5	8	8
The competition helps you in remembering the topic	63	16	4	7	10
Was motivated by the model preparation competition	66	20	2	8	4
Want frequent model making activities in future	55	15	7	10	13
Sufficient time was allotted for model making	57	20	2	10	10
Student's routine activity was disturbed	38	8	6	20	28
You would like to upload pictures of model prepared in social media	35	30	10	12	13

Figure 1: Models on SARS CoV 2 virus, bacterial cell wall, hepatitis B virus, polio virus, HIV virus, adenovirus prepared by the students.

DISCUSSION

In India, national medical council (NMC) has recommended competency based medical education (CBME) with active learning by the students emphasizing self-directed learning. CBME promotes learner centeredness and focuses on outcome. Active learning as defined by Bonwell and Eison "learning that involves students doing things and thinking about the things they are doing." Innovative teaching techniques were the need of the hour to make students do and think things so that they will better understand the subject.[5] The Chinese proverb aptly fits this situation that, "tell me I forget, show me I may remember. But involve me and I understand". This study was thus planned to help student understand microbiology in a better way along with remembering the subject.[6,7]

A study conducted by Soundariya et al states that model making was an active method of learning and was highly significant in students understanding and learning physiology concepts.[8] Barling et al also stressed the importance of creative activity in medical education.[4] He suggested that model development stimulates, informs and educates the constructors and also provides a

teaching resource which can be used later for didactic lecture. Lemons et al also demonstrated in his study that model building had the potential to help students generate, and evaluate design ideas.[9] Model building can also help students investigate the differences between real behavior and the conceptual model used to predict that behavior. Model building as part of an open-ended problem offers opportunities for creative thinking, and helps develop meta-cognitive design skills. Parmar et al was also of the view that model making is a unique approach which enhances student's critical thinking and deep understanding, including series of steps skilled questioning, effective interaction and teamwork.[10] Our findings are comparable with these above studies.

The model making activity was allotted to the students so that they could learn microbiology by themselves doing the task. Students were allotted the topics. They had further collected the information by about the allotted model by searching over the internet and working in a team to make the model. At the end model making competition was organized which helped the students to study in depth regarding the topic allotted to them. This activity helped the students to showcase their cognitive, psychomotor and communication skills. By preparing beautiful models with cost-effective resources students displayed their creativity. The models were displayed during the competition; faculties from different departments visited these models. They appreciated their effort in not only making these models but also in answering the questions asked to them related to model.

Our findings are similar to other reports. In a study by Jittivadhna et al a hand-held model of striated muscle sarcomere made from common items was made to improve students' understanding of the sliding filament mechanism as well as their appreciation of the spatial arrangements of the thick and thin filaments.[11] Frequent interactive teaching among different group of students could be done as it is easy to handle. It does not require elaborate maintenance; it is robust and easy to handle and use as a teaching learning tool.

Rezende-Filho et al was also of the opinion that model making as a teaching-learning methodology produced good learning outcomes, which was attractive and useful approach to facilitate the physiology teaching-learning process.[12] This method was an accessible and relatively easy way to foster meaningful learning and active learning while concomitantly addressing multiple learning styles.

Rodenbaugh et al also demonstrated that model construction provides a hands-on experience that may substantially improve performance in science processes.[13] He also suggested that model construction is an appropriate method for teaching advanced concepts.

Rodenbaugh et al in his study incorporated active learning in undergraduate anatomy and physiology course of 70 nursing students where students constructed working physical models of skeletal muscle during the scheduled class time.[14] He also concluded that the construction of physical models during class was a valuable educational experience.

Feedback form from students revealed that most of the students found that the activity and competition was fruitful and it helped them in better understanding of the subject. Regarding the usefulness of the activity in understanding the subject and concept, building logical thinking, gaining confidence about the subject, working in team, opportunity to show their creativity, positive impact on their attitude towards learning were some of the areas where most of the students had shown a positive response. Even the slow learners were motivated and could perform well after working in a team.

Initially students hesitant and did not show good response but after constant motivation by faculties of the department students started preparing their models. One of the factors which could resist them from doing this could be that they time constraint and other subjects to study. Some students were not motivated but later showed positive winning attitude and had even studied the topic well keeping the aim in mind that their team could win the competition.

Results obtained from student's feedback are in consistent with other reports. In a study conducted by Pant et al 52% students agreed that model preparation was a useful activity which also helped them in learning and understanding physiology, 50% students agreed that this activity helped them to think logically and analyze the topic, 46% agreed that they had opportunity to work in team and most of them agreed to recommend this activity to their friends in other medical colleges.[15]

Limitations of this study were that constant motivation had to be done for the students. Students' progress had to be constantly asked for. There was lack of student initiative in the beginning but later on students enjoyed the activity. Initially students had difficulty in working in group and faculty had to intervene and guide the students. The teaching method could not be compared with other more traditional methods. Limited data in Microbiology is available about use of model preparation as a method for teaching and learning.

CONCLUSION

Many students lack motivation. If teachers provide constant motivation to the students then even the slow learners could try to perform well after looking at the other team members. Working in a team, encouragement by peer members and proper guidance by the teachers is useful in team success. Teachers should adopt such innovative teaching methods which will involve the students in doing the activity with fun making it interesting and easy to understand.

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