## Original Paper

# Development of Training Aids for Teaching-learning of Anatomy Incorporating the Views of Teachers and Students : A Prospective Study

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## Abstract

*Introduction:* Medical educationists in the field of anatomy are in search of alternative to the traditional anatomy education based on topographical structural anatomy. The integration of newer teaching modalities and modern technology is encouraging interest and enhancing retention of anatomical knowledge and its clinical relevance.

*Objective:* This study was designed to build an instructional infrastructure keeping in mind the demand of students as well as teachers and to analyze the effect of developed models on the learning of anatomy of undergraduate students.

*Materials and Methods:* This prospective descriptive study was carried out at the department of anatomy, Armed Forces Medical College (AFMC), Dhaka Cantonment in two stages, during the period of January 2016 to December 2016. In the first stage, infrastructural facilities were developed for intervention in target population. Anatomical models were prepared by copying selected real abdominal viscera and models. During the second stage, the term II students were exposed to the newly developed learning environment and they got assistance from teachers. At the end of the term, students' views were taken using structured questionnaires. After the term examination opinion of the teachers were taken using separate structured questionnaires. Result of the term final was analyzed. Statistical analysis was made using Microsoft Excel and SPSS 19.

*Results:* As per the opinion of the user around 3/4th perfection level was achieved in preparing model (students' view 72.17±15.51% and teachers' opinion 77.56±10.13%; p=0.31). Both students and teachers opined that they got good benefit (mean score 3.82± 0.64 and 4.11±0.33 respectively out of total score 1 to 5)

from the use of models prepared at the department and issued to students. Of the studied students 96.9%, 87.5%, 87.5% and 90.6% expressed that figure/pictures, models, animations and movies and Power Point presentation respectively created positive interest among them and on their learning of anatomy. Only 7%, 6.1% and 2.6% students expressed that models, animations and movies and Power Point presentation respectively do not have positive role on their learning process. On the other hand 100% teachers opined that figure/pictures, models, animations and movies and Power Point presentation created positive interest in the students and on their learning of anatomy.

Analysis of result of oral and practical part of top 80 students (65% of total) was done. Mean of percentage score of the students in term I and II examinations were 60.92±7.54 and 66.39±6.51 (p=00) and ranges 82.25 to 49.50 and 79.5 to 53.75 respectively.

*Conclusion:* Both the teachers and students advised to make the training aids more available to the students by increasing the number and also emphasized on the improvement of quality.

*Key-words:* Model, learning anatomy, training aid.

## Introduction

It is beyond doubt that thorough knowledge and understanding of the gross architecture of the human body underlies sound medical practice. Arguments relating to the use of cadavers in anatomy teaching are coming in front again now-a-days. Possible arguments against use of cadavers, including educational principles as well as costs, hazards and practicality, are considered[1]. There are arguments about not only the educational value of the dissection

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room experience, but also about ethical, moral, and some very practical issues related to the use of human materials in teaching. With the availability of computer-assisted learning applications and 3D printing ability the argument is becoming stronger against use of human material in teaching-learning process.

By learning gross anatomy, medical students get a first impression about the structure of the normal human body, which is the basis for understanding pathologic and clinical problems. Dissection courses still play an important role in learning gross anatomy, in addition to lectures and seminars. Above all, in teaching anatomy practical demonstration and active involvement of the students are vital. Availability of the bone or viscera during studying books assists learning gross anatomy of those. A study conducted in India on 1st year medical students, 88% students said that they would like to keep the bones with them while studying the bones from book. But 24% students had a bone set. Out of them two-third students had artificial bone set made of plaster of Paris (POP) or plastic[2]. On the other hand, original viscera are available for students only at dissection hours. Well prepared models can fulfill the demand of specimen while study. Of course models of viscera cannot replace original viscera but due to its handy quality models are helpful for understanding[2]. Study shows that, approaches to learning correlates positively with the quality of learning. Successful learning of anatomy requires a balance between memorization with understanding and visualization[3]. Collins expressed that efficient use of new technology and teaching methods allow better teaching and understanding[4].

The first phase of undergraduate medical course of Bangladesh includes Anatomy, Biochemistry and Physiology. The subjects are covered over a period of eighteen months. The traditional anatomy education based on topographical structural anatomy taught by didactic lectures and complete dissection of the body with personal tuition, has been replaced by a multiple range of special study modules, problem-based workshops, computers, plastic models and many other teaching tools. In some centres, dissected cadaver-based anatomy is no longer taught even[5]. Of course there are opinion and research findings in favour of cadaver dissection. But in most of the studies those supported cadaver

dissection compared the method with a single alternative method. An integrated method always showed better impact[3,6].

The reduction in the duration of anatomy course in undergraduate level teaching has caused great concern as well as reflection on the knowledge of anatomy of new generation doctors. Anatomy teachers are facing extra challenge to run the course to attain the desired outcome of curriculum. To combat the challenge of the reduction of course duration, students are required to be made self directed learner. This also helps in deep learning. The integration of newer teaching modalities encourages interest and retention of anatomical knowledge and its clinical relevance.

The ultimate aim of this research was to build infrastructure in the department of Anatomy, AFMC to prepare models and to improve them further after incorporating the views of teachers and students, for long term impact on learning anatomy in a better way.

## Materials and Methods

This prospective descriptive study was conducted at the Department of Anatomy, Armed Forces Medical College (AFMC) during the period from January to December 2016 on all the students of batch AFMC 18 and all the teachers working at the department of anatomy. The study was conducted in two phases: during first phase, infrastructure development for production of models and during second phase those were used in training process (interventional stage). Initially following infrastructural facilities were developed for the intervention in target population:

i) Realistic anatomical models preparation: Impressions were taken from actual human abdominal organs (kidneys, testis, stomach, mucosa of stomach, vessels of kidney). Using those image moulds, 8 to 10 copies of models of each were prepared using synthetic material (Fig-1 and Fig-2).

ii) Copying of available models: Selected models present at the Departments of Anatomy of AFMC (liver) and Dhaka Medical College (section of kidney, uterus) were used and multiple copies of those were prepared (Fig-3 and Fig-4). To prepare the model Plaster of Paris (POP), alginate, resin, peroxide, fiberglass and marble dust were used.

During interventional stage the prepared models were supplied to the small group classes of batch AFMC-18 from the beginning of the second term (beginning of third week of March 2016). The term continued till the end of second week of October 2016. Then a summative examination was conducted in a conventional way. Simultaneously as per the availability and interest of the students models were issued to them for limited period. The teachers were encouraged to use prepared materials as training aids in the classes. After the term examination, opinion of the teachers and students' views were taken using structured questionnaires. Results of the term final was also analyzed. Collected data were analyzed using Microsoft Excel as well as SPSS19.

## Results

The teachers and students expressed that the models prepared by the laboratory achieved three fourth accuracy (p=0.31) to the real viscera (Table-I). As per their opinion the aids had good benefit on the teaching learning process. The mean score of students' and teachers' opinion were respectively 3.82±0.64 and 4.11±0.33 (p=0.19).

**Table-I:** Quality of models prepared and their impact on teaching and learning anatomy as per the views of teachers (n=9) and students (108)

| Ser | Subject | Students' view Mean ± SD | Teachers' opinion Mean ± SD | t | p |
|---|---|---|---|---|---|
| 1 | Resemblance of model anatomically to real viscous (expressed in %) | 72.17±15.51 | 77.56±10.13 | 1.022 | 0.31 |
| 2 | Benefit of aids in learning (Likert scale level 1 to 5) | 3.82±0.64 | 4.11±0.33 | 1.329 | 0.19 |
| 3 | Any positive effect on the students in Item examinations (Likert scale level 1 to 5) | - | 3.56±0.53 | | |
| 4 | Any positive effect on the students in term II final examination (Likert scale level 1 to 5) | - | 3.56±0.53 | | |

Likert scale legend: Excellent benefit (score =5), Good benefit (score =4), Not sure (score =3), No benefit (score =2)and Negative impact (score =1)

Of the studied students 96.9%, 87.5%, 87.5% and 90.6% expressed that figure/pictures, models, animations and movies and Power Point presentation respectively created positive interest in them and on their learning of anatomy (Table-II). Only 7%, 6.1% and 2.6% students expressed that models, animations and movies and Power Point presentation respectively did not have positive role. On the other hand 100% teachers opined that figure/pictures, models, animations and movies and Power Point presentation created positive interest in the students and on their learning of anatomy.

**Table-II:** Distribution of students (n=108) and teachers (n=09) as per their views related to addition of the training aids created positive interest in students and on their learning of anatomy

| Method | Students' view | | Teachers' opinion | |
|---|---|---|---|---|
| | Yes(%) | No (%) | Yes (%) | No(%) |
| Figure / Pictures | 96.9 | 0.01 | 100 | 00 |
| Models | 87.5 | 7.0 | 100 | 00 |
| Animations and Movies | 87.5 | 6.1 | 100 | 00 |
| PowerPoint presentation | 90.6 | 2.6 | 100 | 00 |

**Fig-1:** Model of stomach (left) prepared by copying original stomach (right)


**Fig-2:** Model of stomach (left) prepared to demonstrate mucosal folds


**Fig-3:** Model of Liver (both) prepared by copying a model


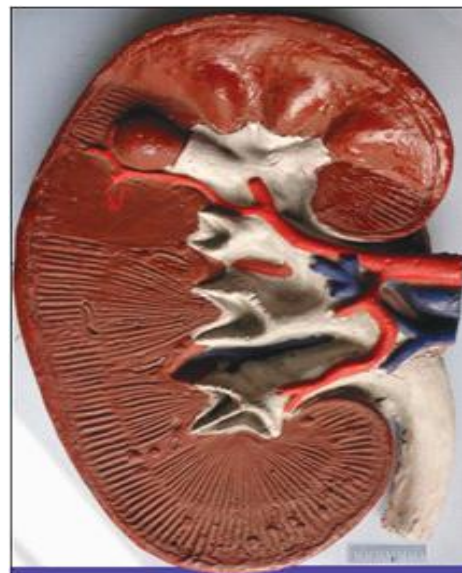**Fig-4:** Model of kidney (copy of organ) and section of kidney (copy of model)

**Table-III:** Percentage contribution of different aids as per the views of Teachers (n=09) and Students (n=108)

| Aids | Teachers' view Mean ± SD | Students' view Mean ± SD | t | p |
|------|--------------------------|--------------------------|-----|-----|
| Figure / Pictures | 70.00±21.21 | 69.2±21.5 | 0.109 | 0.91 |
| Models | 77.56±13.56 | 62.8±25.8 | 1.698 | 0.09 |
| Animations and Movies | 74.44±14.46 | 68.8±28.3 | 0.587 | 0.56 |
| PowerPoint presentation | 58.89±16.92 | 66.1±27.9 | 0.764 | 0.45 |
| Proportion | 1.19 :1.32 :1.26 : 1 | 1.10 : 1: 1.10 : 1.05 | | |

Note: Differences between values are not statistically significant

Analysis of the result of the first term examination (control) and second term examination (experimental) showed significant improvement in second term (Table-IV) though there was reduction of the highest mark in second term.

**Table-IV:** Performance of the students in oral and practical parts Term examination (n=80)

| Examinations | Mean Score in % | SD Score in % | Range in % | t | p |
|--------------|-----------------|---------------|------------|------|--------|
| Term I Examination | 60.92 | ± 7.54 | 82.3 to 49.5 | 4.91 | 0.000* |
| Term II Examination | 66.39 | ± 6.51 | 79.4 to 53.8 | | |

Note: *Difference between values is statistically highly significant

**Table-V:** Important suggestions regarding improvement

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|---|
| **Teachers' suggestions** |
| ★ The training aids shall be made more available to the students by increasing the number |
| ★ The quality of models shall be improved |
| **Students' suggestions** |
| ★ The number of aids shall be increasing |
| ★ The models shall be improved and shall be more realistic |
| ★ Real viscera and prosected cadaver shall be made more available |
| ★ More figures and pictures shall be shown in group teaching |
| ★ Similar aids are required for embryology learning |

## Discussion

The development of more powerful computers, video cards and 3D animation has allowed medical educators to use high-quality imaging, sophisticated training tools and interactive computerized programs projecting cross-sectional, radiologic and living anatomy in the classroom. Successful learning of anatomy by the students requires involving various combinations of memorization, understanding and visualization. Making availability of the viscera during studying book in learning gross anatomy is not practical. Arrangement of quality anatomical models also involves high cost. On the other hand locally made models at the department of anatomy with anatomical perfection is very tough job, but possible. Patil ST et al used POP (Plaster of Paris) to prepare models of viscera and 24.6% & 40% of the user students viewed that those were of best quality of material and good quality material respectively[2]. At the department of anatomy of AFMC different chemicals were used in addition to POP to reduce the fragility. In this study, students and teachers respectively expressed that the models prepared locally had good resemblance to original viscera (72.17±15.51% and 77.56±10.13% perfection respectively).

The result of term examination showed highly significant improvement (p=0.000) in this study. The highest mark was reduced indicating that course of term II is not easier than the term I. The performance of top 80 students was included as the bottom performers were actually struggling with the course. Definite positive role of visualization in anatomy learning was also observed by Pandey and Zimitat[3]. Various efforts by researchers showed positive effect on anatomy learning in the context of decreased course time. Vasan NS earned extreme satisfaction of faculty members and students with the new small group interactive course format. The author used well structured pre-laboratory instructions, focusing on the 'big picture' and integrated embryology, radiology, gross anatomy and problem solving of clinical cases in an interactive format. That innovation produced positive impact on students' attendance in classes as well as on learning[12].

## Conclusion

The best method to teach anatomy continues to be widely debated among medical educators. Till to date, no single teaching modality has been found to meet all requirements of the anatomy curriculum. Introduction of the multimodal integrated system in anatomy progressively improves students' performance. In anatomy teaching, visualization models of viscera cannot replace original viscera but due to its handy quality these are helpful for understanding and maximum features can be visualized as given in the textbook. Presence of models of the specimen during study at dormitory also creates interest in study.

## Acknowledgement

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