

Effect of Flipped Classroom Along with 3D Atlas in Undergraduate BDS Students' Anatomy Education

Farheen Masood

Margalla Institute of Health Sciences, Rawalpindi Pakistan

ABSTRACT

Objective: to analyse the effect of Flipped classroom with the use of 3D atlas as a positive impact on the active learning of anatomy in undergraduate dental students.

Study Design: Quasi-Experimental study.

Place and Duration of Study: Margalla Institute of Health Sciences, Rawalpindi, Pakistan from Aug to Sep 2023.

Methodology: There were 75 first-year BDS students who were randomly assigned to one of two Groups (4 were excluded): one Group got the standard classroom instruction (n=35), and the other Group got the flipped classroom with 3D atlas (n=36). Prior to the classes, there was a pre-quiz, and afterwards, there was a post-quiz. Final evaluation was based on 25 multiple-choice questions. We compared the scores from each Group. In order to assess views and experiences, a questionnaire with a 5-point Likert scale was utilised.

Results: Out of seventy-five students, four students were absent, therefore, they were excluded from the study. Forty-one (57.7%) students had less or equal to 12 marks or fail in pretest while in after test ten (27.0%) students failed. Moreover, 25 (35.2%) students had 13 to 16 marks in pretest and 5(13.5%) had 13 to 16 marks in posttest. Furthermore, only 5(7.0%) Students had >16 marks in pretest whereas after flipped class, 22(59.5%) Students scored >16 which is significantly increased as p -value <0.001.

Conclusion: This study demonstrates that flipped classrooms are successful for teaching anatomy, since they led to a small but statistically significant increase in the number of students passing.

Keywords: Anatomy, Flipped Classroom, Medical education, Medical students, Multiple-choice questions, 3D ATLAS.

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INTRODUCTION

Students are expected to accomplish certain learning objectives by the end of each session in the undergraduate curriculum. Traditional classrooms have the instructor standing in front of a row of students who sit quietly and pay attention during the lecture.^{1,2} The flipped classroom model is one approach.

A flipped classroom, in its broadest sense, is an educational strategy that "flips" or inverts the conventional wisdom about the order of knowledge delivery and application exercises; this strategy has just lately been implemented in anatomy classes, where it has resulted in increased participation and engagement from students.^{3,4} Flipped classrooms offer an alternative to traditional in-person lectures in medical education, allowing students to work on assignments alone or in small Groups. Essential life skills include the ability to think critically, creatively, communicate effectively, and work together

effectively.⁵ Prior research has demonstrated that students' abilities can be enhanced by the implementation of a flipped classroom model in conjunction with a problem-based learning approach to instruction.⁶⁻⁸ There has been no mention of using flipped classrooms in conjunction with 3D atlases for anatomy instruction, though.^{9,10} While studying anatomy is essential for a career in medicine, the subject has a reputation for being difficult and boring. The use of in-person lectures and dissecting human bodies as teaching tools in anatomy classes have also come under fire as of late. This study examined the effectiveness of using a 3D atlas in conjunction with flipped classroom methods to teach anatomy. Examining how well the flipped classroom model works for anatomy education was the primary goal of this research. Does the flipped classroom model enhance student learning? This was our primary study question. We looked at the students' instant comments on the flipped classroom idea.

METHODOLOGY

The Quasi experiment (pre-posttest) study was conducted at Margalla Institute of Health Sciences,

Correspondence: Dr Farheen Masood, Margalla Institute of Health Sciences, Rawalpindi Pakistan

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Sample size was calculated using WHO sample size calculator taking confidence interval 95%, margin of error 5%, Population size 100, mean scores after regular and flipped classes were 12.92 ± 3.13 and 13.41 ± 3.38 respectively.¹¹ Non probability of convenient sampling was used.

Inclusion Criteria: First year BDS students of either gender, who has access to the internet can watch the videos and read the materials ahead of time.

Exclusion Criteria: Participants that do not show up for any class throughout the research.

A total of seventy-five students were included, four students were absent, therefore, they were excluded from the study. Therefore, seventy-one first-year BDS students were divided into two Groups: one received the flipped classroom instruction using a 3D atlas ($n=37$) and the other received the standard classroom instruction ($n=34$). The consort students flow up shown in Figure. Prior to the classes, there was a pre-quiz, and afterwards, there was a post-quiz. Final evaluation was based on 25 multiple-choice questions. We compared the scores from each Group. In order to assess views and experiences, a questionnaire with a 5-point Likert scale was utilised. Every participant gave their informed consent. The control Group of pupils received instruction in the more conventional manner. Even in the control Group, people were talking to each other. Teachers in the control Group had their students research the course material in advance using various print and digital resources, including textbooks, the internet, and library databases. Students were also expected to use the 3D atlas for computer-based, subject-specific self-study prior to class. Teachers emphasised the importance of pupils sharing and discussing their thoughts in class. An educator's function was to facilitate organisation and direction. In addition to providing commentary on student viewpoints, they elucidated the specialised expertise. An ethical issue that could be raised was the deprivation of the control Group from the teaching methodology, this was addressed by taking a separate session of the control Group after the study was completed in a similar manner as done for the experimental Group.

Both the pre- and post-tests included examinations of the human anatomy. Following the investigation, a standardised test with 25 multiple-

choice questions was developed for both Groups. In addition, at the conclusion of the study, every student in the experimental Group was asked to fill out a 5-point Likert scale questionnaire. The answers were presented as an average rating for each item, serving as an additional measure of effectiveness. A score of 5 indicated strong agreement, 4 indicated agreement, 3 indicated broad agreement, 2 indicated disagreement, and 1 point indicated significant disagreement on the questionnaire. Multiple choice questions MCQs test was conducted after the traditional class and the flipped class. A total of 25 MCQs was used with 50 % as a passing criterion. MCQs were of recall type and were also be testing logical and inferential thinking. Feedback questionnaires were filled by the students from the experimental Group.

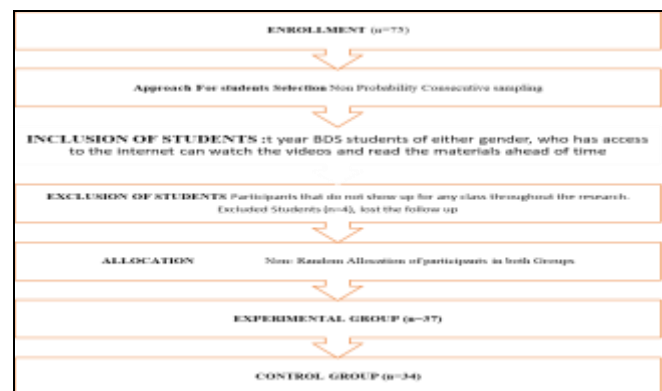


Figure: Follow Diagram

Data was gathered through a structured questionnaire administered in person by trained interviewers to ensure comfort and openness. The questionnaire included multiple sections. A range of questions were designed to analyse the effect of Flipped classroom with the use of 3D atlas as a positive impact on the active learning of anatomy in undergraduate dental students.¹¹ Responses were recorded immediately by the interviewer to minimize bias and errors in data transcription. Efforts were made to maintain a respectful and non-judgmental approach throughout the interviews to create an environment that encourages honest and detailed responses. The confidentiality of the patients was maintained using coding. Data was gathered using a self-modified structured questionnaire that was in accordance the previous literature.¹¹⁻¹³ Questionnaire was subjected to multiple peer reviews for expert opinion. The questionnaire was validated using CVI and content validity rates. Reliability analysis for interclass consistency was done using interclass

correlation coefficient (ICC) and Cronbach's alpha. Those responded with language barriers, translators explained the questions. Data was entered on daily basis to avoid missing values.

We used Statistical Package for Social Sciences (SPSS) 24.0, to do the statistical analysis. Mean $\pm$ SD, frequency, and percentages were the ways in which the data was presented. Following the research, a chi-square test was used to compare the two Groups' average test scores. For each statement in the survey, students were asked to rate their level of agreement or disagreement using a 5-point Likert scale, which was then reported as a percentage.

RESULTS

Out of seventy-five students, four students were absent, therefore, they were excluded from the study. Out of seventy-one Students, 15(21.1%) students were male and 56(78.9%) students were females. Forty-one (57.7%) students had less or equal to 12 marks or fail in pretest while in after test ten (27.0%) students failed. Moreover, 25(35.2%) students had 13 to 16 marks in pretest and 5(13.5%) had 13 to 16 marks in posttest. Furthermore, only 5(7.0%) Students had > 16 marks in pretest whereas after flipped class, 22(59.5%) Students scored >16 which is significantly increased as p value <0.001. The control Group of students also showed statistically significant association but had less score as compared to experiment Group as shown in Table-I.

Table-I: Association of students according to marks scored (n=71)

Marks	Pre-Test	Post Test	<i>p</i> -value
Experimental Group(n=37)			
≤ 12	41 (57.7%)	10 (27.0%)	0.001
13 – 16	25 (35.2%)	5 (13.5%)	
> 16	5 (7.0%)	22 (59.5%)	
Control Group(n=34)			
≤ 12	25 (40.8%)	11 (32.4%)	< 0.001
13 – 16	9 (26.8%)	14 (41.2%)	
> 16	0 (32.4%)	1 (2.9%)	

After two weeks one more assessment was conducted, experiment Group of students had more than 16 marks (n=25, 67.6%) as compare to control Group (n=9, 26.5%) as p -value <0.001 (Table-II).

Table-II: Comparison of Post Assessment among the study Groups (n=71)

Marks	Experimental Group (n=37)	Control Group (n=34)	p - value
≤ 12	3(8.1%)	10(27.0%)	0.001
13 - 16	9(24.3%)	14(41.2%)	
> 16	25(67.6%)	9(26.5%)	

5=Strongly agree, 4= Agree, 3 = neutral, 2= Disagree, 1= Strongly Agree.

Students feedback showed that flipped classroom is much better than traditional classroom (Table-III).

Table-III: Feedback of the Experiment Group of students (n=37)

Statements	5	4	3	2	1
Learning key foundational contact prior to coming to class given by teacher greatly enhanced my learning of course material in class	27(73.0%)	3 (8.1%)	4 (10.8%)	1(2.7%)	2(5.4%)
I read assigned reading prior to coming to class	18(48.6%)	6(16.2%)	4(10.8%)	3(8.1%)	6(16.2%)
The teaching method greatly enhanced my learning	12(32.4%)	4(10.8%)	11(29.7%)	6(16.2%)	4(10.8%)
I participated and engaged in discussion in class	9(24.3%)	7(18.9%)	11(29.7%)	2(5.4%)	8(21.6%)
Enjoyable way of learning, and full of interest	13(35.1%)	4(10.8%)	4 (10.8%)	10(27.0%)	6(16.2%)
This method was more engaging and interesting in comparison to traditional class	6(16.2%)	4(13.8%)	4(13.8%)	10(34.5%)	13(35.1%)
More such modules should be organized in the future	9(24.3%)	2 (5.4%)	12(32.4%)	3(8.1%)	11(29.7%)
I agreed with this teaching model	0(0%)	5(13.5%)	5(13.5%)	8(21.6%)	19(51.4%)
This teaching method has the advantage in understanding and remembering	4(10.8%)	4(10.8%)	17(45.9%)	10(27.0%)	2(5.4%)

DISCUSSION

The idea of a "flipped classroom" is to turn the traditional classroom model on its head. Here, the student studies the "basic" material ahead of time, typically on his own time at home, via reading and viewing an online video. Finding out how well flipped classrooms work for teaching anatomy was the driving force for this research.¹² The term "flipped classroom" is relatively new in the field of educational technology. However, in Pakistan's medical schools, it has not yet taken off. It will clearly establish its own niche in the not-too-distant future. This concept is met with instantaneous enthusiasm on a global scale.

In our study, Forty-one (57.7%) students had less or equal to 12 marks or fail in pretest while in after test ten (27.0%) students failed. Moreover, 25(35.2%) students had 13 to 16 marks in pretest and 5(13.5%) had 13 to 16 marks in posttest. Furthermore, only 5 (7.0%) Students had > 16 marks in pretest whereas after flipped class, 22(59.5%) Students scored > 16 which is significantly increased as p -value < 0.001. The control Group of students also showed statistically significant association but had less score as compared to experiment Group.

According to a comprehensive literature review, over fifty research have examined the benefits of flipped classrooms.^{13,14} Research on medical education is very lacking, with most research focusing on high school and different stages of undergraduate study. Like the current study, the majority of studies had a short duration. Day *et al.* looked at how students did all semester long. Despite the encouraging findings, the evidence is insufficient to apply the findings to a much broader context. In the field of medicine, there has been less effort to assess the efficacy of the flipped classroom model.¹⁵ The aid to the student's comprehension of renal pharmacology has been acknowledged by Pierce *et al.* Once again, only four classes made use of internet delivery.¹⁶

While McLaughlin *et al.* found promising outcomes in his experiments using first-year pharmaceuticals students. After implementing flipped classroom, they noticed an uptick in both student engagement and knowledge retention. Tune Graduate students' performance in pulmonary, cardiovascular, and renal physiology is boosted by the flipped classroom format, according to Jonathan. Important motivating factors, in his opinion, were the usage of homework and in-class quizzes.¹⁷ According to Kurup *et al.* the flipped classroom model could be used to train the anaesthesia residents of the future. A dynamic collection of information and tools for lifelong learning in medicine is FOAM, which stands for Free Open-Access Medical education, almost founded on identical ideas on which flipped classroom operates.¹⁸

More flipped classroom experiments in medical education are needed, according to Prober *et al.* study. He argues that rethinking medical education is necessary due to the demands of today's learners and the ever-growing body of biomedical information. Medical schools should work together to create MOOCs with didactic content in order to synchronise medical education. Using a "flipped-classroom" strategy in which teachers collaborate in small Groups to make use of this online material, students may be "actively" presented with the material.¹⁹ While there is a discernible disparity in the percentage of pupils who pass the test, the average score remains hovering around 50%. That is, students' total performance following both traditional and flipped classes is close to the enchanted 50% mark. Statistically, it's just past the 0.05 mark.

It came to light during the course of the research that majority of pupils responded similarly to material found on the internet. The majority of students found the online course materials to be convenient.

LIMITATIONS OF STUDY

This study does have some limitations. To begin with, there was a noticeably small sample size. Secondly, a 3D atlas and flipped classroom activities might encompass the whole course. Therefore, it was critical to think about how long a course might be effectively taught using this methodology. The efficacy of this method of learning has to be further investigated with bigger samples in randomised controlled trials.

CONCLUSION

Using a flipped classroom model to teach medical students about anatomy would undoubtedly improve their engagement and retention of course material. This study demonstrates that flipped classrooms are successful for teaching anatomy, since they led to a small but statistically significant increase in the number of students passing. Research should be conducted over a longer period of time and cover a wider range of subjects.

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Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

FM: Conception, study design, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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