Impact of Teaching Methods on Clinical Reasoning in Forensic Medicine: A Quasi-Experimental Study

Mehreen Fatima[1], Arshad Khan[2], Ramlah Naz[1] and Muhammad Yahya Noori[3]

[1]*Department of Forensic Medicine, Dow International Medical College and Dow University of Health Sciences, Karachi, Pakistan*
[2]*Department of Forensic Medicine, Jinnah Sindh Medical University, Karachi, Pakistan*
[3]*Department of Pathology, Dow University of Health Sciences, Karachi, Pakistan*

ABSTRACT

Objective: To compare the effectiveness of flipped classroom and video-assisted learning techniques with didactic lectures in promoting clinical reasoning skills in Forensic Medicine.

Study Design: Quasi-experimental study.

Place and Duration of the Study: Department of Forensic Medicine, Dow International Medical College and Dow University of Health Sciences, Karachi, Pakistan, from May to October 2023.

Methodology: The study included 114 third-year medical students divided into three predefined tutorial groups. Over four weeks, within the Forensic Medicine respiratory module, each group was taught one topic per week using a distinct teaching strategy: Traditional lectures (TL) for the first group, flipped classroom (FC) method for the second group, and video-assisted teaching (VAT) for the third group. Students' learning achievements and clinical reasoning skills were assessed through a pre-test, post-test, and revision post-test.

Results: Pre-test scores showed no significant differences among the groups ($p = 0.655$). However, post-test scores differed significantly ($F2:111 = 11.93$, $p < 0.001$). Tukiye's test indicated that the mean score for the FC group was significantly different from the TL group ($p = 0.003$) and the VAT group ($p < 0.001$), but there was no significant difference between the TL and VAT groups ($p = 0.422$). The revision post-test indicated a significant decrease in mean scores across all groups, regardless of the instructional approach ($p < 0.001$).

Conclusion: The FC approach for teaching clinical reasoning in Forensic Medicine shows promising results, effectively improving student performance and learning experience.

Key Words: *Flipped classroom, Video-assisted teaching, Clinical reasoning, Forensic Medicine teaching.*

How to cite this article: Fatima M, Khan A, Naz R, Noori MY. Impact of Teaching Methods on Clinical Reasoning in Forensic Medicine: A Quasi-Experimental Study. *J Coll Physicians Surg Pak* 2024; **34(09)**:1096-1100.

INTRODUCTION

Clinical reasoning is a crucial component of healthcare practice, which emphasises the assimilation, analysis, and categorisation of medical evidence.[1,2] It is regarded as a sophisticated cognitive process that gathers and analyses patient data, assesses the importance of that data, and weighs potential options for action.[1] Forensic Medicine is a branch of medicine that focuses on conducting analysis of forensic data and evidence for developing forensic opinions.[2] This analysis is similar to clinical reasoning in other medical fields, demanding the adept application of cognitive and metacognitive abilities to interpret the array of information gathered during the examination process in order to reach a conclusion.[2]

Correspondence to: Dr. Mehreen Fatima, Department of Forensic Medicine, Dow International Medical College and Dow University of Health Sciences, Karachi, Pakistan
E-mail: mehreen.fatima@duhs.edu.pk

Received: March 30, 2024; Revised: July 11, 2024; Accepted: July 22, 2024
DOI: https://doi.org/10.29271/jcpsp.2024.09.1096

Doctors working in medicolegal department are often sought to assist the law in answering specific legal questions by providing a professional opinion. The quality of that opinion depends on the quality of underlying examination and analysis. Poor quality evaluation may lead to the miscarriage of justice.[2,3] As most of the doctors working in medicolegal section in Pakistan are simple MBBS, with no postgraduate qualification, it is significant to teach clinical reasoning to undergraduate medical students in the subject of Forensic Medicine.

Literature suggests that clinical reasoning is challenging to teach due to its complexity and situational specificity.[4] Despite the obvious need to teach clinical reasoning to medical students, there is no established gold standard for developing these skills. Research suggests the use of active methods of instruction, such as problem-based learning, team-based learning, clinical presentations, video lectures, and flipped classrooms (FC) among others which can support clinical reasoning by facilitating cognitive processes.[5,6] Many studies have suggested the use of innovative teaching strategies such as FC and video-assisted learning to teach clinical reasoning.[7-9] FC are student-centred participatory learning environments where students participate in problem-solving during class-

room discussions and collaborative activities.[10,11] Another teaching strategy highlighted by the literature for teaching clinical reasoning is video-assisted teaching (VAT). Clinical reasoning and observational abilities have been found to be enhanced by the use of videos in undergraduate medical education.[12] This study aimed to compare the effectiveness of FC and video-assisted learning techniques with traditional lectures (TL) to promote clinical reasoning skills in Forensic Medicine among undergraduate medical students.

METHODOLOGY

The study employed a quasi-experimental design with pre-test and post-test. It was conducted at the Dow International Medical College (DIMC), from May to October 2023, after obtaining approval from the Institutional Ethics Committee (IRB: 2989/DUHS/Approval/2023/183, Dated: 11th May 2023). All third-year medical students enrolled at DIMC (n = 150) were included in the study after obtaining informed consent. Students were assured that there would be no adverse consequences on their evaluation of the module if they chose not to participate or opt out of the study. However, the students who did not attend any of the components of intervention were excluded from the study. Because of the large number of students, they had been divided into three tutorial groups in the beginning of first year, each with 50 students. Predefined groups were used. Each group underwent teaching sessions for four weeks, covering various topics in Forensic Medicine, with TL, FC, and VAT methods assigned randomly by simple randomisation technique using chits. Pre-tests and post-tests, consisting of validated multiple-choice questions, were administered to assess baseline and post-intervention clinical reasoning skills. Additionally, a revision post-test was conducted one month later to evaluate retention of the taught content. All of these sessions were conducted by the same teacher (the researcher himself). After the intervention, all the students were taught the same topics by didactic lectures to reduce bias. One week prior to FC sessions, students received study materials *via* email, and case scenarios were discussed during face-to-face sessions. For VAT sessions, relevant videos were uploaded on the university's learning management system (LMS), and students posted queries on a discussion board that were answered by the instructor. The videos were relevant to the topics of autopsy and asphyxial deaths due to drowning and carbon monoxide poisoning. The videos consisted of animations and short case scenarios followed by explanatory lectures.

Statistical analysis, using SPSS version 20, employed descriptive statistics for demographic variables. Quantitative variables were expressed as mean ± standard deviation, while nominal variables were represented as number of participants (n) and percentages (%). The significance level was set at $p < 0.05$. Normality of the numeric variables' distribution was assessed using the Kolmogorov-Smirnov test, indicating that the study group followed a normal distribution. To compare baseline clinical reasoning exam performance (pre-test scores) and evaluate the impact of the FC method, VAT, and TL method on students' clinical reasoning (post-test scores), One-Way ANOVA and variance analysis were conducted. A paired-sample t-test was employed to compare post-test scores and revision post-test scores. A Pearson Chi-square test was used to compare the demographic characteristics of the participants.

RESULTS

One hundred and fourteen out of the total 140 enrolled students successfully completed all stages of the intervention during the study. There were 36 students in the TL group, 39 students in the FC group, and 39 students in the VAT group. The mean age of all students was 21.81 years. The majority of the participants in all three groups consisted of females (n = 66). Descriptive features of the students are presented in Table I.

Table I: Demographic characteristics of participants.

	FC	TL	VAT	p-value
No. of students	39 (34.21%)	36 (31.57%)	39 (34.21%)	
Gender				0.972[a]
Male	17 (14.91%)	15 (13.15%)	16 (14.03%)	
Female	22 (19.29%)	21 (18.42%)	23 (20.17%)	
Age (SD)	21.79 (0.80)	21.75 (0.87)	21.89 (0.85)	0.738[b]
Pre-test (SD)	11.10 (2.04)	11.19 (2.17)	10.76 (2.13)	0.655[b]
Post-test (SD)	13.46 (1.87)	12.02 (1.85)	11.51 (1.73)	<0.001[b]

[a]*The groups were compared using Pearson's Chi-square test.* [b]*The groups were compared using the One-Way ANOVA test.*

Table II: Comparison of post-test scores between the groups.

Group (I)	Group (J)	Mean difference (I - J)	Std. Error	p-value*
Traditional	Flipped	-1.43376*	0.42107	0.003
	Video-assisted	0.51496	0.42107	0.442
Flipped	Traditional	1.43376*	0.42107	0.003
	Video-assisted	1.94872*	0.41256	<0.001
Video-assisted	Traditional	-0.51496	0.42107	0.442
	Flipped	-1.94872*	0.41256	<0.001

**Tukiye's test.*

Table III: Comparison of post-test and revision post-test scores.

	Post-test (SD)	Revision post-test (SD)	p-value*	Percentage decrease
Traditional	12.02 (1.85)	10.75 (1.59)	<0.001	10.56%
Flipped	13.46 (1.87)	12.25 (1.51)	<0.001	8.98%
Video-assisted	11.51 (1.73)	10.94 (1.27)	0.001	4.95%

**Paired sample t-test.*

The pretest scores for the traditional classroom, FC, and VAT groups were 11.19 ± 2.17, 11.10 ± 2.04, and 10.76 ± 2.13, respectively. The post hoc analysis revealed no significant differences in pre-test scores among the groups (p = 0.655), suggesting comparable baseline clinical reasoning exam performance.

Additionally, paired-sample t-tests indicated significant differences between pre-test and post-test scores within all three groups during the study, highlighting changes in performance over time (Table II).

The ANOVA results revealed a significant difference in post-test scores among the three groups (F2:111 = 11.93, p <0.001), assuming equal variance. Post hoc Tukiye's test further indicated that the mean score for FC (M = 13.46 ± 1.87) significantly differed from TL (M = 12.02 ± 1.85) (p = 0.003) and VAT (M = 11.51 ± 1.73) (p <0.001), while no significant difference was observed between TL and VAT (p = 0.422, Table II).

Moreover, Paired-sample t-tests comparing post-test scores with revision post-test scores indicated a significant decrease in mean scores after one month across all instructional approaches (p <0.001). However, the decrease was less pronounced in the video group, suggesting a higher retention level within this group, with an average decrease of approximately 4.95% (Table III).

DISCUSSION

In this study, effectiveness of FC and VAT were compared against TL, regarding teaching clinical reasoning in the subject of Forensic Medicine. The result from this study demonstrate that students who were exposed to FC modules performed better than the conventional TL and VAT group of students, which is consistent with the results of the previous studies.[8,13,14] The notable rise in students' performance scores observed in this study following the implementation of FC can be credited to its combination of constructivist paradigm principles with active, student-centred, and self-directed learning.[8] The current study encouraged participants to engage fully in meaningful classroom activities, such as analysing clinical cases. Clinical scenarios help students learn more actively and develop their analytical, critical thinking, and problem-solving abilities.[2] Several studies in the literature demonstrate a significant improvement in medical students' academic performance when the FC approach is used with adequate preparation and timing.[13,14]

The FC approach, as noted by Xu *et al*., enhances students' high-level learning abilities, allowing them to reflect and examine problems.[15] However, few studies have analysed the effect of the FC method on teaching the clinical reasoning.

Coke *et al.* reported FC as an effective tool to teach clinical reasoning as it transforms class materials into homework for completion outside of class, thus utilising in-class time for more thorough discussions and exploration of the content.[10] Another study suggested that the FC approach fosters clinical reasoning by promoting active learning and emphasising higher-order cognitive skills, such as synthesis, evaluation, and analysis.[16] Some researches have also identified some barriers to this approach such as the full potential of students will not be obtained if the session is not well planned.[13,14,16] Therefore, implementing this strategy requires more resources, such as planning time and instructor training. Another obstacle can be the belief among students that skipping class is safe, which renders them incapable of taking the true benefit of the hands-on experience.[16] In this study, proper planning, training for instructors, and thorough examination of clinical scenarios by senior faculty are some of the measures taken to overcome these barriers.

Regarding VAT, it has been indicated in research as particularly useful for demonstrating procedures, surgical interventions, and facilitating learning related to the affective domain in medicine.[17,18] Jang *et al.* confirmed the favourable influence of online clinical videos on enhancing the clinical skills of medical students.[19] However, the results of this study found no significant difference in the efficacy of VAT when compared to TL for teaching clinical reasoning in the subject of Forensic Medicine. Similar findings were reported by several studies.[11,20] When comparing a virtual PBL course to a traditional PBL course, a randomised controlled trial found no significant difference in the clinical reasoning skills of fourth-year medical students.[20] These findings can be attributed to the interplay of various contributing factors, such as maybe the students utilised these online videos sparingly due to loss of interest, or unavailability of videos with appropriate and relevant content.[9] One interesting finding of this study is that the retention of clinical reasoning skills was better with VAT when compared to the other two strategies. This indicates that the utilisation of videos in medical education holds significant potential in terms of its long-term effects and its ability to enhance student engagement.

A thorough literature search has revealed that no other study has compared three different teaching strategies for the teaching of Forensic Medicine in a Pakistani cohort till yet. This study, however, had some limitations. The study

design was non-randomised and the study was conducted in a single academic institution, which limits the applicability of the findings to different learning environments. Furthermore, uncertainty about student preparation with flipped course materials. Future suggestions include multi-institutional studies spanning a semester with time series analysis.

CONCLUSION

Teaching clinical reasoning in Forensic Medicine with the FC approach improved the students performance and learning experience effectively as compared to TL and VAT. Future research in this area will provide evidence-based principles for designing new and improved teaching strategies to teach clinical reasoning in the subject of Forensic Medicine.

ETHICAL APPROVAL:

An approval was obtained from the Institutional Ethics Committee (IRB No: 2989/DUHS/Approval/2023/183, Dated: 11th May 2023).

PARTICIPANTS' CONSENT:

Informed consent was obtained from all the students enrolled in the study.

COMPETING INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

MF: Literature search, study design and concept, data collection, data interpretation, and drafting.
AK: Literature search, study design and concept, pre- and post-test design, and data analysis.
RN: Literature search, consent form design, data interpretation, and data analysis.
MYN: Study design, data collection, data interpretation, and conduction of online module.
All authors approved the final version of the manuscript to be published.

REFERENCES

1. Richards JB, Hayes MM, Schwartzstein RM. Teaching clinical reasoning and critical thinking: From cognitive theory to practical application. *Chest* 2020; **158(4)**:1617-28. doi: 10.1016/j.chest.2020.05.525.
2. Raharjanti NW, Wiguna T, Purwadianto A, Soemantri D, Bardosono S, Poerwandari EK, *et al*. Clinical reasoning in forensic psychiatry: Concepts, processes, and pitfalls. *Front Psychiatry* 2021; **12**:691377. doi: 10.3389/fpsyt.2021.691377.
3. Kovaleva A, Frolova E. Innovations for teaching forensic science in modern Russian transitive society. *SHS Web Conf* 2019; **70**:11004. doi: 10.1051/shsconf/20197011004.
4. Young ME, Thomas A, Lubarsky S, Gordon D, Gruppen LD, Rencic J, *et al*. Mapping clinical reasoning literature across the health professions: A scoping review. *BMC Med Educ* 2020; **20(1)**:107. doi: 10.1186/s12909-020-02012-9.
5. Jawaid M, Bakhtiar N, Masood Z, Mehar AK. Effect of paper-and computer-based simulated instructions on clinical reasoning skills of undergraduate medical students: A randomized control trial. *Cureus* 2019; **11(11)**:e6071. doi: 10.7759/cureus.6071.
6. Watari T, Tokuda Y, Owada M, Onigata K. The utility of virtual patient simulations for clinical reasoning education. *Int J Environ Res Public Health* 2020; **17(15)**:5325. doi: 10.3390/ijerph17155325.
7. Blanie A, Amorim MA, Benhamou D. Comparative value of a simulation by gaming and a traditional teaching method to improve clinical reasoning skills necessary to detect patient deterioration: A randomized study in nursing students. *BMC Med Educ* 2020; **20(1)**:53. doi: 10.1186/s12909-020-1939-6.
8. Dehghanzadeh S, Jafaraghaee F. Comparing the effects of traditional lecture and flipped classroom on nursing students' critical thinking disposition: A quasi-experimental study. *Nurse Educ Today* 2018; **71**:151-6. doi: 10.1016/j.nedt. 2018.09.027.
9. Parekh U, Gupta S. LIVE FM (lecture improvised with video elements in forensic medicine): Does a video worth a thousand pictures? A comparative study in medical education. *J Vis Commun Med* 2021; **44(2)**:45-51. doi: 10.1080/17453054.2021.1901057.
10. Coke LA. The flipped classroom as a tool to teach clinical reasoning. *Clin Nurse Spec* 2020; **34(2)**:85-6. doi: 10.1097/NUR.0000000000000501.
11. Ding C, Li S, Chen B. Effectiveness of flipped classroom combined with team-, case-, lecture-and evidence-based learning on ophthalmology teaching for eight-year program students. *BMC Med Educ* 2019; **19(1)**:419. doi: 10.1186/ s12909-019-1861-y.
12. Nongmeikapam M, Sarala N, Reddy M, Ravishankar S. Video-assisted teaching *versus* traditional didactic lecture in undergraduate psychiatry teaching. *Indian J Psychiatry* 2019; **61(4)**:376. doi: 10.4103/psychiatry.IndianJPsychiatry_265_18.
13. Ito A, Isohama Y, Watanabe K. Comparison of flipped and traditional lecture-based classrooms for Kampo (traditional Japanese medicine) education in a medical school. *Int J Educ Res* 2022; **3**:100156. doi: 10.1016/j.ijedro.2022.100156.
14. Bhavsar MH, Javia HN, Mehta SJ, Bhavsar M, Mehta S. Flipped classroom *versus* traditional didactic classroom in medical teaching: A comparative study. *Cureus* 2022; **14(3)**:e23657. doi: 10.7759/cureus.23657.
15. Xu P, Chen Y, Nie W, Wang Y, Song T, Li H, *et al*. The effectiveness of a flipped classroom on the development of Chinese nursing students' skill competence: A systematic review and meta-analysis. *Nurse Educ Today* 2019; **80**:67-77. doi: 10.1016/j.nedt.2019.06.005.
16. Rodrigues A, Zealand W. Use of the flipped classroom model in the clinical learning curriculum for third year nursing students. In: Hamerton H and Fraser C (Eds.). Te tipuranga – Growing Capability: Proceedings of the 2015 National Tertiary Learning and Teaching Conference. Tauranga, New Zealand; Bay of Plenty Polytechnic; 2016: p.83-8.

17. Sahu S, John J. To play or pause: Video-based or conventional lectures in medical classrooms. *Indian J Physiol Pharmacol* 2021; **65(1)**:55-9. doi: 10.25259/IJPP_18_2020.

18. Srinivasa K, Chen Y, Henning MA. The role of online videos in teaching procedural skills to post-graduate medical learners: A systematic narrative review. *Med Teach* 2020; **42(6)**:689-97. doi: 10.1080/0142159X.2020.1733507.

19. Jang HW, Kim KJ. Use of online clinical videos for clinical skills training for medical students: Benefits and challenges. *BMC Med Educ* 2014; **14(1)**:56. doi: 10.1186/1472-6920-14-56.

20. Raupach T, Muenscher C, Anders S, Steinbach R, Pukrop T, Hege I*, et al*. Web-based collaborative training of clinical reasoning: A randomized trial. *Med Teach* 2009; **31(9)**: e431-7. doi: 10.1080/01421590903095502.