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Original Article

Effect of Technology-Assisted Teaching on Student Engagement in Undergraduate Medical Education- a Quasi Experimental Study

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ABSTRACT

Objective: To evaluate the effect of technology-assisted teaching on student engagement in undergraduate medical students.
Study design: Quasi-experimental study.
Place and Duration of Study: Mohi-ud-Din Islamic Medical College, Mirpur, Azad Jammu and Kashmir, Pakistan, from Jun to Sep 2024.
Methodology: An experimental study was carried out, using technology-assisted teaching as the intervention among 100 third-year medical students. For the intervention, the class was divided into two halves by non-random sampling technique. Group-A (control) was taught with traditional teaching and Group-B (experimental) was additionally assisted by technology. For measuring engagement, a validated student engagement questionnaire was used.
Results: Results showed that students in the technology-assisted teaching group (Group-B) showed higher mean engagement scores, (65.34±7.537) as compared to the traditional teaching group (Group-A), (61.14±11.421). The means between two groups were compared, which showed a significant difference between both groups ($p< 0.05$).
Conclusion: The study provided statistical evidence that students who received technology-assisted teaching showed increased engagement in their classes than those who were taught by traditional teaching methods.

Keywords: Medical Education, Student Engagement, Technology-Assisted Teaching

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INTRODUCTION

The changing dynamics in medical education have added momentum to technology usage and its significant role in instruction.[1] Globally, medical educators are using the benefits of digital tools to facilitate active learning and engagement among students.[2]

A study from Canada has investigated various mobile learning modalities such as online courses, learning applications and virtual reality models to augment cognitive abilities and content dissemination with promising results.[3] Harvard Medical School researchers have exhaustively worked on technology and its benefits in medical academia. They have reported that evidence-based technological innovations are enhancing teamwork, fostering interdisciplinary collaboration, and integrating advanced technologies like artificial intelligence (AI) to reshape how clinicians and educators prepare for the future.[3,4] During this period of transformation, medical educators hold a vital responsibility in preparing future health professionals to address current challenges and remain adaptable to the evolving needs of tomorrow.[5]

However, in Pakistan, the use of technology for health sciences education is suboptimal.[6] There are numerous barriers to this, such as internet connectivity issues, a lack of faculty training and a dearth of institutional support.[6,7] Furthermore, in Pakistan, lack of student engagement in classes has been identified as a major factor towards the issues of failures, dropouts and deficiency of motivation.[8] Therefore, the problem under investigation is that, since in our country, most medical institutions rely on traditional methods of teaching, the impact of technology-assisted teaching in improving engagement remains understudied. This gap means that the rising potential of technology to enhance learners' engagement through interactive learning and motivation among medical students is not well understood.

The present study aimed to address the gap in the scientific publications regarding the effect of technology-assisted teaching on the engagement of students.

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METHODOLOGY

This quasi-experimental study using technology implementation as the intervention was conducted at Mohi-ud-Din Islamic Medical College, Mirpur, Azad Jammu and Kashmir, Pakistan, from June 2024 to September 2024, after approval was obtained from the Institutional Review Board (IRB) of National University of Medical Sciences, Rawalpindi, Pakistan (Reference number 06/IRB&EC/NUMS/20) and Mohi-ud-Din Islamic Medical College, Mirpur, Azad Kashmir (Ref.no. 3/25-MIMC-HR/A-36/8).

Inclusion Criteria: Third year MBBS students (2024-25) of either gender, with age range of 20 to 24 years were included.

Exclusion Criteria: Students who did not have access to any technological devices were excluded from the study.

Sample size was calculated using the WHO sample size formula, with an expected proportion of 50% for student engagement.[8] Since our total population size was100, our final sample size came to 80. For the purpose of this study, we included all the enrolled 100 students in the class,using non-probability consecutive sampling, after taking informed consent.

Regarding instrumentation, a validated student engagement questionnaire was used. This specific questionnaire was chosen as it was considered highly relevant to the undergraduate medical educational setting of Pakistan, furthermore, it was recent and up to date, easy to understand and free to use. Indicators of the questionnaire include a scale validity index of 0.84 and a reliability score, evaluated using Cronbach's alpha of 0.721.[9] Permission to use the questionnaire was obtained from the author before the study. It was converted into a Google Form and distributed electronically. The questionnaire had closed-ended questions based on a 5-point Likert Scale.

For data collection, firstly permission was sought from MIMC, Mirpur. Participants were provided with detailed information about the study, after which a consent form was distributed electronically via Google Forms. For the intervention, the class was divided into two halves. Non-random sampling was employed to ensure both Group A and Group B maintained the pre-existing gender ratio observed within the third-year class. The use of non-random sampling introduces the risk of selection bias which is acknowledged as a limitation. The control group (Group-A) was taught using traditional methods, while the study group (Group-B) received additional assistance through technology, including Google Classroom, Padlet and e-textbooks (Figure-1). To enhance thoroughness and measure student engagement more accurately, teaching took place in seven consecutive classes of 1 hour duration each. Standardization was maintained across all seven sessions by employing the same instructor, in the same module and same subject. This minimized bias from variations in teaching style and curriculum. Student engagement was assessed in both groups through a questionnaire distributed via Google Forms. Participants completed the structured questionnaire, ensuring anonymity and confidentiality. Responses were securely stored by the researcher.

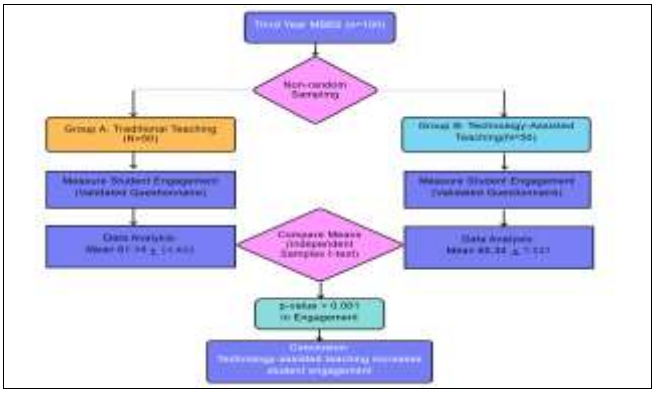

Figure-1: Flow diagram for Quasi-experimental study

Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 25.0. Frequencies and percentages were calculated for gender, and means and standard deviations (SDs) were calculated for age and the overall engagement scores for each group to summarize their central tendency and variability. Normality of student engagement scores was assessed using both histograms (visual inspection) and the Shapiro-Wilk test (statistical confirmation), which showed a normal distribution. Independent Samples t-test was employed to compare the means of engagement levels between two independent groups. In order to measure the effect size and enhance statistical interpretation, Cohens' d was calculated.

RESULTS

All 100 students of third year class consented to participate in the study. In Group-A, age of students ranged from 20 to 24 years, with a mean of

21.441±0.823 years. In Group-B, age of students ranged from 20 to 24 years, with a mean of 21.611±0.861 years. Regarding gender distribution, in Group-A male were 16(31%) and female were 34(68%) and in Group-B male were 15(30%) and female were 35(69%) as shown in Table-I.

Regarding student engagement levels, results showed that students of Group-B showed higher mean engagement scores, (65.34±7.537) as compared to Group-A, (61.14±11.421), as shown in Table-II. It showed that students showed more engagement and motivation when they were taught with technology-assisted teaching than with traditional methods alone.

Difference in means between the two groups was assessed using the independent samples t-test. A *p*-value of < 0.001 showed a statistically significant difference in student engagement between students who receive technology-assisted teaching and those who receive traditional teaching methods. In order to measure the strength of differences between the two groups, Cohens' d was calculated as 0.44.

Table-I: Demographics of Study Groups (n=100)

Characteristics	Group-A n=50	Group-B n=50
Age (years) Mean±SD	21.441±0.823	21.611±0.861
Gender; n(%)		
Male	16(31%)	15(30%)
Female	34(68%)	35(69%)
Total	50(100%)	50(100%)

Table-II: Comparison of Student Engagement levels between groups (n=100)

Groups	n	Mean + SD	*p*-value
Group-A	50	61.14 ±11.421	< 0.001
Group-B	50	65.34 ± 7.537	

DISCUSSION

This study highlights the role of instructional methods in influencing student engagement. The principal finding of this study is that technology-assisted teaching significantly enhanced the overall level of student engagement as compared to traditional methods. Descriptive statistics showed that students taught through technology-assisted teaching achieved a higher engagement score as compared to those taught through traditional methods. The results were further validated by the independent samples t-test, which indicated that the observed difference between the two groups is statistically significant and not due to random variation. This difference suggests that integrating technology may provide students with a more motivating and stimulating learning environment, which is consistent with other studies.[9-14]

Critical comparison with a study conducted by Barzansky *et al.,* in 2024 showed that technology-assisted instruction was associated with improved motivation and engagement.[15] These findings are aligned with the outcomes of the present study. Freitas *et al.* conducted a study in 2023 emphasizing that technology-assisted teaching can address diverse learning preferences more effectively than traditional methods.[16] This corroborates the present study. With regards to the context of Pakistan, Farrukh *et al.* showed that technology integration in the form of artificial intelligence enhances enthusiasm and learning outcomes.[17] Our findings are consistent with this study. Research by Khan et al., published in 2021, identified that by offering multimedia resources, interactive platforms and real-time feedback, we can improve student engagement in classes more than with only traditional teaching, which may rely only on lecture-based delivery.[18] A study by Naseem *et al.,* in 2022 at a renowned medical college in Karachi, showed positive results within classroom settings when bioethics was taught with technology-assisted teaching.[19] The present study builds upon these findings in showing that technology-assisted teaching is crucial to enhancing engagement in classes, which will lead to mitigating issues such as academic underperformance and student attrition.

The major practical implications of this study are that, since medical students today are a fully digitally native generation; with technology-supported learning we can foster a more active learning environment, leading to better healthcare professionals in the future. Additionally, educational institutions and policymakers may benefit from these findings and adapt their educational programs to include digital tools and blended learning approaches for more participatory and engaging learning experiences for medical students.

Based on the findings and limitations of this research, some prospective recommendations include introducing curriculum reforms to incorporate technology-assisted teaching into the core curriculum of medical colleges. A policy may be developed for investing in technology infrastructure to support the effective use of technology-assisted teaching in medical institutes. Appropriate training for faculty may be implemented to help them use technology-

assisted tools effectively and support student learning. Instructors may consider the various learning styles of medical students when integrating technology-assisted teaching. Ensure that the technology used aligns with educational objectives. Teachers may compare the effectiveness of different technology-assisted tools and approaches to identify the most promising methods; for example, blended learning models may effectively utilize technology.

This study makes an important contribution to current scientific literature by establishing an empirical relationship between technology-assisted teaching and student engagement in medicine in Pakistan, an area that has not been extensively studied so far. By demonstrating a positive influence of technology-assisted teaching on learner engagement, the findings of this study encourage educational policymakers to implement digital tools in their institutions to enhance learner engagement and motivation. By adopting these recommendations, medical institutions can harness the potential of technology-assisted teaching to boost student engagement, improve learning outcomes and prepare medical graduates for the challenges of modern healthcare.

LIMITATIONS OF THE STUDY

The present study was conducted at a single medical college in a single year of education. This limits the generalizability of the findings to other institutions and different years of medical education. Lack of qualitative data may not capture the students' thought processes and reasoning. Self-reported data might have introduced biases such as social desirability bias and the Hawthorne effect, as the awareness of being studied could have influenced their self-reported engagement levels. Hawthorne effect was mitigated by using a control group that received the same level of observation, ensuring that any increase in self-reported engagement was effectively distributed. The use of non-random sampling introduces the risk of selection bias. Despite proportionate gender balance, it is possible that pre-existing differences exist between the two groups (e.g., academic motivation, baseline technical literacy) that could influence the final engagement scores. This study acknowledges the non-random allocation as a limitation, which necessitates cautious interpretation of claims.

CONCLUSION

The study provided statistical evidence that students who received technology-assisted teaching showed increased engagement in their classes than those who were taught by traditional teaching methods.

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Authors' Contribution

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

SZ & AZ: Data acquisition, data analysis, critical review, approval of the final version to be published.

AM & RA: Study design, data interpretation, drafting the manuscript, critical review, 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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