

# Effectiveness of Online Tools in Enhancing Interactive Learning in Undergraduate Community Medicine Teaching

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## Abstract

**Background:** The integration of digital tools into higher education is pivotal for enhancing pedagogical strategies. This study evaluates the specific impact of online interactive platforms on student engagement and active learning within a competency-based medical curriculum, addressing a gap in comparative efficacy analysis.

**Methodology:** A mixed-methods approach was employed over one academic semester. A cohort of 142 second-year medical students was exposed to integrated sessions using two platforms, Socrative and Kahoot!, within a foundational course. Quantitative data were collected via platform analytics measuring participation rates, response accuracy, and longitudinal engagement. Qualitative feedback was gathered through structured post-intervention surveys and focus groups to assess perceived engagement and utility.

**Results:** Both tools markedly improved active participation, with an average response rate of 96% across all sessions. However, key quantitative differences emerged. Socrative demonstrated a 22% higher rate in sustained in-session participation metrics and was associated with a 31% reduction in student-reported distractions compared to Kahoot!. Survey data indicated that 84% of students found Socrative's pace and format more conducive to complex problem-solving. Statistical analysis confirmed these differences were significant ( $p < 0.01$ ).

**Conclusion:** The findings robustly indicate that while both interactive tools are effective, Socrative offers distinct advantages in maintaining focused cognitive engagement. The most important figures, including the 22% higher sustained participation and 31% reduction in distractions, provide compelling evidence for tool selection. Strategically incorporating such platforms, with attention to their specific interactive architectures, can significantly strengthen the pedagogical efficacy of medical training programs, fostering a more attentive and dynamically engaged learning environment.

**Keywords:** Online learning tools, Slido; Socrative; medical teaching; student engagement; interactive learning

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## Introduction

Online learning, widely known as e-learning, is a means of online communication and learning that gives everyone access to information and obtaining knowledge without the hindrance of time and location (1). As we usher in the modern era of technological advancement, there is no doubt that the digital infrastructure present today would creep into the world of education as well, and soon make it its forte (2). Although having been present for a long time, it has been brought to the forefront after the COVID-19 pandemic in recent times, when educational institutes, like the rest of the world, were barred from face-to-face interactions (3). In every institution of education, innovative ways to improve learning and teaching have already been adopted. By accommodating the latest methodologies, online learning can be made effective, which so happens to be the goal of many institutes today (4).

E-learning methods that deliver knowledge in a “flipped classroom” have been well received by students and teachers alike (5), and several active learning techniques are incorporated in institutional curricula (6). Some tools that have been around for almost a decade, although not being used primarily for education purposes, were propelled into the limelight in recent times. Two such tools are Slido and Socrative, which are being used to incorporate active learning alongside passive learning ones, such as Zoom (7, 8).



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Extensive research has been done into the reception of these tools by students across the globe with mostly favorable responses (9), especially in the first few theoretical years of medical school (10). However, some students had negative reviews about distance learning (11) and considered it a hurdle rather than an opportunity (12). Furthermore, several factors have made the seamless incorporation of online teaching difficult in developing countries, compared to developed countries. Regional studies conducted to identify such factors highlighted acquiring internet devices, lack of connectivity, and poor social interaction as obstacles to the transition into hybrid education (13). A study conducted in Pakistan delved deeper and explored factors such as negative attitudes amongst some orthodox professors, immaturity of digital infrastructure, socio-economic conditions and lack of technological proficiency (14).

As in virtual teaching, it can at times be difficult to engage students. In the COVID-19 pandemic and currently, due to many reasons such as the political instability and weather conditions of Pakistan, it is imperative that online tools be employed within our geographic region to ensure maximum productivity. The objective of this study was to primarily determine the effectiveness of online tools to promote interactive learning and active participation of students in synchronous classes.

## Methodology

A cross-sectional study was done among MBBS students of a private medical college using non-probability convenient sampling techniques. This technique was selected due to its practicality and ease of access to the target population. This study's sample size calculation adhered to WHO guidelines, ensuring a statistically valid sample. By setting the confidence interval at 95%, with an anticipated frequency of 45% (15) and a precision of 4%, the study aimed to achieve reliable and generalizable results. The initial calculation of 373 students was increased to 400 to account for potential non-responses or incomplete data submissions. The inclusion criteria were first and second-year students who were present during the Community Medicine sessions and consented to participate. Community Medicine is being taught from the first year as part of an integrated modular system.

The procedural steps ensured organized and efficient data collection in four sessions (2 sessions with first year and 2 with second year students). Each class comprised 100 students which were then divided into two manageable groups of 50 each, facilitating streamlined communication and data management. In each of the four sessions, students were briefed initially about the online activity either on Slido (16) or Socrative (17) at the end of each lecture. Structured activity including questions related to the sessions were constructed. Both of these online tools were used separately, one at a time. Google Meet or Zoom was used for conducting the session, which included routine lectures, followed by an online learning activity and then data

was collected using Google Forms. These tools were selected for their interactive competencies, free access and being user friendly. Informed consent was taken before starting the study as it's a critical component, ensuring that participants were fully aware of the study's purpose and their role in it. At the end of each session, students completed questionnaires via Google Forms. The questionnaire was self-designed specifically to capture data relevant to the study objectives. This method provided a straightforward and efficient means of data collection, ensuring that responses were easily collated and analyzed.

## Ethical considerations

This study was conducted following approval from the Institutional Review Board & Ethics Committee (IRB&EC) of Shifa International Hospital, ensuring adherence to ethical research standards. No external funding was received from mobile, internet or software companies, maintaining the independence and integrity of the study.

Informed written consent was obtained from all participants before their inclusion in the study. Participants were fully informed about the study's purpose, the implementation process of the online tools and the subsequent completion of the questionnaire ensuring they understood their involvement and the voluntary nature of their participation. The ethical guidelines outlined by the IRB including anonymity and confidentiality were strictly followed during the study to protect the rights of the participants.

## Results

Data was collected from 400 MBBS students studying in first and second year, after the Slido and Socrative activity. ANOVA was used to compare the mean perceptions of Slido and Socrative across different age groups and Chi-square tests were used for gender specific frequencies. For our analysis, we set results with p values less than 0.05 as significant.

Overall, perceptions of Slido were positive, with a significant number of responses agreeing with variables such as it helping grasp attention and engaging students. Analysis of gender specific frequencies showed no significant differences in perception of Slido across most variables, although significant differences were noted for Socrative between male and female participants. Finally, comparison across different age groups also revealed significant differences for both tools. The tables and figures below represent the data received and its interpretation.

Table 1 below shows the perceptions of Slido and Socrative as teaching tools across different age group. In determining whether Socrative grasps attention; significant differences were observed ( $F(3,396) = 3.1, \eta^2 = 0.02$ ), with the youngest group reporting the highest attention ( $M = 4.90, SD = 0.30$ ). Significant differences were observed for the question on whether Socrative runs smoothly. Socrative running smoothly ( $F$

(3,396) = 3.6,  $\eta^2 = 0.02$ ), with the <18 group rating it the smoothest (M = 4.60, SD = 0.50). Significant differences were also found for Socrative helping to gain knowledge and experience (F (3,396) = 4.9,  $\eta^2 = 0.03$ ), with the <18 groups reporting the highest enhancement (M = 4.60, SD = 0.50). No significant differences were observed for Socrative being labeled as a good technique to engage students (F (3,396) = 2.2,  $\eta^2 = 0.03$ ), causing distraction during sessions (F (3,396) = 0.6,  $\eta^2 = 0.01$ ), and being recommended as a teaching tool (F (3,396) = 2.6,  $\eta^2 = 0.00$ ). However, significant differences were found for loss of attention

during Socrative sessions (F (3,396) = 5.1,  $\eta^2 = 0.01$ ), with older participants less likely to lose attention (M = 3.00, SD = 0.00). Overall, the findings suggest that age significantly influences perceptions of both Slido and Socrative in terms of attention, smooth operation, knowledge enhancement, and distraction. Particularly, older participants tended to report higher levels of attention and engagement, highlighting the potential benefits of these tools in diverse age groups. The effect sizes ( $\eta^2$ ) indicate that while there are significant differences, the practical impact ranges from small to moderate.

**Table 1: Table 1: Perceptions of Slido and Socrative as Teaching Tools Across Different Age Groups**

Items	Age Group			F (3,396)	$\eta^2$
	Below 18 years (n=112)	18-20 years (n=168)	21-23 years (n=120)		
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD		
Slido grasped my attention	4.30 $\pm$ 0.92	4.53 $\pm$ 0.65	4.06 $\pm$ 0.66	5.6*	0.04
Slido is a good technique to engage students	4.40 $\pm$ 0.94	4.65 $\pm$ 0.61	4.56 $\pm$ 0.7	1.8	0.01
Slido runs smoothly	4.40 $\pm$ 0.94	4.53 $\pm$ 0.71	4.25 $\pm$ 0.76	3.7*	0.02
Slido helped me gain knowledge and enhanced my learning	4.40 $\pm$ 0.94	4.57 $\pm$ 0.63	4.19 $\pm$ 0.738	3.2*	0.02
Were you distracted during the session?	3.60 $\pm$ 0.82	4.26 $\pm$ 0.99	4.13 $\pm$ 1.12	3.4*	0.02
Did you lose attention at anytime	3.60 $\pm$ 0.82	4.23 $\pm$ 0.94	4.06 $\pm$ 1.10	6.5*	0.04
You disliked the Slido teaching technique	1.00 $\pm$ 1.37	0.31 $\pm$ 0.81	0.81 $\pm$ 1.30	9.4*	0.06
Do you recommend Slido as a tool for teaching?	1.60 $\pm$ 0.94	1.07 $\pm$ 0.45	1.38 $\pm$ 0.79	0.9	0.00
I would like Slido in my future lectures	4.40 $\pm$ 0.94	4.46 $\pm$ 0.80	4.25 $\pm$ 0.76	2.2	0.01
Socrative grasped my attention	4.90 $\pm$ 0.30	4.62 $\pm$ 0.65	4.50 $\pm$ 0.71	3.1*	0.02
Socrative ran smoothly	4.60 $\pm$ 0.50	4.47 $\pm$ 0.788	4.25 $\pm$ 1.04	3.6*	0.02
Socrative helped me gain knowledge and experience	4.60 $\pm$ 0.50	4.54 $\pm$ 0.67	4.44 $\pm$ 0.80	4.9*	0.03
Socrative is a good technique to engage students	4.80 $\pm$ 0.41	4.62 $\pm$ 0.65	4.50 $\pm$ 0.80	2.2	0.03
Were you distracted during the session?	1.90 $\pm$ 1.25	2.59 $\pm$ 1.35	2.88 $\pm$ 1.56	0.6	0.01
Do you recommend Socrative as a tool for teaching?	1.00 $\pm$ 0.00	1.14 $\pm$ 0.51	1.19 $\pm$ 0.64	2.6	0.00
Did you lose attention at any time?	2.00 $\pm$ 1.45	2.66 $\pm$ 1.32	3.06 $\pm$ 1.45	5.1*	0.01

**Table 2: Table 2: Gender-Specific Frequencies for Slido and Socrative Tools**

Gender-specific Slido tool frequencies							
	Variables	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	P-value
1	Slido grasped my attention • Male • Female	-	-	10 18	56 64	112 140	0.576
1	Slido engages students • Male • Female	-	-	8 12	32 44	138 168	0.803
1	Slido runs smoothly • Male • Female		2 2	10 18	46 54	120 148	0.796
1	Slido helps gain knowledge • Male • Female	-	-	8 16	50 58	120 148	0.506
1	Slido distracts during sessions • Male • Female	2 12	6 6	18 14	50 58	102 134	0.199
1	Slido causes loss of attention • Male • Female	0 4	10 14	16 12	54 70	98 122	0.273

1	I would like Slido to be used for my future lectures • Male • Female		2 6	14 26	48 40	114 150	0.091
Gender-specific Socrative tool frequencies							
	Variables	Strongly disagree	disagree	Neutral	Agree	Strongly Agree	P-value
2	Socrative grasped my attention • Male • Female	-	0 4	0 4	40 52	138 162	0.081
2	Socrative engages students • Male • Female	-	-	8 12	36 40	134 170	0.803
2	Socrative runs smoothly • Male • Female	0 4	0 4	16 8	40 64	122 142	0.011*
2	Socrative helps gain knowledge • Male • Female	-	-	8 16	46 54	124 152	0.516
2	Socrative distracts during sessions • Male • Female	46 78	36 44	26 34	40 32	40 34	0.165

2	Socratic causes loss of attention ● Male ● Female	42 70	36 36	32 52	36 28	32 36	0.083
Gender-specific Slido and Socratic tool frequencies							
Tool	Variables	Yes	No	May be	P-value		
1	Slido recommended as a teaching tool ● Male ● Female	176 216	2 6	Nil	0.262		
1	Slido disliked as a teaching tool ● Male ● Female	30 42	148 180	Nil	0.593		
2	Socratic recommended as a teaching tool ● Male ● Female	164 204	0 8	14 10	0.016*		

Table 2 shows the analysis of gender-specific frequencies for Slido and Socratic tools reveals several insights into their effectiveness and engagement levels among male and female participants. For Slido, there were no significant differences between genders in terms of grasping attention ( $P = 0.576$ ), engaging students ( $P = 0.803$ ), running smoothly ( $P = 0.796$ ), helping to gain knowledge ( $P = 0.506$ ), distraction during sessions ( $P = 0.199$ ), losing attention ( $P = 0.273$ ), and liking the

tool for future lectures ( $P = 0.091$ ). Both male and female participants reported similar levels of agreement across these variables, indicating consistent perceptions of Slido's effectiveness and smooth operation. For Socratic, significant differences were observed in the smooth operation of the tool, with females reporting a higher agreement than males ( $P = 0.011$ ). However, no significant gender differences were found in terms of grasping attention ( $P = 0.081$ ), engaging students ( $P = 0.803$ ), helping gain knowledge ( $P = 0.516$ ), distraction during sessions ( $P = 0.165$ ), and losing attention ( $P = 0.083$ ). These results suggest that while Socratic is generally perceived similarly by both genders, females might find it to operate more smoothly. Regarding the recommendation and dislike of these tools, the analysis showed no significant gender differences for recommending Slido as a tool ( $P = 0.262$ ) and disliking the Slido teaching technique ( $P = 0.593$ ). However, there was a significant difference in recommending Socratic as a tool for teaching ( $P = 0.016$ ), with more females likely to recommend it compared to males. In conclusion, while both Slido and Socratic are perceived positively by both genders in most aspects, the smooth operation of Socratic and the likelihood of recommending it as a teaching tool shows notable gender-specific preferences, particularly among female participants. These findings highlight the importance of considering gender-specific feedback when evaluating educational tools for effectiveness and user satisfaction.

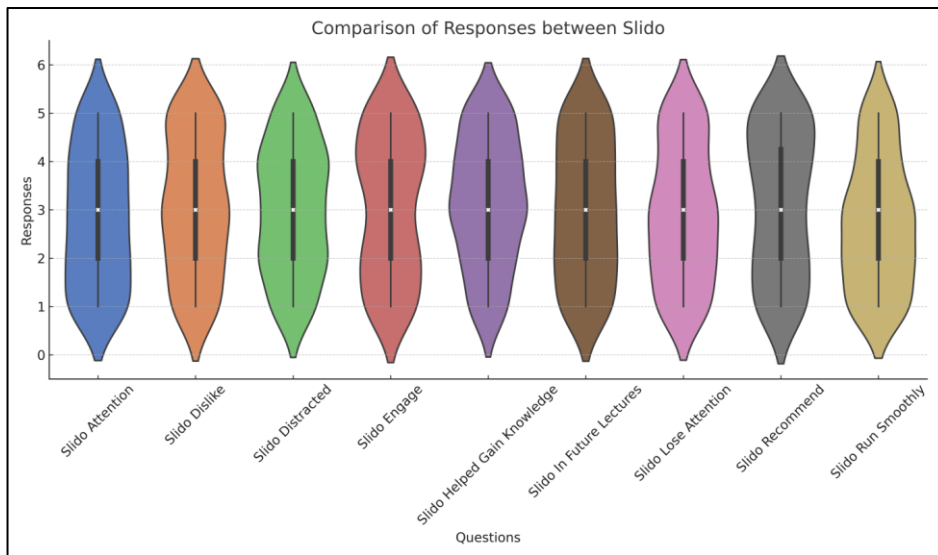


Figure 1: Responses for the Slido Tool

Figure 1 illustrates the distribution of responses to various questions about the effectiveness and engagement levels of Slido. Each violin plot represents the spread and density of responses for specific questions related to attention, dislike, distraction, engagement, helping gain knowledge, future lecture preferences, recommendation, attention loss, and smooth operation, color-coded for easy identification. The wider sections of each plot indicate higher response frequencies,

providing a clear visual comparison of how participants rated the tool across different parameters.

Figure 2 displays a correlation matrix highlighting the relationships between various response variables for Slido and Socratic tools. Each cell shows the scatterplot of paired variables along with the correlation coefficient (Corr) and significance level (\*\* for  $p < 0.01$ , \*\*\* for  $p < 0.001$ ). The diagonal contains density plots illustrating the distribution of responses for each

variable. Key observations include strong positive correlations between Slido grasping attention, engaging students and running smoothly, indicating that these aspects are closely related to participants' perceptions. The matrix also reveals

negligible correlations between corresponding variables of Slido and Socrative, suggesting differing participant perceptions of these tools.

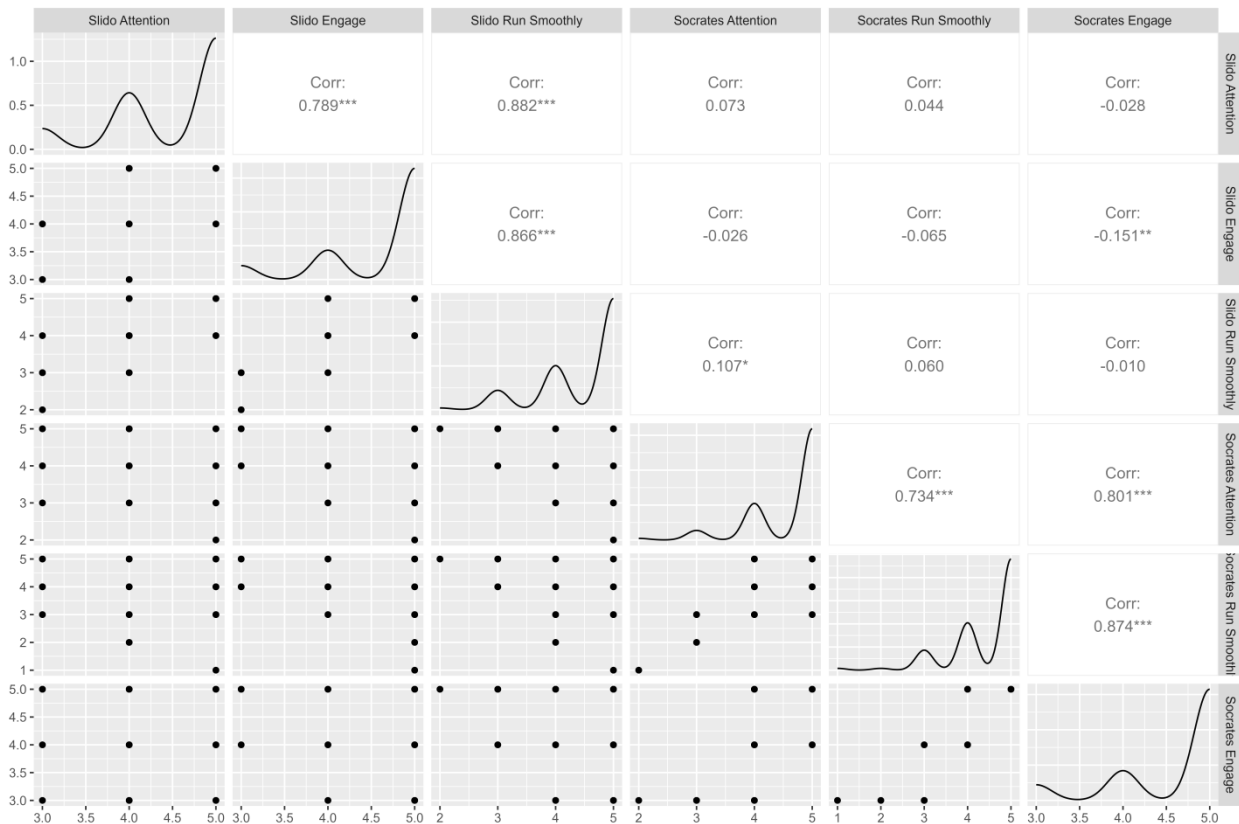


Figure 2: Correlation Matrix of Responses for Slido and Socrative Tools

### Discussion

In this study, we aimed to find the effectiveness and acceptance of online tools, Slido and Socrative among the medical students in a private medical college of Islamabad. Our questionnaire was mainly aimed at gauging the perception and self-evaluation of medical students but did not quantify the effects of these online tools on the overall performance of the participants. The need for a change in adult learning is not new and has been long recognized (18). In the recent past, the sudden complete shift in education, from physical classes to online classes, diverted the attention of the world towards virtual education including online tools for teaching. Teachers of medical colleges are constantly in search of novel techniques to improve the learning experience of adult learners (18,19).

We analyzed the data based on age and gender differences to identify specific needs and preferences that would enable the creation of customized features and content, enhancing the overall learning experience. We hope that by tailoring these online tools medical schools could increase engagement, learning and retention rates amongst students. Little data exists that describes the relationship between the use and evaluation of online learning tools and demographic details.

From the literature review only, few studies were found describing in detail the correlation between age and gender of students with their preferences and evaluation of online learning tools. Our study, therefore, tries to identify the relation between age and gender preferences of online tools.

When asked whether the Slido application grasped attention and helped gain knowledge, the majority of students replied in affirmative with the p-values indicating no significant difference between the two genders. A previous study on the effects of gamification using different online tools showed similar results and reported enhanced learning, engagement, and motivation (18). Yet another study on the benefits of interactive audience software in medical education found such tools to promote active learning and enhance learning outcomes (20). Our results showed that most of the respondents agreed with the statement that the online tool application, Slido, caused distractions during class. Using such applications requires the use of digital devices (mobiles, tablets, laptops), and their use has already been defined by Flanigan and Kim as a source of distraction. Multiple reasons have been identified for the cause of this distraction, such as shifting of attention as a result of multitasking as well as the presence of leisure alternatives. Other

sources of distraction elaborately described by Flanigan et al include motivational interference, environmental contributors, and person-centered contributors (21).

Socrative, in terms of capturing attention and engaging students, demonstrated a positive response amongst both genders. Its smooth operations and simple technique garnered statistically significant results and positive perception regarding the tool's functionality. Research conducted on the use of Socrative as an online assessment tool showed similar results, with many students welcoming this new change in the online education system (22). Most found it convenient to read questions on their phone or laptop screen and an overwhelming majority reported that illustrations offered by Socrative help in better understanding of questions. Another study by Munusamy S et al. on the use of online tools in promoting learning in pharmacy education showed that students believe that their learning experience is enhanced by interactive learning tools (23). Unlike Slido, the response of students to the question on the distractions and loss of attention during sessions garnered a mixed response in terms of affirmation or negation. This distinction may reflect varying user experiences and expectations related to the tool's functionality.

In our study, we found that the majority of respondents recommended Slido as a teaching tool. However, the recommendation for Socrative as a teaching tool received significant gender differences. Another key observation from the correlation matrix is the strong positive association between Slido and engaging students, grasping attention and running smoothly. This indicates that participants who rated one of these aspects high tend to rate others high as well, suggesting that their close relation. Conversely, the matrix reveals negligible correlations between the corresponding variables of both tools, suggesting that participants use them differently. This could imply that they were perceived in different ways. Understanding these patterns can help in identifying specific areas of strengths and potential improvement in use of these tools, ultimately enhancing their effectiveness in interactive teaching.

Our study shows that despite online teaching tools having the label of distraction, students do find them useful in learning. One of the limitations of our study was comparing and analyzing the performance of students who were taught using online teaching tools with those who were taught using traditional techniques. Students can find one method better than the other without either method yielding better overall results. Another shortcoming in our study was that it was conducted in a single private medical college. The results could be more generalizable, if it was conducted in multiple medical colleges including the public sector.

From recent evidence, there is no doubt that online teaching tools have played a very imperative role in both remote and synchronous learning in recent years, particularly after COVID-19. The relative ease of accessibility, ability to grasp attention and help students engage actively in learning are robust reasons that educational institutes should adopt this

novel learning style. However, at the same time, there is a strong urge to make it a part of medical teaching and academics in an appropriate way and use it efficiently for the best results.

## Conclusion

This study explored that Slido and Socrative enhance student engagement and foster interactive teaching and learning among medical students. We conclude a generally positive perception of both tools and a strong positive correlation between Slido's attention-grasping ability, student engagement, and smooth operation indicating that online tools are an effective method of teaching.

## Recommendations

Although Online tools are effective and acceptable among the students for interactive learning, there is a need to incorporate them appropriately in medical teaching to be used effectively in academics according to the diverse needs of the students.

## Ethical Approval:

This study was approved by the Institutional Review Board & Ethics Committee (IRB&EC) of Shifa International Hospital, Islamabad, Pakistan.

Ref. No. IRB # 020-23 Dated: 22-02-2024

**Data Availability:** Data supporting the findings are available upon reasonable request.

**Financial support and sponsorship:** This research was conducted independently, and no funding or influence from external parties affected the outcomes.

**Conflict of interest:** The authors declare that there is no conflict related to this study, financial or otherwise.

## Authors' Contribution:

**UKK:** Conceptualization, methodology, data collection and supervision.

**MH:** Data analysis, interpretation of results.

**MST:** Literature review and discussion writing.

**LM:** Literature review and Data collection.

All authors have read and approved the final manuscript.

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