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Factors Affecting Undergraduate Medical Students' Perception of Online Education During the COVID Pandemic at a Teaching Hospital in Eastern India

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Abstract

Background: Shift from medical education to online mode during the coronavirus pandemic started without much preparation. Students' perception is vital to further improve online medical education.

Objectives: This study aimed to assess undergraduate medical students' perception of online education and conduct factor analysis of responses to identify latent variables.

Methods: This descriptive cross-sectional online survey was conducted among the phase II undergraduate medical students. A structured questionnaire was mailed to 200 randomly selected students. Variables collected were demographics (age, sex, residence, and mother language), academic profile, and perception of online education. Outcome measures were frequencies, percentages, and the degree of agreement to given statements about online education. Factor analysis was done by principal component analysis with varimax rotation to identify latent factors.

Results: Analysis was done for 115 completed questionnaires. The mean age of the respondents was 21.2 yrs, with a male preponderance (82.6%). The students had low satisfaction with online classes and did not consider online education as effective as offline classes. Exploratory factor analysis identified three factors, including 'planning and delivery of online lessons', 'satisfaction with online education,' and 'opportunity to interact.'

Conclusions: Online education was not as effective as in-person education. The reason was mainly changes in student-teacher interaction.

Keywords: Factor Analysis, India, Online Systems, Undergraduate Medical Education

1. Background

In December 2019, the novel coronavirus, COVID-19, began to spread first in China and then in the rest of the world. This unprecedented situation forced governments to shut down educational institutes and pursue an online learning policy. Most students in India, including undergraduate medical students, started to attend online classes from their own homes. Students' home locations often caused variability in internet networks, emerging as an essential factor in the success of online education. Students from lower socioeconomic backgrounds and rural localities faced great difficulty due to lack of equipment, the need for device sharing, and poor network connectivity. The 'digital divide' disproportionately affected developing countries, where only 47% of the population used the Internet before the COVID-19 outbreak (1, 2).

Thus, the medical schools in India faced the new challenge of implementing high-quality medical education, adaptable to rapidly changing technologies, and simultaneously meeting the needs presented by the pandemic situation. As the World and India were adapting to the pandemic, the World Health Organization (WHO), on Nov 26, 2021, designated a new variant of concern, B.1.1.529, as Omicron, which had undergone 26 - 32 mutations in the spike protein. Omicron is a highly divergent variant associated with humoral immune escape potential and higher transmissibility (3). The spread of this variant in India sealed the case for the continuation of online education. The applicability of online education in the context of the medical curriculum has been a much-debated issue (4, 5). It is even more challenging in low-resource countries with limited exposure to formal online instruction in higher education (1, 6, 7). Advancement in online education necessitates

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insight into students' perceptions. Student-centered education emphasizes understanding personal learning experiences. Thus, scientific research is justified to describe and determine how formal online education is perceived by undergraduate medical students, who will be the pillar of the future health workforce. Such exploration could be a crucial predictor of the ultimate effectiveness of online learning and could thus have vital implications for improving ongoing online and blended learning.

2. Objectives

The present study aimed to assess undergraduate medical students' perception of online education and conduct factor analysis of responses to identify latent variables.

3. Methods

Study type and design- This was a descriptive cross-sectional online survey conducted from Jan 1 to Jan 7, 2022, among undergraduate medical students at Medical College Kolkata, India, to determine the students' perception of formal online learning conducted by the college. The inclusion criteria were all undergraduate students admitted in 2019 - 20. Students with invalid or unavailable e-mail IDs and those who attended < 50% of online classes were excluded. This batch was selected as they received online teaching in basic sciences and clinical disciplines. According to the new medical education system in India, this batch is referred to as Phase II of Bachelor of Medicine and Bachelor of Surgery (MBBS). MBBS is the bachelor's degree in the modern medical system offered in India (8). Sample size- Considering the a priori probability of 31.3% perceived usefulness from a previous online survey (9), the absolute error of 10%, and the α value of 0.05, the sample size was calculated by the formula $n = 4pq/l^2$. With P = 0.3, q = 0.7, and an absolute error of 10%, the sample size was 84. There is a high non-response rate in online surveys, and it was 52.4% in the referenced study, with a sampling efficiency of 84.4% (9). Thus, the calculated sample size was multiplied with a correction factor of 2.3 to obtain the final sample of 198 (rounded to 200). By simple random sampling, 200 students were randomly selected as per their roll numbers using Google's random number generator.

3.1. Data Collection Tool

An online pre-designed structured questionnaire was developed by reviewing published literature (9, 10). The content of scale items was validated with inputs from three public health experts. It was then pre-tested on ten undergraduate medical students outside the study sample, and modifications were made according to the suggestions. The variables captured by the tool were demographics (age, sex, residence, and mother language), academic profile, and perception of online education. Perception items required responses in one of three options: agree/neutral/disagree to given statements. The electronic data collection tool (Google Forms) was mailed to all selected students.

3.2. Ethical Considerations

The study adhered to the STROBE (Strengthening the reporting of observational studies in epidemiology) protocol and was compliant with the Helsinki Declaration of bioethics policy. The study protocol was approved by the Institutional Ethics Committee of Medical College Kolkata with the approval number MC/KOL/IEC/NONSPON/1249/01/2022. All participants provided informed consent, and all personal identifiers were removed before data analysis.

3.3. Data Analysis

Data were entered in Microsoft Excel 2010 and analyzed using Statistical Package for Social Sciences (SPSS) IBM Corp. Released 2010. [IBM SPSS Statistics for Windows, Version 19. 0. Armonk, NY: IBM Corp. United States of America]. $P < 0.05$ was considered statistically significant. Questionnaires with missing data elements were not analyzed. Outcome measures were frequencies and percentages for categorical variables and the percentage of agreement to given statements about online education. The agreement to statements on online education was checked for correlation and exploratory factor analysis. Factor analysis was done by principal component analysis with varimax rotation and was used to identify latent factors.

4. Results

Among 132 returned survey forms, 115 questionnaires were found suitable for analysis, with a response rate of 66% and sample effectiveness of 87.1%. Table 1 presents the distribution of the students according to their demographic and academic profile. The students' responses in agreement with the scale items presented as statements are given in Table 2. The relatively favorable appraisal was for preparation of lessons (50.4%), teacher's responsibility (50.4%), and provision of learning resources (45.2%). Effective student-teacher interaction had an extremely low agreement (10.4%). The students had low satisfaction with online classes and did not consider this method as effective

as offline classes. Table 3 shows the inter-correlation matrix between the scale items by Pearson's correlation. Correlation coefficients varied from weak to modest, and most values were significant. The highest correlation between items 8 and 3 indicated that satisfaction with online education depended on the support and service provided by the online platform. A high correlation was also seen between items 3 and 2, indicating that platform support was also required for good teaching. Item 9 (Online education is equal to or more effective than offline education) had a weak correlation with all other items except item 8 (Satisfied with ongoing online education). Exploratory factor analysis (EFA) was performed for an in-depth understanding of the response pattern. Before using EFA, Bartlett's test of sphericity was performed, which gave significant results ($\chi^2 = 675.720$; degree of freedom 36; $P < 0.001$), showing that the inter-correlation matrix contained enough common variance to make the factor analysis meaningful. The Keyser-Meyer-Olkin measure for sampling adequacy was 0.713, indicating that the sample size was sufficient for performing EFA. Three factors with more than one eigenvalue were extracted from the nine-item scale. Together, these factors explained 77.04% of the variance. As per convention, a factor loading score of 0.4 was considered the cut-off. Seven out of nine items loaded on factor I, which can be referred to as 'planning and delivery of online lessons.' Fewer items loaded on factor II, related to satisfaction with online education, and factor III, related to the opportunity to interact. Items 3, 4, and 8 cross-loaded on more than one factor (Table 4).

Table 1. Distribution of Students According to Their Demographic and Academic Profile (n = 115)

Variables	Frequency (%)
Age (y)	
18 ≤ 21	69 (60.0)
21 - 23	46 (40.0)
Sex	
Male	95 (82.6)
Female	20 (17.4)
Residence	
Urban	57 (49.6)
Rural	58 (50.4)
Postal address	
Kolkata	35 (30.4)
Outside Kolkata	80 (69.6)
Mother language	
Bengali	90 (78.3)
Hindi	25 (21.7)
Medium of schooling	
Bengali	46 (40.0)
English	59 (51.3)
Both	10 (8.7)
Marks obtained in last summative assessment	
50 - 60%	8 (7.1)
>60 - 75%	90 (78.3)
> 75%	17 (14.8)

5. Discussion

The COVID pandemic has transformed medical education by replacing conventional classroom teaching with technology-driven learning. However, in the given study, only two out of ten students agreed that online education was equal to or more effective than offline education. Further, EFA identified three factors that influenced students' opinions on online learning. These factors were 'planning and delivery of online lessons,' 'satisfaction with online education,' and 'opportunity to interact.' Opinions on the effectiveness of online classes showed a weak correlation with items related to the planning and delivery of online lessons. Previous studies conducted factor analysis of perception scale on distance education among medical students. Distance education was an optional learning choice, in contrast to present online education, that was formal and mandatory (11, 12). Nevertheless, factors including 'instructional design' and 'students' perception' were overlapping themes in the present study. Initial research on students' perceptions exhibited students' preference for offline classes and the requirement of structured guidance irrespective of advanced technology (9, 13, 14). A study done in Germany after one year of online learning showed that students preferred offline classes, similar to the present study findings (15). Poor agreement about online class satisfaction is in line with another Indian study where 69% of students had low to moderate satisfaction with online education (16). Data from 1255 health sciences students from 11 countries have shown that satisfaction with online education was lower in developing countries. Although considered adequate for knowledge, E-learning was perceived to be less effective in acquiring clinical and technical skills (17). In the given study, only 30% of students agreed on the appropriateness of the teaching-learning method. This variable can be separately explored for cognitive and clinical skills. In a nationally representative study on UK medical students, which used similar items as in the present study, more than 70% of students felt online teaching did not successfully replace clinical

Table 2. Agreement of Students to Statements About Online Education Provided During COVID Pandemic (n = 115)

Statements on Online Education	Agreement, Frequency (%)
1. Online education material was prepared well	58 (50.4)
2. Teachers took responsibility for students' learning	58 (50.4)
3. The online teaching platform provided good support and service	40 (34.8)
4. Assessment of learning was done with clarity	40 (34.8)
5. Effective student-teacher interaction occurred during online sessions	12 (10.4)
6. Teaching learning aids were appropriate for topics	35 (30.4)
7. Online resources were sufficiently provided	52 (45.2)
8. Satisfied with ongoing online education	33 (28.7)
9. Online education is equal to or more effective than offline education	20 (17.4)

Table 3. Correlation Between Responses to Scale Items About Online Education (n = 115)

Item Serial Numbers	1	2	3	4	5	6	7	8	9
1	1								
2	0.662 [b]								
3	0.669 [b]	0.693 [b]							
4	0.433 [b]	0.394 [b]	0.565 [b]						
5	0.182	0.142	0.195 [a]	-0.123					
6	0.351 [b]	0.681 [b]	0.465 [b]	0.291 [b]	0.138				
7	0.606 [b]	0.688 [b]	0.634 [b]	0.519 [b]	0.306 [b]	0.690 [b]			
8	0.458 [b]	0.593 [b]	0.771 [b]	0.330 [b]	0.132	0.573 [b]	0.425 [b]		
9	0.276 [b]	0.311 [b]	0.400 [b]	0.117	0.040	0.028	-0.121	0.554 [b]	1

[a] Significant at P < 0.05
[b] Significant at P < 0.01

Table 4. Rotated Factor Loadings for Scale Items [a]

Statements on Online Education	I	II	III
1. Online education material was prepared well	**0.693**	0.335	0.014
2. Teachers took responsibility for students' learning	**0.800**	0.337	0.051
3. The online teaching platform provided good support and service	**0.739**	**0.526**	-0.026
4. Assessment of learning was done with clarity	**0.636**	0.100	**-0.527**
5. Effective student-teacher interaction occurred during online sessions	0.208	0.043	**0.895**
6. Teaching learning aids were appropriate for topics	**0.776**	0.031	0.126
7. Online resources were sufficiently provided	**0.941**	-0.118	0.130
8. Satisfied with ongoing online education	**0.543**	**0.693**	0.051
9. Online education was equal to or more effective than offline education	-0.043	**0.952**	-0.012
Eigen Values (λ)	3.900	1.916	1.118

[a] Factor scores > 0.4 are given in bold.

teaching. Students provided a similar response pattern as in the present study, with favorable responses to teachers' preparation and responsibility during a negative response on interactivity (10). Students of the Faculty of Medicine, University of Gezira, Sudan, expressed concern over lack of face-to-face interaction, technical problems during online exams, the issue with platform support, and low internet bandwidth, which is closely aligned with the present study (6). Similarly, in a study from Punjab, India, around 40% of respondents reported frequent technology failures and limited access to the Internet (18). More than 60% of students of Jordan universities considered online exams unfair, and 48% would not enroll in online classes if the offline option were available (19). Examination and certification

are vital elements of medical teaching; thus, universities must find ways to institute credible evaluation methods (20). In a study on students of Alborz University of Medical Sciences, the lowest overall mean score was given by medical students (compared to allied health sciences students) with wide dispersion (9.09 $\pm$ 41.48). Among different domains, mean scores were lower for content and feedback (21). Another study from India reports that 75% of respondents did not agree that online classes were as practical as offline classes, while 80% wanted classes to be more interactive. Concern was again shown over the delivery of practical learning online (22). In the present study, satisfaction with online education had a high factor loading on interaction. A study conducted in pre-pandemic time also reported a high correlation of satisfaction of blended learning with interaction (23). Virtual simulation training may be one way to modify poor interaction with instructors and/or patients on online platforms (24). A study on Croatian medical and nursing students reported a deviation from other study findings, where the response to online education was comparatively favorable. This may be attributed to the theoretical content of the online education and pre-existing information technology setup in Croatia, which allowed for a smooth transition (25).

Studies have explored the global phenomena of online medical education during the COVID-19 pandemic from international, national, and regional perspectives (6, 10, 15, 17-19, 22). There is general agreement about the lower perceived effectiveness of online mode with less scope for interaction, learning practical/clinical skills, and proper evaluation. The present study adds more critical information to this ever-expanding knowledge repository. Our study inferred that interaction was deficient in online classes and satisfaction with online education would not improve without careful planning in this area. Students found the online evaluation system unclear, which should be another area targeted for improvement. The strength of this study was the use of a very brief questionnaire that can be reproduced for rapid appraisal.

Limitations of this study were the single institution-based nature of the study and respondent self-selection inherent to online surveys. Perception of learning clinical and cognitive skills was not separately assessed, which might have added further value to this study.

5.1. Conclusions

It can be concluded from this study that online classes are not as effective as offline classes. Factor analysis revealed that such an opinion was not due to poor planning or delivery of online lessons but due to changes in the mode of human interaction. An online evaluation system requires structure and clarity. Factors identified in this study can be used for planning new scales and improving existing ones to measure the perception of online education.

Footnotes

Authors' Contribution: Study concept and design: M. D. and S. B.; Analysis and interpretation of data: M. D.; Drafting of the manuscript: M. D.; Critical revision of the manuscript for important intellectual content: M. D. and S. B.; Statistical analysis: M. D.

Conflict of Interests: There are no conflicts of interest.

Data Reproducibility: The data presented in this study are openly available in one of the repositories or will be available on request from the corresponding author by this journal representative at any time during submission or after publication. Otherwise, all consequences of possible withdrawal or future retraction will be with the corresponding author.

Ethical Approval: The study protocol was approved by the Institutional Ethics Committee of Medical College Kolkata with the approval number MC/KOL/IEC/NONSPON/1249/01/2022.

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Informed Consent: All participants provided informed consent, and all personal identifiers were removed before data analysis.

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