Prevalence of medical students’ satisfaction with online education during COVID-19 pandemic: A systematic review and meta-analysis [version 1; peer review: awaiting peer review]

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Abstract

Background: Electronic (E)-learning is defined as the use of electronic tools for education, training, and communication. Education, among many other sectors, has been profoundly affected by the spread of the coronavirus disease 2019 (COVID-19). More than 90% of the world's students are unable to attend teaching sessions due to the COVID-19 pandemic.

Methods: This study was conducted in accordance with the published guidelines for meta-analysis and reviews (PRISMA) reporting guidelines. A database and electronic search was performed on September 21st, 2021 using PubMed, Medline and Embase through the OVID platform, and ScienceDirect. We removed duplicates, and screened the title, abstract, and full texts of included papers. We included studies published only in English and excluded studies without sufficient data, case reports, editorials, and protocols. The quality of included articles was examined using the AXIS tool for cross-sectional studies, and the Newcastle-Ottawa scale for observational case-control studies. From the included studies, demographic and satisfaction with online education (OE) prevalence data were extracted and analyzed. We calculated the pooled prevalence of medical students' satisfaction.

Results: Eighteen studies with a total sample of 7,907 students were included in the meta-analysis. The pooled prevalence of medical students' satisfaction with online education was 0.57 (95% CI: 47 - 67%). Publication bias was assessed and reported.
Conclusions: The pooled prevalence of medical students' satisfaction with online education was 53%. Online learning satisfaction was associated with students' prior experience with OE. The greatest benefit of OE is overcoming obstacles faced with learning. Major challenges for implementing OE were technical and infrastructural resources.

Keywords
Prevalence, Medical students, Satisfaction, Online education, COVID-19, Meta-analysis.
Abbreviations
OE: Online education
E-learning: Electronic learning
COVID-19: Coronavirus disease 2019
MA: Meta-analysis
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analyses

Introduction
According to United Nations Educational, Scientific and Cultural Organization (UNESCO) estimates, more than 90% of students globally are not able to attend teaching sessions due to the COVID-19 pandemic. Education, among many other sectors, has been profoundly affected by the spread of the coronavirus disease 2019 (COVID-19) which upset many aspects of our lives. Widespread closure of schools and educational facilities has resulted into the implementation of prevention policies, including social distancing policies, to tackle the pandemic. Nevertheless, in such exceptional circumstances, an increase in academic activities which utilize Electronic (E)-Learning is a common trend. Such a trend represents a rapid changeover from on-campus classes to virtual sessions.

As an adaptation to overcome the lockdowns and social restrictions, social media platforms and many others medical education tools have been largely and creatively utilized, however, not without difficulties: these methods have faced setbacks in replicating in-person clinical experiences for training those who are expected to join the healthcare workforce soon. Other concerns include the difficulties to maintain dynamicity over video meetings and other platforms, as balancing home and work life, and handling the raised workload due to providing these activities has been known to lead to burnout among facilitators.

E-learning is defined as the use of electronic means for education, training, and communication. Studies have suggested a number of advantages of E-learning, including better communication and interaction between the teacher and students, higher adaptability and accessibility. Irrespective of their location or time, E-learning sessions can reach a large audience. This advantage, however, comes with possible limitations and prerequisites, as all enrolling students need to own a minimum range of equipment; also in addition, E-learning presents limitations relating to effectiveness, and difficulties in keeping academic decency.

We aimed to systematically review the literature and evidence on the level of medical students’ satisfaction with online education (OE) during the COVID-19 outbreak.

Methods
This study was conducted in adherence to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guidelines. Institutional review board approval was not required.

Search strategy
An electronic literature search was performed on September 21st, 2021 using PubMed, Medline and Embase through the OVID platforms and Science-Direct. PubMed was queried using the following strategy: (((Satisfaction) AND (((Medical Student) OR (Medical students))) AND (((Distance Education) OR (Distance Learning) OR (Online Learning) OR (Online Education) OR (Correspondence Courses))) AND (((COVID 19) OR (SARS-CoV-2) OR (coronavirus disease 2019) OR (2019-nCov) OR (Wuhan Corona virus)))). ScienceDirect was queried forth the following strategy (((Satisfaction) AND (((Medical students))) AND (((Online learning) OR (Distance Learning))) AND (((COVID 19) OR (SARS Cov 2))).

Medline and Embase search strategies are attached in the appendix. We removed duplicate references, and screened the title and abstract of all included papers, followed by full-text screening for all eligible studies investigating medical student satisfaction with online education during COVID-19.

Eligibility criteria
We only included studies published in English, and only medical students was involved, all published studies at time of search were included. We excluded all case reports, editorials, and protocols, because of the weak evidence they reported. Studies with insufficient data, which did not involve the main items from our PICO, i.e., had either no data about satisfaction, had not been carried out during COVID19 pandemic, did not focus on medical students, or did not mention OE, were excluded. Of all included studies, two independent reviewers (HA, OM) screened the titles and abstracts. A third reviewer helped resolve any discrepancy between the reviewers by consensus (LM).

Data extraction and quality assessment
Two independent reviewers (HA, OM), used Microsoft Excel to examined the quality of each article using the Newcastle–Ottawa scale for observational case-control studies, and the AXIS tool for cross-sectional studies. Using an arbitrary cut-off, articles scoring 50% or more were considered of good quality.

Two independent reviewers (HA, LM) extracted information from each included study as follows: summary of involved studies (first author, country, study design, including study period, sample size, previous experience with online education, medical students’ satisfaction with online education result, and method of satisfaction assessment, advantages and disadvantages/challenges of online education) and the data for meta-analysis (total number of students and number of satisfy with online education). Data was gathered using Microsoft Excel 2019 (Microsoft Corporation, Redmond, WA). The meta-analysis was conducted using MARVIS app (R-based web application for meta-analysis), using the DerSimonian model and inverse variant method.

Results
Study characteristics
The search led to the selection of 96, 630, and 14 records in PubMed, ScienceDirect, Medline, and Embase through the
OVID platform, respectively. After removing duplicates, we included 708 studies for title and abstract screening, and 664 were excluded due to irrelevant data. We excluded 10 records after full-text screening with an agreement kappa of 0.921. One study was included through the snowball method, and the remaining 34 studies were assessed for quality. A total of 18 studies, from Asia and the United States of America (US), were found to be of good quality and were used for qualitative synthesis (Table 1). Selection process details are showed and summarized in Figure 1.

Demographic characteristic
Most studies were from Asia and the US, and only one was from Europe. The total number of assessed students was 7,907.

Satisfaction with online education
In some studies, students reported OE to be positively influencing their perception of their online learning experience and therefore was one of the main factors that affected their satisfaction. These benefits included saving time25–26 and physical effort relative to commuting to attend lessons in-person22. In other studies, students reported that one of the key advantages of OE was good, focused interaction with instructors, and with peers22,23. Moreover, OE provided a convenient and flexible learning experience22,23,25,27,30,31, accompanied by an improved, stress-free environment22. Students reported the experience as a whole to be more enjoyable25,30. They also mentioned good access to resources27,32,33, high image resolution, and the ability to record as important technological benefits22. Other reported benefits of online learning included better knowledge gain and understanding22,34, improved integration and linking the knowledge with clinical skills, as well as help building interest in clinical medicine24, better self-efficacy in the fields of learning, technology, time management22, concentration22 and satisfaction with academic performance25.

Challenges
Among negative impacts on their experience with online learning, students mentioned that OE was not particularly useful in developing the required clinical and practical skills needed for practice22,23,27,30. In some studies, students reported low levels of confidence in taking clinical examinations4 and managing patients without hands-on sessions4,27,28. Technical issues and limited access were some of the most common issues mentioned in the literature22,30–32,34. Several studies reported issues such as low levels of interaction with instructors23,29,30 and peers25,26 and diminished level of interest and focus22,29,30. Another major concern was the stress brought on by keeping up with schedules and tasks21,25,30,31. This was further explored when OE was reported to be boring and lengthy31, leading to long screen time and long waits for downloading learning materials31. Other complaints were about the insufficiency of collaborative activity31 and feedback on assignments4.

Meta-analysis
The pooled prevalence of medical student satisfaction with OE during the COVID-19 pandemic was 57% (95% CI: 47 - 67%) (Figure 2). An F test revealed significant study heterogeneity (I² = 99%, p < 0.01). We examined the risk of publication bias using an Egger test (t-value = -0.85, p-value=0.933) and carried out a visual examination using a funnel plot (Figure 3). Drapery plot representing the P-value of each individual study (Figure 4).

Discussion
The COVID-19 outbreak forced educational systems to migrate towards OE. This study aimed to evaluate the prevalence of medical students’ satisfaction with OE globally during the COVID-19 pandemic, and provides insights into major advantages and challenges that faced students using OE. The overall prevalence of medical students’ satisfaction was 57%.

OE is widely used in educational programs worldwide. In 2013, more than 7.1 million students were enrolled in OE according to a survey conducted by the Babson Survey Research Group46.

Advantages of OE are time saving, good time management and increased time for self-study, advanced technology like virtual microscopes, high resolution on radiology images4 Similar findings were reported by Gilbert et al. and Subhashni et al.37.

We found major disadvantages were that medical student were not confident in treating patients relying only on OE and not real-life cases, as well as a lack of skill, sense of isolation and isolation from friends. A similar finding was presented in a study by Maria et al.38.

One of the important advantages frequently mentioned in the literature was the convenience and flexibility of OE, and being mainly conducted in a relatively stress-free environment49.

The satisfaction was low in developing countries in comparison with developed countries. A review by Than et al. concluded that many obstacles stand in the way of OE in developing countries, such as cost of information and communications technology infrastructure, the need to develop a new curriculum adapted for OE, absence of motivation, insufficient experience of the tutors and lack of computer competency to use OE platforms, and electricity supply problems40. On the other hand, developed countries do not suffer from these obstacles due to availability of adequate resources41.

A review by Karen et al. stated that, when comparing OE with on-campus education, students had a higher or similar level of clinical skills42. This may be due to students’ capability to replay the online activity and revise the content at their own pace, as reported by Duijin et al.43.

Medical schools that have clinical or practical aspect are less likely to be satisfied than colleges that mainly have theoretical aspect44. The advanced technology in OE increases the satisfaction of students e.g., they were found to be deeply impressed by virtual microscope45.
<table>
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<tr>
<th>Study</th>
<th>Year</th>
<th>Region</th>
<th>Country</th>
<th>Study Period</th>
<th>Sample Size</th>
<th>Events</th>
<th>Design</th>
<th>Online platform tool</th>
<th>Study characteristics and meta-analysis data.</th>
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<tr>
<td>Maria et al.</td>
<td>2020</td>
<td>Europe, North America, Asia, Middle East</td>
<td>11 countries from developed and developing nations</td>
<td>March and April 2020</td>
<td>1255</td>
<td>828</td>
<td>cross-sectional</td>
<td>Google Hangout, Zoom, online university portal/recorded lectures, Moodle, and Microsoft Teams.</td>
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<td>Ali et al.</td>
<td>2021</td>
<td>Asia</td>
<td>Saudi Arabia</td>
<td>N/A</td>
<td>12</td>
<td>7</td>
<td>cross-sectional</td>
<td>Blackboard</td>
<td>No</td>
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<td>Mahmoud et al.</td>
<td>2020</td>
<td>Middle East/Asia</td>
<td>Jordan</td>
<td>May 5th</td>
<td>652</td>
<td>175</td>
<td>cross-sectional</td>
<td>WhatsApp groups, Facebook, and Google Drive.</td>
<td>Yes</td>
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<td>M. G. N. Amer, D. M. Altaif</td>
<td>2020</td>
<td>Saudi Arabia</td>
<td>Saudi Arabia</td>
<td>March, April 2020</td>
<td>166</td>
<td>84</td>
<td>cross-sectional</td>
<td>Virtual microscopy (VM)</td>
<td>N/A</td>
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<td>K. F. Aziz Ansari</td>
<td>2021</td>
<td>Saudi Arabia</td>
<td>Saudi Arabia</td>
<td>between May and June 2020</td>
<td>281</td>
<td>176</td>
<td>cross-sectional</td>
<td>Blackboard Ultra or Zoom</td>
<td>N/A</td>
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<td>Che Ahmad Azlan</td>
<td>2020</td>
<td>Malaysia</td>
<td>Kuala Lumpur</td>
<td>July</td>
<td>11</td>
<td>8</td>
<td>cross-sectional</td>
<td>Spectrum, Google Drive, YouTube, email, WhatsApp</td>
<td>Yes</td>
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<tr>
<td>Tarh H. Fathi</td>
<td>2020</td>
<td>North America</td>
<td>USA</td>
<td>April 2020</td>
<td>162</td>
<td>122</td>
<td>cross-sectional</td>
<td>Virtual microscopy (VM)</td>
<td>Yes</td>
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<tr>
<td>Gillian Franklin</td>
<td>2021</td>
<td>Saudi Arabia</td>
<td>Saudi Arabia</td>
<td>May 2020</td>
<td>60</td>
<td>23</td>
<td>cross-sectional</td>
<td>Zoom, Google meeting, Skype</td>
<td>Yes</td>
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<td>Monirian et al.</td>
<td>2020</td>
<td>Malaysia</td>
<td>Kuala Lumpur</td>
<td>July</td>
<td>11</td>
<td>8</td>
<td>cross-sectional</td>
<td>Spectrum, Google Drive, YouTube, email, WhatsApp</td>
<td>Yes</td>
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<tr>
<td>Siddhartha et al.</td>
<td>2021</td>
<td>Rajasthan</td>
<td>India</td>
<td>9-28 September 2020</td>
<td>1068</td>
<td>392</td>
<td>cross-sectional</td>
<td>Zoom and Facebook</td>
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<td>Chandrasekhar et al.</td>
<td>2020</td>
<td>Sri Lanka</td>
<td>USA</td>
<td>10 October to 10 February 2020</td>
<td>303</td>
<td>98</td>
<td>cross-sectional</td>
<td>Zoom, Google meeting, Skype</td>
<td>Yes</td>
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<td>Nisha et al.</td>
<td>2021</td>
<td>Mount Sinai</td>
<td>USA</td>
<td>N/A</td>
<td>36</td>
<td>30</td>
<td>cross-sectional</td>
<td>Zoom</td>
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<td>Siddhuratha et al.</td>
<td>2021</td>
<td>Sharjah</td>
<td>UAE</td>
<td>April and May 2020</td>
<td>358</td>
<td>108</td>
<td>cross-sectional</td>
<td>Zoom and Facebook</td>
<td>N/A</td>
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<td>Wiam et al.</td>
<td>2021</td>
<td>Sharjah</td>
<td>UAE</td>
<td>15 Days</td>
<td>1047</td>
<td>837</td>
<td>cross-sectional</td>
<td>Zoom and Facebook</td>
<td>N/A</td>
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<tr>
<td>Abdulla et al.</td>
<td>2021</td>
<td>Saudi Arabia</td>
<td>Saudi Arabia</td>
<td>5 Days</td>
<td>376</td>
<td>112</td>
<td>cross-sectional</td>
<td>Zoom and Microsoft Teams</td>
<td>N/A</td>
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<tr>
<td>Brian et al.</td>
<td>2021</td>
<td>Europe</td>
<td>USA</td>
<td>20 April - 15 May</td>
<td>67</td>
<td>46</td>
<td>cross-sectional</td>
<td>Blackboard and Microsoft Teams</td>
<td>N/A</td>
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Figure 1. The PRISMA flow chart of the systematic search strategy.

Figure 2. Forest plot of included studies and their pooled estimate.
Conclusions
Online education is a novel and effective method of teaching and assessing the performance of students. The prevalence of medical students' satisfaction with online education was 57%. The major benefit of OE is to overcome obstacles faced with learning, and to adapt for any challenges at any circumstances in order to continue the educational process, especially during pandemics. Efforts to facilitate the running of OE, in terms of connectivity, training, and platforms must be considered.

Strengths and limitations
To the best of our knowledge following our search, this is the first comprehensive meta-analysis to assess medical students' satisfaction with online education. Students from schools spanning all medical disciplines were involved. However, we were met with some limitations: First, we assimilated only studies in English, which may have led to language bias. Secondly, we searched only for published articles, which can also lead to some degree of publication bias.
Recommendations

We need to think of electronic learning not just as an alternative method to be used as required, but also as an integrated part of the curriculum after analysis and evaluation of available resources. Moreover, blended or hybrid approach of education which involve both online methods for theory and hands-on sessions for clinical skills, may help bridge the gap in clinical skill learning with OE.

A qualified training of both tutors and students must be conducted as preparatory sessions to overcome the technical difficulties and to familiarize them with the platform. Governmental and institutional should support developers and technology companies to make and update the appropriate, unified platforms, as well as providing accessible and cheap or free internet access, especially in developing countries.

More research must be conducted to analyze and quantify the benefits against challenges faced by educational institutions, and to design appropriate solutions for effective and easy delivery of educational content.

Data availability

Underlying data


This project contains the following underlying data:
  • OE data.xlsx (Study characteristics and data for meta-analysis).
  • edited PRISMA-checklist.doc
  • file 1.docx (PRISMA Flow Chart)
  • file 2.docx (Medline and Embase search strategy)

Data are available under the terms of the Creative Commons Zero "No rights reserved" data waiver (CC0 1.0 Public domain dedication).

References


Page 8 of 9


