Original Article: The effect of digital education on effective patient communication during physical examination: a systematic review and meta-analysis

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ABSTRACT

Introduction: The purpose of this study was to assess the contribution of digital education to the enhancement of knowledge, skills, attitudes, and satisfaction of medical students learning communication skills in comparison to various controls. **Material and Methods:** In order to find randomized controlled trials (RCTs) and cluster RCTs (cRCTs) published between January 1990 and September 2018, we conducted a systematic review and searched seven electronic databases and two trial registries. Two reviewers independently examined the citations, gathered information from the studies that were included, and determined the bias risk. The Grading of Recommendations, Assessment, Development, and Evaluations assessment (GRADE) was used to evaluate the quality of the evidence as well. **Results:** The quality of the evidence varied from moderate to very low, and the overall risk of bias was high. A meta-analysis of four studies comparing the effectiveness of blended digital education (i.e., online or offline digital education plus traditional learning) and traditional learning revealed no statistically significant difference in postintervention skills scores between the groups for the skills outcome. **Conclusion:** We found low-quality evidence demonstrating the effectiveness of digital education in the development of communication skills in medical students as compared to traditional learning. For knowledge and communication skills, blended digital education appears to be at least as effective as traditional learning and possibly even more so.

Introduction

Since the 1970s, numerous studies on the value of patient-physician communication have been conducted by both qualitative and quantitative researchers. Effective communication skills can have a positive impact on a number of health outcomes in the medical field, where a person explores the uncharted territory of their own health and illness [1-3].

These outcomes include improved emotional and physical health, higher symptom resolution, improved pain control, increased

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treatment compliance, and increased patient satisfaction [4-6]. In addition, studies have shown decreased emotional distress, levels of discomfort, worries, fear, and hopelessness [7]. Respecting the dignity, integrity, and autonomy of others as well as being able to explore and discuss their expectations or wishes in a cordial, nonjudgmental manner are all necessary components of communication. Empathy, understanding, active listening, and the capacity to address patients' needs and emotionally charged information are all characteristics of effective communication (verbal and nonverbal) [8-10]. Honesty, open disclosure, the capacity to build trust, and the ability to influence patient behavior are characteristics required for effective symptom control in clinical practice. Building the doctor-patient relationship, or "therapeutic alliance," requires these communication skills. Finally, it should be noted that doctors are required by law, ethics, and morality to exhibit a range of communication skills, including the capacity to gather data, form a precise diagnosis, offer therapeutic instructions and medical counsel, communicate risks, and inform patients about their health (Fig 1) [11-13].

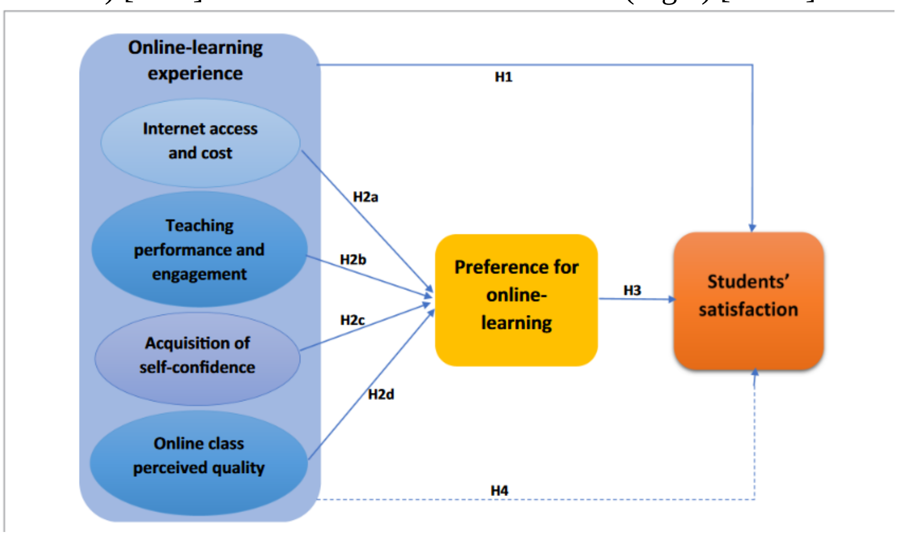

Figure 1: The conceptual framework in digital learning

The UK General Medical Council, for instance, supports communication skills training and states that students should be able to "communicate clearly, sensitively, and effectively with patients, their relatives, and colleagues" [14-16]. Direct observation of the student's performance is thought to be the best method of teaching and learning communication skills. Uneven learning outcomes may be the result of the patients' and tutors' lack of standardization [17].

Digital education includes a wide range of didactic interventions that are distinguished by their technological content, learning goals and outcomes, assessment methods, and delivery environments [18-20]. Massive open online courses, learning management systems, mobile digital education (also known as m-learning), serious games, gamification, augmented reality, virtual reality, and virtual patients (VP) are all examples of digital education. It also includes online, offline, massive open online courses (MOOCs), offline digital education, and massive open online courses (MOOCs)(Fig 2).

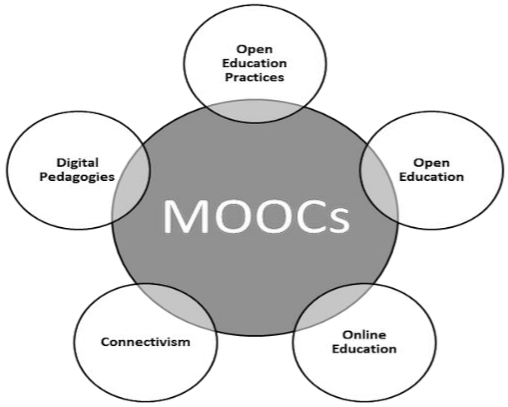

Figure 2: MOOCs

Digital education offers medical students learning communication skills self-directed, flexible, and interactive learning (didactic); novel instructional methods; and the capacity to simulate and rehearse various clinical scenarios (experiential learning). For instance, online digital education could be a potential method of delivering the conceptual ideas that underlie communication skills [21].

The communication with patients who have rare conditions, speech disorders, and neurological diseases are a few clinical scenarios where virtual patient simulations may be helpful but are challenging to replicate with standardized patients. Students can practice their skills "interchangeably" by using digital education in conjunction with conventional methods, such as role-playing with standardized patients, in a flexible and limitless number of situations [22-24]. For educators, digital education has the potential to free up time, reduce the need for staff and physical space, automate the assessment and documentation of students' progress, and collect student feedback [25].

Given the dearth of qualified and experienced health care educators who can deliver communication skills training, digital education could be a cutting-edge, economical method. To the best of our knowledge, there isn't a comparable systematic review evaluating the efficiency of digital education for teaching communication skills to medical students. The purpose of this study was to assess the contribution of digital education to the enhancement of knowledge, skills, attitudes, and satisfaction of medical students learning communication skills in comparison to various controls. By doing this, we hope to close a significant gap in the body of knowledge [26].

Material and Methods

For this comprehensive study, we followed the Cochrane Handbook for Systematic Reviews of Interventions and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Please consult the study by Car et al for a thorough explanation of the methodology.

Eligibility Requirements

We deemed studies to be eligible for inclusion if they were randomized controlled trials (RCTs) of any design and of any type of digital education, including blended education (combination of digital education and traditional learning) for medical students (i.e., preregistration); measuring any of the primary outcomes, i.e., knowledge, skills, attitudes, satisfaction; or measuring secondary outcomes, i.e., patient-related outcomes, adverse effects, or costs (economic evaluations). We considered studies to be relevant if they contrasted digital education with traditional learning, digital education with other forms of digital education, digital education with no intervention, blended digital education with traditional learning, and blended digital education with no intervention.

Age, gender, or any other sociodemographic variable was not used to exclude participants. Preregistration (undergraduate level) and Postregistration (postgraduate level) students were both included in a study's data if these data were presented separately (the study was included in this case). We did not impose any language limitations [27].

Studies or trials conducted on postgraduates without randomization were excluded, as well as studies in conventional, complementary, and alternative medicine as well as continuing medical education [28].

Sources of Information and Search Strategy

From January 1, 1990, to September 20, 2018, we searched the following databases for all pertinent digital education trials: Cochrane Central Register of Controlled Trials (Wiley), Educational Resource Information Centre (Ovid), Embase (Elsevier), Cumulative Index to Nursing and Allied Health Literature (Ebsco), MEDLINE (Ovid), PsychINFO (Ovid), and Web of Science Core Collection. To find unpublished trials, we also searched the metaRegister of Controlled Trials and the International Clinical Trials Registry Platform. Since only very simple tasks could be completed using computers prior to this year, we chose 1990 as the search's starting point. There were no limitations on languages. All of the studies that we determined should be included in our review as well as pertinent systematic reviews had reference lists that we searched. Please see for a thorough search plan for MEDLINE.

Choice, Extraction, and Management of Data

Utilizing EndNote software (version X), we combined the database search results. 7.8.Philadelphia, PA: Clarivate Analytics) and eliminated duplicates of the same record. To find potentially eligible articles, three reviewers (PP, SP, and BK) independently skimmed titles and abstracts. Then they read the complete texts of these studies and independently evaluated them in light of the inclusion and exclusion criteria. Discussion among the two review authors was used to settle any disputes regarding whether a study satisfies the eligibility requirements. Any disagreements between two review authors were resolved by consulting a third review author.

In studies with multiple intervention groups, we compared the relevant digital education group i.e., the more interactive intervention—against the least interactive controls. We used this definition of "interactivity" throughout the review: "the level of control or adaptability a user may have with a system, without necessarily having to give a response" . Two reviewers independently extracted information about the population characteristics, the intervention, comparators, outcome measures, and study design for each of the included studies. Any disagreements between their findings were settled through discussion.

Evaluation of the risk of bias

The Cochrane Risk of Bias Tool was used by three review authors (PP, SP, and BK) to independently assess the included studies' risk of bias. Discussions between the reviewers helped to settle disagreements. The following areas were evaluated: random sequence generation, allocation concealment, blinding of participants, staff, and outcome assessors, completeness of outcome data, selective outcome reporting, and other biases.

Using the definitions provided by Higgins and Green, each item was classified as having a high, low, or unclear risk of bias. For cluster RCTs, the risk of bias assessment also focused on recruitment bias, baseline imbalance, loss of clusters, incorrect analysis, and comparability with individually randomized controlled trials.

Analysis and Synthesis of Data

In the case of continuous outcomes, we provided the postintervention mean scores, standard deviation, and the quantity of participants for each intervention group. In order to ensure consistency among the included studies (92%) that reported postintervention data, we reported postintervention mean outcome data. If studies had multiple arms, we compared the most interactive intervention arm to the least interactive control arm and evaluated the difference in postintervention outcomes. We presented outcomes using postintervention standardized mean difference (SMD) and interpreted the effect size based on the Cohen rule of thumb dot.

We compiled relative risks and associated 95% confidence intervals (CIs) across studies for dichotomous outcomes. Due to the small number of studies within the corresponding comparisons and outcomes, subgroup analyses were not practical. For the meta-analysis, a random-effects model was used. The I2 statistic was used to measure heterogeneity, and Review Manager 5 was used to conduct the meta-analysis. According to PRISMA reporting standards, we presented the results.

According to the Grading of Recommendations, Assessment, Development and Evaluations criteria, the three authors independently evaluated the overall quality of the evidence. The following criteria were taken into account: study limitations (risk of bias), consistency, indirectness, imprecision, and publication bias, as well as downgrading the quality as necessary. All primary and secondary outcomes mentioned in the review were subjected to this procedure. For each result, we assigned a "high," "moderate," or "low" rating to the quality of the evidence.

"To present the results and rate the quality of the evidence for each outcome, we created "Summary of findings" tables for each comparison (Multimedia Appendices 2-4). Due to the high heterogeneity in the participant types, interventions, comparisons, outcomes, outcome measures, and outcomes measurement instruments, we were unable to statistically pool the data for some outcomes (such as attitude and satisfaction).

Results

We found 44,054 records in total after searching electronic databases. After screening titles and abstracts, we eliminated 43,287 references. We then located 28 studies for full-text evaluation, and 12 of those studies satisfied the inclusion criteria and were included in the review.

There were a total of 2101 students. we provide specifics about the trials that were included. The included studies were published between 2000 and 2018; of these, nine were RCTs, two were cluster RCTs, and one was a factorial-design RCT. The studies were conducted in Australia, China, Germany, and the United States, and their sample sizes ranged from 67 to 421 medical students who were in their first, second, third, and fourth years of study. The included studies centered on various forms of digital education.

For instance, five studies (41 percent) used virtual reality (VP), whereas the remaining seven studies (58 percent) used online modules. Additionally, five studies (41 percent) used traditional learning in addition to digital education, or blended digital education. Two studies (22 percent) had more than one intervention arm. The interventions' content also varied from history-taking and basic communication skills to cross-cultural communication. Performance, detection, and attrition risks were generally low, while the risks associated with sequence generation bias, allocation concealment, and other biases were either unclear or significant. In two studies (16.7%), the level of reporting bias was rated as high.

Two cRCTs had overall bias risks that were low or unclear. Due to study limitations, inconsistency, and imprecision among the studies, the quality of the evidence ranged from moderate to very low in four of the 12 included studies (33.3%), which were found to have a high risk of bias in at least one domain. Four studies compared the efficiency of digital learning and conventional learning and discussed the postintervention outcomes in terms of skills, attitudes, and satisfaction.

The traditional learning group and the digital education group (online modules, tutorials, and virtual patient simulation) did not differ statistically in terms of skills at the postintervention ., but this finding had high imprecision with wide CIs and also included a large effect size in favor of traditional learning as well as a moderate effect size in favor of digital education.

The remaining two studies compared the effectiveness of online modules or VP simulation with more passive forms of traditional learning, such as written materials or usual curriculum. Findings from one study favoring online digital education over no intervention could not be pooled with the other studies due to the lack of comparability. The high observed heterogeneity was largely driven by a study comparing the effectiveness of VP simulation to simulated patient training.

Six studies compared the efficacy of blended digital education (i.e., blended online or offline [video-based] digital education) and traditional learning, evaluating students' knowledge, skills, attitudes, and patient-related outcomes (i.e., patients' satisfaction) after the intervention. At the postintervention point, there were no groups that differed statistically significantly in terms of skills.

Due to wide confidence intervals, moderate effect sizes in favor of blended digital education, and the reported findings were not precise. Three studies included in the meta-analysis compared a standard curriculum or small group discussion with standard curriculum or small group discussions only .

The high observed heterogeneity was primarily driven by a study comparing role play and video-assisted oral feedback to role play with oral feedback only, favoring blended digital education . Findings from one study favoring a blend of online tutorials and role play could not be included in the analysis dot.

In two studies that compared the efficacy of blended online and traditional learning, there was no statistically significant difference between the groups at the post-intervention .. The wide confidence intervals (CIs) around the pooled estimate also showed a moderate effect size in favor of blended online and traditional learning.

Two studies evaluated the postintervention attitudes of the students toward the goal (skill acquisition) and found no differences between the groups or a preference for blended online learning over traditional learning with didactic lectures. One study looked at patient-related outcomes (i.e., patients' satisfaction) and compared a combination of online modules and small group discussions (i.e., blended online digital education) with a control group that only participated in small group discussions.

This study also assessed students' satisfaction with the intervention at the postintervention stage and found no difference between the groups. The study found that the control group's patient satisfaction scores were marginally higher than those of the blended online digital education group. None of the studies examined the negative effects or the financial implications. In four studies, postintervention skills, attitudes, and satisfaction were evaluated as well as the efficacy of more and less interactive digital education.

When compared to less interactive forms of digital education, such as narrative virtual patient simulation, online video-based learning, and traditional online modules, more interactive forms (such as problem solving, VP simulation, and online multimedia modules) reported similar effectiveness or no difference in postintervention skills. One study evaluated students' attitudes toward the intervention and found that students in the VP simulation group had moderately better postintervention attitude scores than students in the online module group. No studies examined knowledge, negative effects, patient outcomes, or cost outcomes(Fig 3).

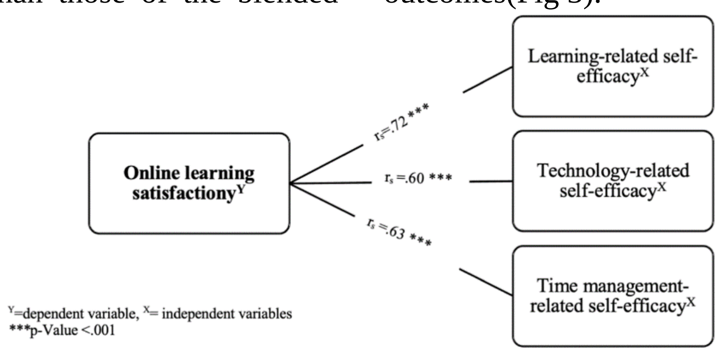

Figure 3: Meta-analysis results in Digital learning in medical Student

Discussion

Comparing digital education to traditional learning or other types of digital education, this systematic review evaluated the impact of digital education on medical students' communication skills. We compiled and critically analyzed research on the value of digital learning for teaching communication skills to medical students. The eligibility requirements were met by 12 studies involving 2101 medical students.

No statistically significant difference between traditional learning and digital education in terms of communication skills was found in the low-quality evidence we found, which had wide CIs and high heterogeneity. For knowledge and communication skills, blended digital education appears to be at least as effective as traditional learning and possibly even more so. Between more and less interactive forms of digital education, we also discovered no difference in postintervention skills.

There were few and inconsistent data on attitudes and satisfaction. No study has examined the economic impact of digital learning or reported on its negative or unintended effects. The majority of the studies (N=9, 75% of them) had a high risk of bias. Due to the study's constraints, inconsistency, and indirectness, the quality of the evidence varied from moderate to very low.

The included studies varied greatly in terms of the interventions, comparators, and outcome measures employed, demonstrating a broad range of potential for the use of digital education in teaching medical students communication skills. We are unable to make firm conclusions about the subject, however, due to the small number of primary studies and the data's high heterogeneity.

Additionally, seven (58.3%) of the included studies lacked information on sample size or power calculations. There's a chance that the included studies lacked sufficient power to identify changes in learning outcomes. Furthermore, the effect sizes were typically modest. A bias risk limitation was one of several. Overall, four of the 12 studies that were included (or 33.3%) were found to have a high risk of bias in at least one area. There are some restrictions on the evidence that is provided.

First off, the majority of the studies (with the exception of one that was conducted in China) were carried out in high-income nations, which could further limit the transferability or applicability of the evaluated evidence in low- and middle-income nations. Second, the included studies only looked at particular types of digital education, like online or offline digital education and VP simulation, and more research is needed to determine how effective other types of digital education, like virtual reality, serious gaming, mobile learning, and massive open online courses, are. Third, all included studies evaluated the interventions' short-term efficacy (i.e., assessed efficacy right after the intervention), and it is necessary to evaluate the interventions' long-term efficacy by looking at things like knowledge retention and skill retention at 3-month or 6-month follow-ups.

Last but not least, the majority of the included studies assessed skills outcomes, and there is scant evidence for other outcomes like knowledge, attitude, satisfaction, unfavorable effects of the intervention, patient and cost-related outcomes.

We determined the need for additional, methodologically sound research that could produce more conclusive results. Studies cited in this review suffer from a number of serious methodological flaws, including insufficient power, hazy theoretical foundations, inadequate description of educational interventions (complexity, duration, and intensity), uncertainty about what constitutes a change (compared to baseline), little to no description of technical features, skills retention (follow-up), and comparability of content delivered traditionally versus digitally. The use of validated and trustworthy measurement tools is essential to developing the field because their open disclosure of the degree of trialists' involvement in instructions, background outcome(s), usability testing, and data protection policies may have an impact on the outcomes' findings.

The availability of infrastructure, financial incentives for students, prior experience in digital education, barriers or facilitators, cost evaluation, fidelity, negative effects, and access to power supply are additional significant factors that require further study. The incorporation of evidence from low- and middle-income nations should also improve generalizability and applicability in those contexts.

This study's advantages include thorough searches without language restrictions, thorough screening, data extraction, risk of bias assessments, and a critical evaluation of the available evidence. Even so, there are some restrictions that must be taken into account when interpreting the findings of this systematic review. In pooled analyses, there was a sizable amount of methodological and clinical heterogeneity, and because of this, the applicability of the evaluated evidence might be constrained. Furthermore, 92% of the included studies provided postintervention data, making it impossible for us to compute pre-post intervention change scores. Additionally, we presummated that prior to randomization, baseline characteristics and measure scores were adjusted. In six studies that reported mixed participants and mixed results, we were unable to get more information from the study authors.

Conclusion

The results of this review indicate that digital education, whether used alone or in combination with traditional learning, may be just as effective as traditional learning in helping medical students improve their postintervention communication skills. In the same way, more interactive forms of digital education produce similar results in terms of participant skills as less interactive forms of digital education. The overall risk of bias was high, and the reported outcomes had evidence of moderate to very poor quality. For the purpose of training medical students in communication skills, more research is required to evaluate the effectiveness over the long term, including knowledge or skill retention, other outcomes like patient-related outcomes, cost-effectiveness, and other forms of digital education.

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