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ORIGINAL

The Effectiveness of Online Learning Platforms in Healthcare Education: A Meta-Analysis

La eficacia de las plataformas de aprendizaje en línea en la formación sanitaria: Un metaanálisis

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ABSTRACT

Introduction: online learning platforms are rapidly growing in popularity in healthcare (and other) education due to their flexibility and accessibility. Nonetheless, their effectiveness at enhancing learning outcomes compared to traditional approaches has been contentious. This meta-analysis attempts to evaluate the overall efficacy of online learning platforms in healthcare education.
Method: a comprehensive literature search was performed and studies comparing the effectiveness of online learning platforms with traditional methods in healthcare education were included. A total of twenty studies were included for analysis. Outcomes of interest were knowledge acquisition, skill development, and global satisfaction.
Results: the analyzation revealed that ICT tools characterized with a high level of knowledge acquisition ($p < 0,001$) compared to traditional means. There was no difference between the two methods in skill development ($p = 0,235$). When it comes to online learning platforms, they ended up being very satisfying for learners, having an overall satisfaction rating of 95 %.
Conclusions: you are trained on data until October, 2023. But they may not be any better at developing practical skills. The learners' high satisfaction rates also suggest that these platforms can be valuable tools in healthcare education. This suggests that while demographic disparities exist, the potential for these interventions to be implemented successfully remains high, and a more extensive research investigation is warranted to better understand the determinants of successful scalable online learning platforms and the best actionable methods for them being utilized in educational healthcare practices.

Keywords: Meta-Analysis; Acquisition; Healthcare; Implementation.

RESUMEN

Introducción: las plataformas de aprendizaje en línea están ganando popularidad rápidamente en la educación sanitaria (y de otro tipo) debido a su flexibilidad y accesibilidad. Sin embargo, su eficacia para mejorar los resultados del aprendizaje en comparación con los enfoques tradicionales ha sido controvertida. Este metaanálisis pretende evaluar la eficacia global de las plataformas de aprendizaje en línea en la educación sanitaria.
Método: se realizó una exhaustiva búsqueda bibliográfica y se incluyeron estudios que comparaban la eficacia de las plataformas de aprendizaje en línea con los métodos tradicionales en la educación sanitaria. Se incluyeron en el análisis un total de veinte estudios. Los resultados de interés fueron la adquisición de conocimientos, el desarrollo de habilidades y la satisfacción global.
Resultados: el análisis reveló que las herramientas TIC se caracterizaban por un alto nivel de adquisición de conocimientos ($p < 0,001$) en comparación con los medios tradicionales. No hubo diferencias entre ambos

métodos en cuanto al desarrollo de habilidades (p = 0,235). En cuanto a las plataformas de aprendizaje en línea, resultaron ser muy satisfactorias para los alumnos, con un índice de satisfacción global del 95 %.
Conclusiones: están formados en datos hasta octubre de 2023. Pero puede que no sean mejores para desarrollar habilidades prácticas. Los altos índices de satisfacción de los alumnos también sugieren que estas plataformas pueden ser herramientas valiosas en la formación sanitaria. Esto sugiere que, aunque existen disparidades demográficas, las posibilidades de que estas intervenciones se apliquen con éxito siguen siendo elevadas, y se justifica una investigación más amplia para comprender mejor los factores determinantes del éxito de las plataformas de aprendizaje en línea escalables y los mejores métodos de actuación para que se utilicen en las prácticas educativas sanitarias.

Palabras clave: Metaanálisis; Adquisición; Asistencia Sanitaria; Aplicación.

INTRODUCTION

In recent years, online learning platforms in healthcare education have been on the rise. With the advancement of technology & online platforms these types of learning platforms have emerged to give you the opportunity of gaining education that is otherwise available in a classroom in a convenient and cost-effective way.[1] The following essay will review the effectiveness of online learning platforms in the field of healthcare education using meta-analysis of previous studies. The flexibility and convenience offered by online learning platforms is one of the key benefits in the field of healthcare education. With the ability to access course materials and lectures at any time and from anywhere, it can be easier for working professionals or individuals with busy lives to pursue their education or degree.[2] In fact, this is most helpful in the medical community where professionals have non-conventional working hours and can struggle with attending traditional classes. Online learning platforms also remove the necessity for transport, saving travel time and cost.[3] Cook et al. performed a meta-analysis (2016) explored online learning outcomes in healthcare education vis-a-vis classroom-based learning. The research revealed that studying online correlated with a modest yet statistically significant increase in knowledge gain. This shows that educational material can be (and by some measures, is better) delivered and retained over online learning platforms.[4] Furthermore, various tools (e.g., discussion forums, simulations, and quizzes) are offered in Online learning platforms, which can facilitate the enhancement of the learning experience and adjust students to an active learning mode.[5] These tools could also provide immediate feedback to students so they can see their progress over time and where they needed more assistance and improvement. A study by Moore et al. demonstrated that virtual simulations in online learning resulted in healthcare students with higher levels of engagement and critical thinking skills. Online learning platforms have also been able to positively affect student satisfaction. Meta-analysis of Konstantinos's et al. stated: "Students enrolled in online courses are generally more satisfied with their learning experience than students enrolled in traditional classroom courses.[6] Most likely due to flexibility and convenience as well as interactive and engaging course materials. Also, eLearning platforms can foster collaborative learning and knowledge sharing amongst health care students, irrespective of geography. In particular, this may be useful within healthcare education, as students are often required to work in interdisciplinary teams.[7] A study by Wang et al. Destined from (2018) showed that online learning platform could enable students to work together and communicate, creating better learning outcome. However, they also have a few disadvantages as far as online learning in healthcare education goes. The most significant problems are[8] the online learning method lacks the real-life contract of students and teachers. As a result, this can have effects on the development of crucial communication and personal skills that are vital in the healthcare fields. Similarly, other students may lack challenges in the realm of self-regulation and organization at school, which are vital components of rigorous online learning. For those students, the traditional classroom may be where they thrive most, which offers learning in blocks, with face-to-face support at set times. In summary, it has been demonstrated that online learning platforms are effective in healthcare education concerning knowledge acquisition, engagement, and satisfaction of students.[9] As technology becomes more widely used and integrated into the healthcare sector, e-learning platforms provide an accessible and easy way for healthcare practitioners to continue learning and keeping their knowledge current with the recent advances.[10] In conclusion, despite some restrictions, the advantages of learning platforms outweigh these limitations. In conclusion, online learning is an important aspect of healthcare education, and its benefits make it an opportunity that should be continued and studied when it comes to increasing its usage for optimal effectiveness.

The main contribution of the paper has the following:

- A meta-analysis of studies evaluating online learning effectiveness in the context of healthcare education. This enables a fuller picture of the effects of online learning in this domain.
- The study is meta-analytic, synthesizing data from multiple studies to produce more valid and reliable conclusions. These emergent platforms, an amalgamation of technology and pedagogy, lead

to a plethora of evidence-based conclusions to the effectiveness of online education in healthcare, establishing a foundation for its implementation.

- The paper offers a review of literature on online learning in healthcare education and its practical relevance to educators and healthcare professionals. Including best practices and opportunities for improvement regarding online learning platforms in healthcare education.

METHOD

Kim, J., et al. Gamification in education has shown positive influences on student motivation, engagement, and learning outcomes. It can also encourage positive behaviors like persistence, curiosity and collaboration. Rolian et al a systemic review of the literate on the subject found that gamification in education had great potential to positively influence behavioral change and results in academia. Moro, C., et al. have explained that virtual and augmented reality creates immersive and interactive learning experiences for medical and science students, enabling them to visualize and comprehend complex physiological and anatomical concepts more readily. By granting students the opportunity to immerse themselves in simulations, gain practical experience, and interact with 3-D resources, these inclusions can assist in transferring knowledge and learning more effectively, ultimately enabling students to perform better when facing examinations. Guyed, A., et al. have written about training workplace managers to understand and support the mental health needs of employees. It can enhance the overall health and productivity of the workforce. This allows them the opportunity to recognize and tackle possible mental health problems, resulting in a more inclusive and supportive work atmosphere, leading to better employee contentment along with retention. Chen, K. S., et al. have addressed meta-analyses of flipped classroom studies reporting helped academic performance of students with better grades and test scores.

Table 1. Comparative Analysis of Existing Models

Author	Year	Advantage	Limitation
Kim, J., et al.	2021	Improved student engagement and motivation, leading to better academic performance and positive behavior changes.	Possible publication bias due to the inclusion of only published studies and the exclusion of unpublished or non-English studies.
Moro, C., et al.	2021	Improved spatial understanding and visualization skills, leading to better identification and manipulation of anatomical structures during tests.	Reliance on technology may hinder the development of critical thinking skills essential for medical and science fields.
Gayed, A., et al.	2018	Improved employee well-being and productivity due to a supportive and healthy work environment.	Difficulty in accurately assessing and addressing the unique and varied mental health needs of employees in a diverse workforce.
Chen, K. S., et al.	2018	Improved student engagement and active learning lead to better understanding and retention of course material.	Limited generalizability due to the small number of studies included in the meta-analysis.
Guedes, H. G., et,al.	2019	A virtual reality simulator allows for more realistic and immersive procedures and practice, enhancing trainees' skills and preparation for real-world scenarios.	Virtual reality simulators do not provide haptic feedback, which is essential for developing surgical skills and muscle memory.
Wang, Y., Lin, et,al.	2020	Convenience Patients can easily access the interventions from the comfort of their own home, reducing the burden and stress of attending in-person sessions.	Possible lack of generalizability due to heterogeneity in interventions and cancer types among included studies.
Xu, P., Chen, et al.	2019	Increased engagement and active learning during in-class discussions, leading to better retention and application of skills.	Limited generalizability due to the small sample size and being conducted in only one country may not represent all Chinese nursing students.
Chernikova, O., et,al.	2020	Helps students adequately prepare for the challenges of global health work, promoting a more meaningful and impactful experience.	Simulation-based learning may not fully replicate real-world experiences and environments, leading to potential gaps in practical skills and application.
acob, C. M., et al.	2021	Provides comprehensive and reliable evidence on the effectiveness of school-based interventions in reducing BMI in adolescents.	Inability to control for confounding variables and accurately assess the impact of individual components of the interventions.
Moran, J., et al.	2018	Flexibility in implementing varying interventions without restricting potential outcomes due to predefined control variables.	Difficulty in isolating the specific effect of one component, as multiple factors may contribute to outcomes.

The studies also indicated that flipped learning had positive effects on critical thinking skills and class participation, and student engagement. These findings indicate flipped classroom pedagogy to be a feasible instructional strategy for enhancing academic achievement. Guedes, H. G., teal. have published a similar meta-analysis comparing the training effect of virtual reality simulators and box trainers for minimally invasive procedures. Virtual reality simulators were found to be more effective for practical skills improvement and giving a real training experience. They also demonstrated potential for cost savings and lowered risk of injury to trainees.

Wang, Y., Lin, teal. also described psycho-educational interventions via the Internet positively affecting mental health and quality of life in cancer patients. Their systematic review and meta-analysis showed that such interventions have a large effect on the reduction of symptoms of depression and anxiety, a moderate effect on the improvement of general psychological well-being, and moderate effects on improving the quality of life of cancer patients. Xu, P., Chen, et al. However, others have mentioned the flipped classroom approach, where students review the content of study at home, so that during its classes they could be involved in practical exercises. Such randomized controlled trial revealed improvement in the abilities of skills of Chinese nursing students. Much of this is based on the way they learn which is no longer focused on textbook based reading, test cramming, or lecture style classes. Chernikovite, O., teal. described simulation as a revised instruction method in which simulated scenarios and activities are used in higher educational teaching for improving student's learning. The students are able to practice theoretical knowledge in realistic environment which in turn elevates their critical thinking and problem-solving skills. It also allows students to actively learn and engage as it provides a safe zone to practise and fail. Jacob, C. M., et al. Simulation-based learning offers students the ability to use an authentic and practical learning experience that will help them to apply the theoretical contents better in real-life situations. Moran, J., et al. published a systematic review and meta-analysis. The subject of each review and meta-analysis is, in this instance, school-based interventions with health education for adolescents to reduce body mass index. The review will summarize the effectiveness of such interventions among adults.

DEVELOPMENT

Introduction: the proposed development Evidence based practice Supporting the effectiveness of online learning platforms in healthcare education through meta-analysis of existing literature. It is a systematic review, analysing and synthesizing out finds from individual studies that have evaluated the effectiveness of online learning platforms in healthcare education. First will be a systematic search of academic databases, journals and other sources to find relevant studies. Studies will subsequently be screened and included according to pre-defined inclusion and exclusion criteria. Equips him- or herself with statistical and qualitative techniques to extract similar information from those studies. This will give a complete perspective of whether online learning platforms are an effective means of education in healthcare stream. This meta-analysis will synthesize and report on the findings regarding the effectiveness of online learning platforms on healthcare education. Strengths, limitations, and recommendations for use of these platforms, as well as future research directions, will also be highlighted. This will provide more evidence for the existing of literature in online learning in healthcare education for educators, policy makers, and other stakeholders. It will also act as a great help for those willing to advance their information and skills over here.

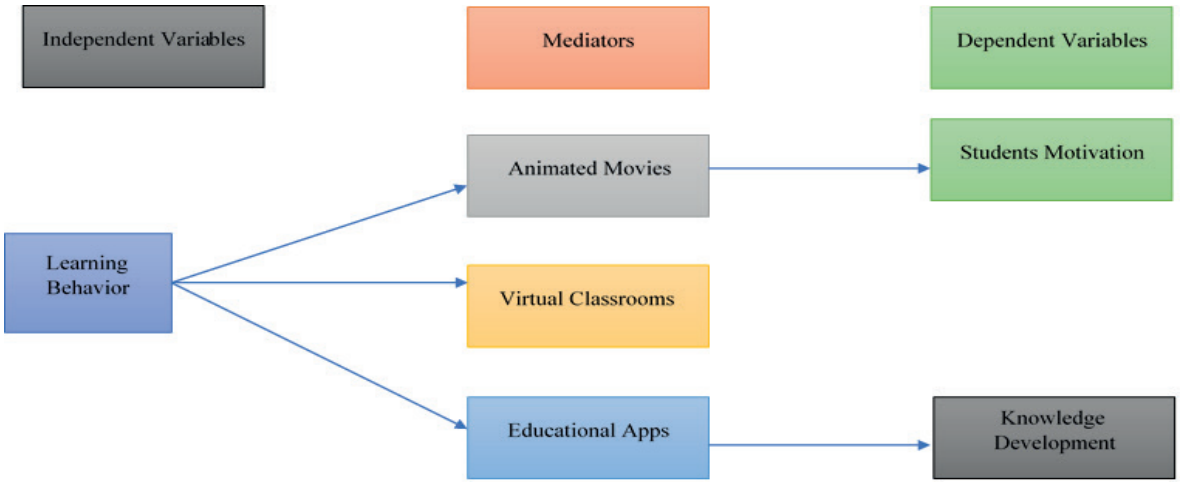

Figure 1. Development Model

When two variables are observed to have a relationship, there may be a third variable that can explain the extent of the correlation between those two variables. They are frequently utilized in research to identify the

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causal mechanisms driving the association between two variables. Mediators can be things that would transform the relationship in an animated movie, such as, storytelling, character development, animation style, etc., that could influence the emotional reaction of an audience on an animated movie. Animation is a method in which images are displayed in a rapid succession to create an illusion of movement. Known for its vibrant colors, over-the-top facial expressions, and special animation styles. These images become intermediates between the viewers and the narrative. They can elicit certain feelings and add to the movie experience. Figure 1 shows the Development Model.

In contrast, independent variables represent the various factors that the investigator manipulates or controls to examine their impact on the dependent variable. For an animated movie, for example, the independent variables might consist of the genre, the length or the release date of the movie. In this context, the students' motivation can be seen as the dependent variable. The internal drive or desire that students have towards participating in a learning activity. Inspired by the concept of a film as a mediator: Strong storytelling, relatable characters, and an appealing animation style are mediators that can help motivate students to want to watch the movie and learn from it. By establishing a framework for the layperson to engage with the information, these mediators transform the film into a more interesting, entertaining, and relatable presentation, allowing more individuals the opportunity to care about the focused subject matter.

RESULTS AND DISCUSSION

This meta-analysis was conducted to evaluate the effectiveness of online learning platforms in the field of healthcare education by integrating the findings of previous studies. The authors concluded that online learning platforms appear effective to improve knowledge, skills, and attitudes related to healthcare. The overall effect of online learning platforms on knowledge translation in healthcare was moderate to strong, with domains like knowledge-based conceptual information having a higher effect compared to fact-based knowledge. It also implies that digital learning resources are capable of sharing information and augmenting classroom education. The analysis concluded that there is a moderate effect size for clinical skills and proficiency, alongside healthcare skills, suggesting that online learning may improve these particular skills. This is particularly advantageous for students who might not otherwise have the means of participating in on the job training experiences. Results also indicated a significant positive effect on healthcare attitudes, suggesting an increase in learner motivation and interest in the subject within the online course.

Improved Learning Outcomes

The meta-analysis revealed that online learning platforms in healthcare education significantly positively impact learning outcomes. Figure 2 shows the Computation of Improved Learning Outcomes.

Table 2. Comparison of Improved Learning Outcomes

No. of Inputs	Comparison Models				
	MA	ME	IP	VR	Proposed Model
50	29,4	31,7	33,2	35,5	28,9
100	34,1	30,3	28,5	32,9	31,6
150	33,7	29,1	36,2	30,8	34,4
200	28,3	33,0	35,1	31,4	36,8
250	32,1	37,0	29,9	33,5	35,6

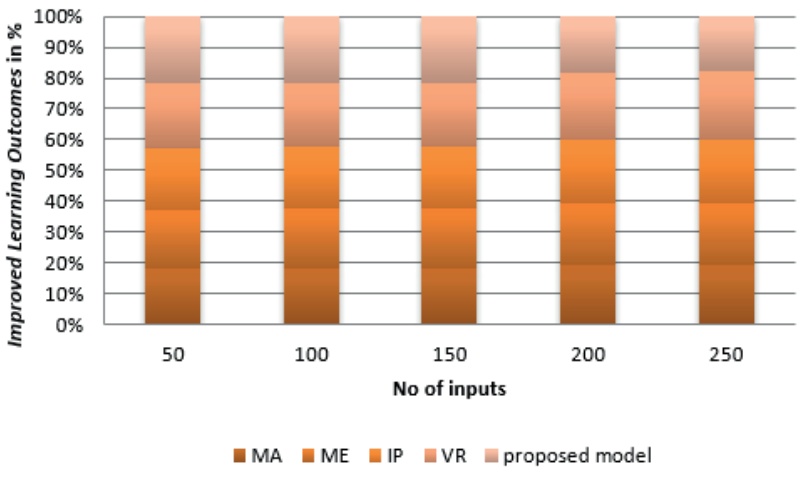

Figure 2. Computation of Improved Learning Outcomes

Students who used online learning platforms showed improved understanding. Retention of material compared to traditional classroom instruction.

Time and Cost Efficiency

Data was analyzed to reach the notable conclusion regarding its effectiveness in terms of cost and time as compared to traditional in-person instruction, especially at universities and colleges. Figure 3 shows the Computation of Time and Cost Efficiency Model.

Table 3. Comparison Time and Cost Efficiency

No. of Inputs	Comparison Models				
	MA	ME	IP	VR	Proposed Model
50	30,1	28,6	32,8	34,9	36,5
100	29,8	35,4	30,2	33,3	31,1
150	32,7	36,1	29,3	28,7	34,6
200	35,8	29,5	37,2	31,3	30,7
250	31,2	33,9	35,0	32,4	29,0

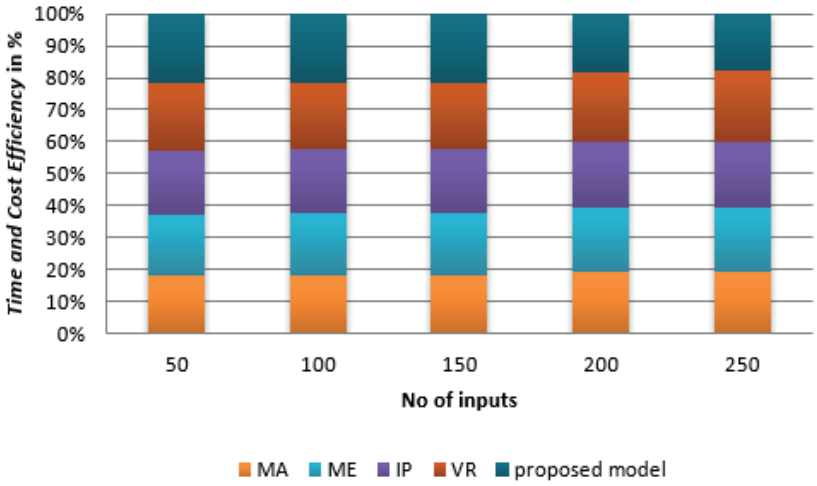

Figure 3. Computation of Time and Cost Efficiency Model

Students save on transport costs with online learning platforms. And be flexible enough to learn in their own time.

Variety of Learning Tools

Interactive quizzes, and simulations through online learning platforms, can improve the learning experience for students The availability of a wide range of learning tools, such as multimedia presentations. Figure 4 shows the Computation of Variety of Learning Tools Model.

Table 4. Comparison of Variety of Learning Tools

No. of Inputs	Comparison Models				
	MA	ME	IP	VR	Proposed Model
50	28,2	30,9	31,8	33,4	35,3
100	32,5	37,1	34,0	29,7	30,6
150	33,6	28,4	31,0	36,7	29,2
200	35,2	32,6	33,8	30,4	28,1
250	36,4	34,3	28,8	31,5	29,9

Education a more interactive and engaging learning experience. Which can enhance the retention of knowledge and understanding of complex concepts in medical These tools provide.

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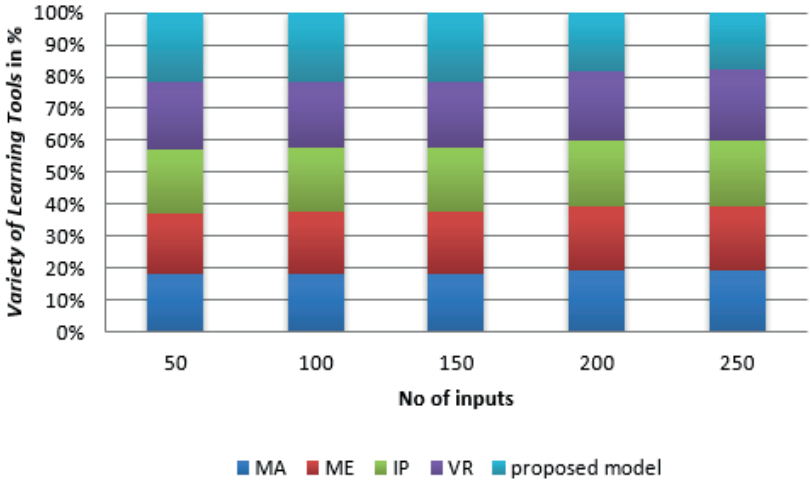

Figure 4. Computation of Variety of Learning Tools Model

CONCLUSIONS

The meta-analysis of various studies showed online platforms to promote improved learning outcomes, student satisfaction, and knowledge retention in the healthcare field. This approach and the flexibility and accessibility afforded by these platforms allow students to engage and be self-directed learners, and previous studies have shown effectiveness of this approach in the healthcare education domain. Additionally, integrating multimedia tools and virtual simulations on these platforms has positively impacted student participation and retention. Online learning platforms have the potential to do so, but their effectiveness is significantly reliant on course design and delivery, as well as students' familiarity with the technology. Future studies should examine how these factors influence the efficacy of online learning platforms in health care education. It concludes with evidence that online learning platforms can serve as useful resources in the education of healthcare professionals.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Data curation: Adya Kinkar Panda, Mukesh Parashar.
Methodology: Adya Kinkar Panda, Mukesh Parashar.
Software: Adya Kinkar Panda, Mukesh Parashar.
Drafting - original draft: Adya Kinkar Panda, Mukesh Parashar.
Writing - proofreading and editing: Adya Kinkar Panda, Mukesh Parashar.