




Strategies and didactic resources used in virtual teaching/learning in university students in the context of COVID-19

Estrategias y recursos didácticos empleados en la enseñanza/aprendizaje virtual en estudiantes universitarios en el contexto de la COVID-19

Estratégias e recursos didáticos utilizados no ensino / aprendizagem virtual em estudantes universitários no contexto da COVID-19


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KEYWORDS

COVID-19, teaching, learning, virtual simulation, educational technologies, university.

ABSTRACT. The global health crisis caused by the Covid-19 pandemic has forced teaching and learning models to be rethought. The objective of this literature review was to demonstrate the teaching strategies and resources used in university teaching/learning in the biomedical area in the context of the Covid-19 pandemic. The literature search was in the PubMed, Science-Direct, and Scielo databases; original articles published in 2020 and 2021 were considered, which have addressed virtual simulation as a didactic strategy, its educational design, resources, implementation, and limitations. It is concluded that the different study programs in the biomedical

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area incorporated the virtual simulation of reality as a strategy and didactic resource in the face of the Covid-19 pandemic, obtaining satisfactory experiences.

PALABRAS CLAVE

COVID-19, enseñanza, aprendizaje, simulación virtual, tecnologías educativas, universitarios.

RESUMEN. La crisis sanitaria originada por la pandemia de la Covid-19 a nivel mundial, ha forzado que se tengan que replantear los modelos de enseñanza y aprendizaje. El objetivo de esta revisión de literatura fue demostrar las estrategias y recursos didácticos empleados en la enseñanza/aprendizaje universitario en el área de biomédicas en contexto de pandemia Covid-19. La búsqueda de literatura fue en las bases de datos PubMed, Science-Direct y Scielo, se consideró artículos originales publicados en el 2020 y 2021, que hayan abordado la simulación virtual como estrategia didáctica, su diseño educativo, recursos, implementación y limitaciones. Se concluye que los diferentes programas de estudio del área de biomédicas incorporaron la simulación virtual de la realidad como estrategia y recurso didáctico frente a la pandemia por la Covid-19, obteniendo experiencias satisfactorias.

PALAVRAS-CHAVE

COVID-19, ensino, aprendizagem, simulação virtual, tecnologias educacionais, universidade.

RESUMO. A crise de saúde global causada pela pandemia de Covid-19 forçou os modelos de ensino e aprendizagem a serem repensados. O objetivo desta revisão de literatura foi demonstrar as estratégias e recursos de ensino utilizados no ensino / aprendizagem universitário na área biomédica no contexto da pandemia de Covid-19. A busca bibliográfica se deu nas bases de dados PubMed, Science-Direct e Scielo, foram considerados artigos originais publicados em 2020 e 2021, que abordaram a simulação virtual como estratégia didática, seu desenho educacional, recursos, implementação e limitações. Conclui-se que os diferentes programas de estudos na área biomédica incorporaram a simulação virtual da realidade como estratégia e recurso didático frente à pandemia de Covid-19, obtendo experiências satisfatórias.

1. INTRODUCTION

On January 8, 2020, the Chinese Center for Disease Control and Prevention announced a new coronavirus. This virus started an epidemic in Wuhan, China, in December 2019, becoming a challenging public health problem not only for China but also for all countries in the world (Phelan, 2020). The virus that causes this epidemic was named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), whose mode of transmission is by direct and indirect contact; in addition, the outbreak of coronavirus pneumonia is lethal (Chengge et al., 2020; Martinelli et al., 2021; Organización Mundial de la Salud-OMS, 2020). For this reason, the governments of the different countries took as a control measure to decree compulsory social isolation.

The global health crisis caused by the Covid-19 pandemic has forced teaching and learning models to be rethought. We went from face-to-face to virtuality, where the need for didactic strategies and technological resources arises in this new teaching-learning methodology at the university level.

Thus, new innovative teaching strategies and technologies developed by educators with the purpose of a rapid recovery of learning originated (Favale et al., 2020; Huang, 2021). The main challenge for educators was to identify the appropriate measures that should be taken to prevent student learning loss (Okoye et al., 2021; Rafi et al., 2020; Ray et al., 2021). Amid the Covid-19 pandemic, several university institutions consider digital



technologies an inevitable and indispensable part of learning (Huang, 2021; Liu et al., 2020; Martinelli et al., 2021; Pinos et al., 2020; Wilcha, 2020).

It is essential to know what the experiences have been in the teaching/learning process using technological resources adhered to the didactic strategy of virtual simulation. Thus, the idea for this theoretical review arises to demonstrate the result of virtual simulation experiences using technical resources in university teaching-learning in the biomedical area in the context of a Covid-19 pandemic.

Teaching strategies

Díaz (1998) indicates that didactic strategies are procedures and resources used to promote meaningful learning. These facilitate more profound and more conscious processing of new content.

Simulation

Education in traditional biomedical programs is based on the 19th-century ideology promoted by Sir William Osler (citado por McGaghie, 2015) who mentioned that students learn best through direct experiences with patients, complementing themselves with classroom learning. However, already in the XXI century, to increase understanding based on experience and reduce risk with the patient, a new educational tool, “simulation” emerges, to standardize educational experiences that are not so possible in a clinical setting and place students in high-risk settings in a safe environment (Armenia et al., 2018).

According to the Association of American Medical Colleges (AAMC), simulation is possibly the most prominent innovation in biomedical education in recent history (McGue et al., 2021). Its importance lies in the connection that exists between theoretical and practical competencies, which prepares students for real medical challenges (Zoltán et al., 2020).

They are experiential experiences that refer to attempts to design training processes based on actual or simulated situations. They are part of the educational didactic model inspired by the structuralism and constructivism of knowledge according to the theory of Jean Piaget (Parra, 2003).

With simulation, you can anticipate the consequences of decisions to be made in natural conditions. Therefore, you can learn from your behavior and others (Parra, 2003). In simulation-based education, experiential learning and active learning are essential, including factors related to authentic tasks, social interaction, fostering

ownership, reflection, and participant engagement (McLeod, 2019). As well as teamwork, communication, and awareness of the situation (Bracq et al., 2019).

In this situation, due to the COVID-19 pandemic, many biomedical programs have implemented simulation as a complementary tool for training in high-risk situations (Ahmad et al., 2021; Prasad et al., 2020; Ray et al., 2021).

2. METHOD

A preliminary search for studies was carried out in the PubMed, Science-Direct, and Scielo databases using Covid-19, teaching-learning, virtual simulation, educational and university technologies.

In the selection of the studies, the following criteria were considered as inclination criteria: original articles published between 2020 and 2021, which have used virtual simulation as a didactic strategy and which contain information on the educational design, technological resources, the implementation process, and the study limitations. Thus, the sample was made up of studies carried out in university educational programs such as medicine (1), dentistry (1), and nursing (2), in which they applied virtual simulation as a didactic strategy accompanied by technological resources. These studies were designed with virtual telesimulation, home simulation learning, an effective instructional template for virtual simulations, and a program.

The information contained in these studies was analyzed and presented following the following structure: proposed educational design, the technological resources used, the implementation process, and the identification of limitations. In the end, a table is presented that contains the qualitative analysis of the experiences of the analyzed studies.

3. RESULTS

3.1. Experience 1: Virtual Telesimulation for Medical Students (Ray et al., 2021)

3.1.1. Educational design

The high-fidelity simulation activates the emotional state of students, supporting the development of clinical decision-making by providing them with opportunities to manage critically ill patients independently. To achieve results similar to those resulting from high-fidelity in-person simulation, they retained many cognitive and affective learning characteristics from the live simulation environment. In addition, they used David Kolb's experiential learning model (McLeod, 2019).

3.1.2. Technological resources and personnel

They used the Microsoft Remote Desktop application (version 10.3.7, Microsoft, Redmond, Washington) to gain remote access both to the control computer to access the Laerdal LLEAP software (Laerdal Medical, Stavanger, Norway) and to a second computer to display Live vital signs monitor visible to all participants via screen sharing (Supplemental Digital Annex 1 at <http://links.lww.com/ACADMED/B103>) using Zoom video conferencing software. Cases were pre-programmed within the simulation software, and appropriate multimedia files were incorporated to allow the live presentation of the media within the shared screen of the vital signs monitor.

While all staff conducted the simulation sessions from home, Google Hangouts instant messaging (Google LLC, Mountain View, California) was used. Each session involved at least one simulation technician, one patient actor, one confederate nurse, and one facilitator/informant from the faculty. In addition, I managed to recruit another educational faculty in the faculty of medicine to act as expert consultants in subspecialty areas.

3.1.3. Implementation

Each week's 90-minute session included two 45-minute segments, each of which, in turn, consisted of a 20-minute simulation and a 25-minute briefing. Three students handled one scenario and observed the other scenario each week, doing 12 procedures during the six weeks. The students remained within their assigned team. Each session began with a 2–3-minute organizing period during which the team leader posted roles for specific tasks.

3.1.4. Limitations

The main limitation of the virtual telesimulation format has been the inability to practice psychomotor skills and techniques (e.g., physical examination maneuvers) or procedures (e.g., endotracheal intubation, placement of a chest tube).

3.2. Experience 2: Simulation Design and Student Satisfaction with Home Simulation Learning in Oral Health Therapy (Tan et al., 2021)

3.2.1. Educational design

Simulation-based training in dentistry can range from low to moderate fidelity simulations, such as practice with typodont (artificial tooth models), to high fidelity simulations, such as enhanced virtual reality. However, practical sessions are essential for acquiring critical psychomotor and operational skills

in dental and surgical training. Thus, home simulation learning (HBSL) is a process-based learning method through which students are active.

3.2.2. Resources

Simulation Learning at Home (HBSL) was proposed as an innovative educational method. In which portable mannequins, phantom heads of the dental simulator with typodont, instruments, and materials were used by students of the first, second and last year.

3.2.3. Implementation

The HBSL program for students was developed and implemented a teaching and learning approach based on self-directed learning. Materials for the HBSL program are uploaded to a pre-reading platform for students.

Class size comprised 22-26 students, dental hygiene and therapy coordinators, and supervisors conducted synchronized lectures and demonstrations during scheduled 3-week time intervals. After the discussions, the students were divided into groups of six, and the meeting room function on the Zoom teleconferencing platform was used to practice with the mannequin heads, with real-time feedback from dedicated clinical supervisors observing through remote monitoring.

Students were not graded during HBSL activities. However, they received written assignments and theoretical tests on dental therapy and infection control; the test scores did not count towards the final module scores.

3.2.4. Limitations

The limitations of this study are the small sample size and the inclusion of students from a single school, which may limit the generalizability of the results.

3.3. Experience 3: Effective Instructional Design Template for Virtual Simulations in Nursing Education (Rim & Shin, 2021)

3.3.1. Educational design

A virtual reality simulation (VRS) is defined as “a persistent and synchronous network of people, represented as avatars, facilitated by networked computers” (Bell, 1970). A well-structured simulation

is a central element for constructivist learning and is a representative teaching method for empirical and active knowledge (Mattar, 2018; Shin et al., 2019)

3.3.2. Resources

The developed template has educational elements, virtual elements, and scenario diagrams.

3.3.3. Implementation

Each scenario session included pre-orientation, simulation, and briefing and lasted from 130 to 150 minutes. Sixteen nursing students were divided into two teams of eight for the virtual reality simulation. During a 20-minute orientation period, participants received an overview of the simulation and its operation. Then, during a 30–40-minute pre-briefing session, the theoretical content of the simulation was provided. For each scenario, students were able to repeatedly practice the task for the first 30 minutes of the session, and then they performed the test for the last 10 minutes. After the scenario, a structured 40–50-minute briefing was held, during which the students shared their experiences with the SRVs.

Then, a focus group interview was conducted with each team; they were audio-recorded and lasted between 45 and 60 minutes. Interviews were performed using a semi-structured interview guide, and questions included "Tell me about your experience with the virtual reality simulation" "How did the virtual reality simulation affect your learning?" "What is the difference between virtual reality simulation, clinical practice, and mannequin simulation?"

3.3.4. Limitations

Students reported initial difficulties manipulating items and objects in simulated virtual reality settings due to unfamiliarity. They also said that it took them time to learn to use the program due to the English sets.

3.4. Experience 4: Specific simulation program for web-based nursing training (Kim et al., 2021)

3.4.1. Educational design

This program consists of six steps: 1. suggested reading, 2. pre-simulation questionnaires that provide students with an overview of the contents, 3. interactive clinical nursing scenarios authorized by the

National League of Nursing NLN, 4. questionnaires of post-simulation, 5. documentation assignments and 6. guided reflection questions.

3.4.2. Resources

The virtual simulation (vSim® for nursing) used in this study is a specific simulation program for nursing training; it was developed jointly by Wolters Kluwer Health Lippincott and Laerdal Medical in cooperation with the National League of Nursing (NLN) of the USA. VSim®. It has peer-reviewed clinical cases, and the simulations are based on high-fidelity mannequins adapted for use in a virtual environment where it measures students' actions in terms of low, moderate, and high risk of harm to the patient. In addition, it calculates a score based on the nursing activities carried out correctly (Foronda et al., 2016; Zaragoza et al., 2021).

3.4.3. Implementation

The virtual simulation was considered in the curriculum during the spring semester of 2020 and replaced the hours of clinical practice. The students received guidance in an online class through a tutorial. A facilitator-led the virtual simulation. The nursing care actions were automatically recorded, which generated a performance score and a personal feedback record.

3.4.4. Limitations

The low English proficiency of the students increases the time of the session, the preparation of the virtual simulation with cultural traits different from the context where it is used, and the little detailed instruction provided before the virtual simulation session.

Table 1

Qualitative analysis of the results of teaching / learning experiences through virtual simulation

Simulation design	Qualitative analysis
Virtual telesimulation for medical students (Ray et al., 2021)	In those teams with more than 3 participants, there is confusion in communication and less activity in the roles assumed for learning. But, on the other hand, there is a rapid adaptation with the full participation of the students.



Simulation learning at home in oral health therapy (Tan et al., 2021)	The most critical factors perceived by students with this learning methodology were feedback with guided reflection, timely support received during the process, and greater self-confidence for learning.
Effective instructional design template for virtual simulations in nursing education (Rim & Shin, 2021)	The virtual elements included in the developed template help educators create educational environments and resources mediated by the simulation; however, it demands a technical level for the use of the platform and perseverance when designing virtual simulations.
Specific simulation program for web-based nursing training (Kim et al., 2021)	The virtual simulation program developed in students the confidence to provide patient-centered care. It also showed difficulties such as the English language in which both the program and the materials were prepared, the lack of reality, and the rating methods.

Source: self made

4. DISCUSSION

The results obtained with the instructional design template and vSim® applied by Kim et al. (2021) y Tjoflåt et al. (2018) confirm that these tools optimize virtual education since they imply the preparation of teachers, give orientation details, and supports students struggling with the program.

The findings found by Kim et al. (2021) and Tjoflåt et al. (2018) indicate that, since English is not the students' mother tongue, it reveals a short familiarization of students with virtual simulation programs. Regarding the development of students' confidence and competence for patient-centered care, other studies indicate similar results using different virtual simulation designs such as training with vSim® that increases knowledge, allows the development of skills, and provides a high level of self-confidence in the student (Foronda et al., 2016; Gu et al., 2017). However, another study reports that it only enables the training and development of non-technical skills (D. Díaz et al., 2021).

Ray et al.(2021) and Kim et al. (2021) agree that a limitation is that the students were not graded during the activities carried out in the virtual simulation sessions. Also, a study carried out by Zaragoza et al., (2021) adds that there is no option for simulating critical cases, and the student assumes the cost of the program license.



In this review, unlike other studies, which mainly analyze the efficacy and effectiveness of virtual simulation as an educational strategy in biomedical areas, the experience of applying virtual simulation in a non-face-to-face and distance education context is described an emphasis on educational design, resources, implementation, and limitations, with the support of online platforms.

However, certain limitations are identified, such as the number of articles found, generated by the restrictions that there are only studies in the context of the Covid-19 pandemic and undergraduate education in biomedical areas. Studies that do not show the description of virtual simulation as an educational strategy are discarded. It was not possible to make comparisons between the systems analyzed. The bias would be because only articles published in a short period were analyzed.

It is recommended to carry out other studies considering other strategies used in the teaching-learning of biomedical areas in the context of a Covid-19 pandemic. Likewise, carry out investigations to know the students' satisfaction with the implementation of these new resources, especially in those that require clinical interaction.

5. CONCLUSIONES

The different study programs in the biomedical area in university education have incorporated the virtual simulation of reality as a strategy and didactic resource in the face of the Covid-19 pandemic, obtaining satisfactory experiences for the benefit of students.

Findings on virtual simulation in the teaching/learning process may assist educators in designing future virtual telesimulation and home simulation learning programs for students.

To generate a more active role in student learning, a maximum of 3 participants is recommended. In addition, the main limitations of the programs for virtual simulation were the students' low command of the English language and the insufficient time given to the student to master the programs.

It is recommended that sufficient time be provided in the early stages for students to master the program's operation.

Likewise, it is recommended to carry out future studies that evaluate the effectiveness of virtual simulation in the development not only of procedures and technical skills but also cognitive, problem-solving, and decision-making.

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