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Research Article

Use of the Light Board Tool as a Didactic Strategy during COVID-19 Pandemic

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Abstract: After the declaration of the COVID-19 pandemic in 2020, the conventional way of teaching and learning had to move towards virtualization. The light board tool is a technology that allows conventional lessons on a blackboard to be adapted to a virtual context without losing the essence of the classroom. The objective of this work was to know the opinion of pharmacy students from the Universidad de Costa Rica about the light board employment as a didactic strategy for mathematical topics study in the context of virtualization of education due to the COVID-19 pandemic. Therefore, 19 videos were developed on the light board to explain various mathematical topics related to the Pharmaceutical Physicochemistry II and Biopharmacy and Pharmacokinetics courses of the Faculty of Pharmacy in 2020 and 2021. After its implementation, 80 students were surveyed to find their opinion about their experience related to teaching and learning processes. The data were tabulated, and the main results were graphed. All students accepted the strategy as a compliment in their study and considered it useful in their learning process. Also, more than 91 % indicated that it was helpful in the order, understanding, explanation, study, and learning of the topics with a mathematical nature. In conclusion, the light board was a good technique for developing mathematical topics, and students recommend utilizing this tool in other similar career courses.

Keywords: light board, education, virtualization, pandemic, COVID-19, pharmacy students.

INTRODUCTION

On March 11, 2020, the World Health Organization (WHO) declared a pandemic due to the disease caused by the coronavirus 2019 (COVID-19) (Karis *et al.*, 2021). As a result, the world adopted measures to stop infections and reduce deaths, such as social distancing, hygiene care, and teleworking, among others (Andrasfay *et al.*, 2022; Niu *et al.*, 2021). The education process was tested since the strategies before the pandemic demanded the student's presence in the classrooms to construct learning. This scenario forced professors to deconstruct the teaching process and reinvent new ways of transmitting knowledge to their students, now from virtuality (Hickling *et al.*, 2021; McCartney *et al.*, 2021; Luetkemeyer, 2021).

University education, where constant interaction between the teacher and the student is required, demands training strategies that allow the adequate balance between the learning of theoretical knowledge and the development of skills necessary for the future professional (Hickling *et al.*, 2021; Luetkemeyer, 2021; Aristovnik *et al.*, 2016). The pharmacy career at the Universidad de Costa Rica (UCR, for its Spanish acronym) has not escaped the challenges posed by the virtualization of education due to the COVID-19 pandemic, especially those subjects in which the development of mathematical skills is essential for understanding and obtaining the essential knowledge for future pharmacists in the country (McCartney *et al.*, 2021; Dohle *et al.*, 2021; Torres Rodríguez & Anta Vega, 2006).

Information and communication technologies (ICT), created to improve the processing, storage, and transmission of information, became a more important ally in education after the pandemic, allowing the interaction of information technology and telecommunications with the teaching and learning processes (Aristovnik *et al.*, 2016; Borcsa *et al.*, 2021; González Aldana *et al.*, 2017).

The light board is a technological tool that consists of an electronic device that allows the preparation of educational videos and whose methodology is developed through virtual teaching in a novel and innovative way. This strategy allows direct interaction between the professor and the students as in a conventional classroom. This resource becomes truly relevant for developing content in subjects whose objective is acquiring mathematical skills (Dohle *et al.*, 2021; González Aldana *et al.*, 2017; Skibinski *et al.*, 2015; Fung, 2017).

In this experience, we proposed developing a series of videos through the light board tool to explain mathematical topics, including colligative properties, tonicity, and pharmacokinetic characterization of compartmental models. They are studied in courses at the UCR, specifically Pharmaceutical Physicochemistry II and Biopharmacy and Pharmacokinetics, in the third year of the pharmacy career. Additionally, it is vital to know the relevance of this ICT application from the students' perspectives to whom the materials were directed.

MATERIALS AND METHODS

Nineteen videos on the light board were prepared to cover several topics. They comprise colligative properties, drug tonicity, monocompartimental pharmacokinetic characterization of drug absorption and distribution processes by the extravasal route, and bicompartmental pharmacokinetic characterization of drugs administered by intravenous injection (intravenous bolus).

Before starting with the video recording, the material was compiled into a digital document to give logical order to the contents and choose which sections would be exposed through these videos. Once the information developed with this instrument had been determined, the videos were recorded and edited. Finally, they were made available to the students through the official university virtual environment of the career courses.

In the study plan for the pharmacy career at the UCR, the Pharmaceutical Physicochemistry II course is taught annually between March and June. This course is required by the Biopharmacy and Pharmacokinetics subject, also taught annually, from August to November.

Eighty students who had contact with the videos recorded to explain the mathematical contents in the courses in 2020 and 2021 were surveyed through a digital questionnaire designed by Google Forms to know their perception of the tool in the teaching and learning processes within mathematical subjects. The survey contains a header informing that their participation was voluntary and anonymous and that the results would be handled confidentially.

The researchers created the survey and included questions in different formats, such as single selection and Likert scales. With them, the students' perception was explored regarding the amount of study time employed by the videos, the relevance to exposing topics of a mathematical nature from virtuality, positive and negative aspects in the utilization of this type of ITCs, motivation to study these issues using this tool; as well as the order, clarity, and ease of learning this type of content.

The results were tabulated, and subsequently, with the Excel® program, a frequency analysis of the responses to each single-choice question and the Likert scales was performed. Percentage graphs were prepared to establish the students' perception regarding the tool use.

RESULTS

A survey with 80 students was done to know their opinion about this new didactic strategy, developed as a response to the restrictions adopted due to the COVID-19 pandemic. They had as input the light board utilization for learning some contents of mathematical nature in courses of their study plan.

Table 1 shows the number of hours the students invested watching the videos provided, in which the mathematical contents of the Pharmaceutical Physicochemistry II and Biopharmacy and Pharmacokinetics courses were explained. More than half of them dedicated between one and five hours to their study using the available material, and more than 44 % spent between five to 10 hours or more than 10 hours studying them.

Table 1: Number of hours of study using the videos created with the light board tool

Study hours	All students (N = 80) (%)
Less than one	3,75
Between one and five	52,50
Between five and 10	30,00
More than 10	13,75

Then, it was essential to know if the persons who utilized the explanatory videos considered the light board valuable. This information is shown in **Figure 1**.

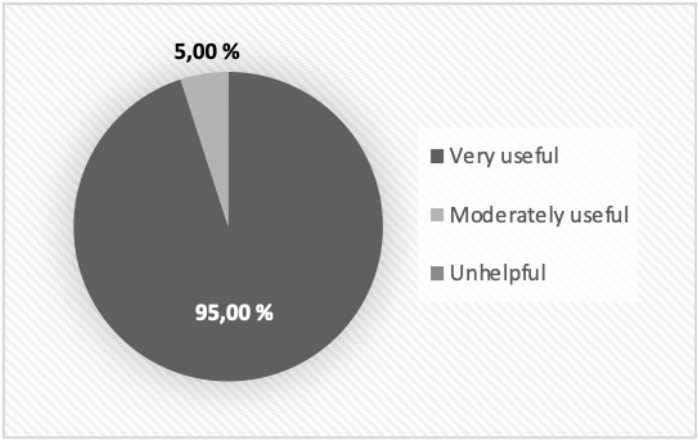

Figure 1: Assessment of the usefulness of the light board tool for learning topics with a mathematical nature in career courses. 100 % determined that this input was moderately useful or very useful; being this last consideration the one chosen by 95 % of the students.

Due to the high acceptance and establishment of the usefulness of this didactic tool, the main reasons why the students contemplated the audiovisual material developed with the light board beneficial were investigated, as shown in **Table 2**. More than 91 % indicated that they agreed or strongly agreed with aspects such as that this teaching strategy offers order in the development of the contents, allows a clear understanding, offers a better explanation of the information, and facilitates the learning and study of the topics as well as their study.

Table 2: Evaluation of students' aspects related to the usefulness of the light board strategy.

Aspects evaluated by the students	Perception of the students (N = 80) (%)			
	Totally agree	Agree	In disagreement	Strongly disagree
Order in the contents	80,00	13,75	0	6,25
Clear understanding of the issues	71,25	22,50	0	6,25
Better explanation of information	73,75	20,00	0	6,25
Ease of learning	78,75	13,75	1,25	6,25
Ease of studying the topics	78,75	13,75	1,25	6,25

Figure 2 shows their opinion regarding the light board relevance for explaining mathematical contents in the context of the virtualization of education. Furthermore, **Figure 3** describes the influence this strategy had on the students' interest in studying mathematical topics in the courses where it was employed.

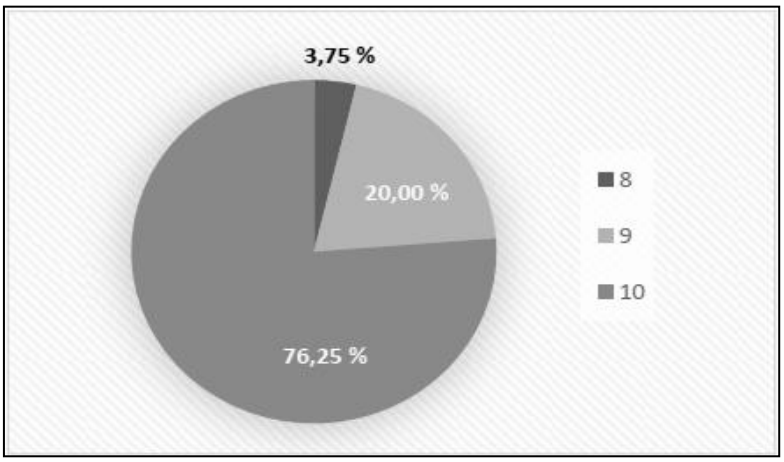

Figure 2: Relevance rating of the didactic strategy in the study of mathematical topics. 100 % of the students indicated that this strategy was relevant in at least a grade of 8, on a scale of 1 to 10.

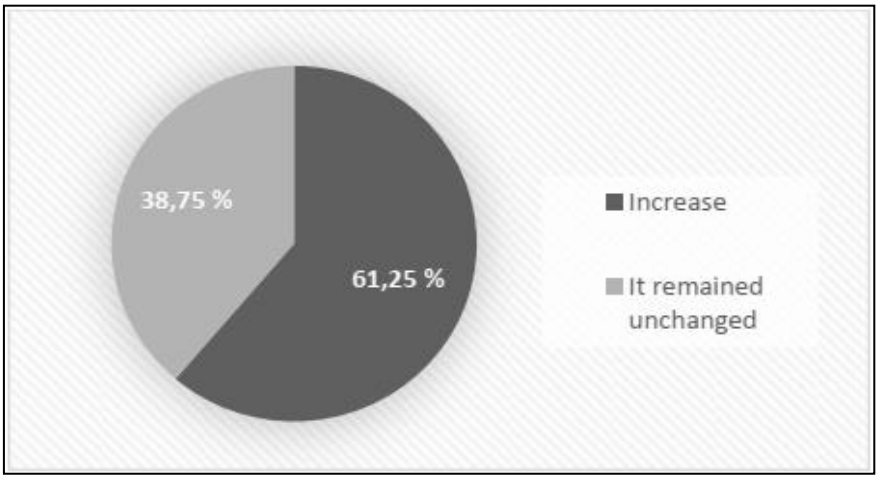

Figure 3: Interest in the content studied with the light board tool. 65 % of the students indicated that their interest increased and none of them thought that it decreased due to the use of this tool.

Finally, based on their experience, the students were asked to indicate if they recommended this instrument in other career courses, at least with mathematical contents. These opinions are shown in **Figure 4**.

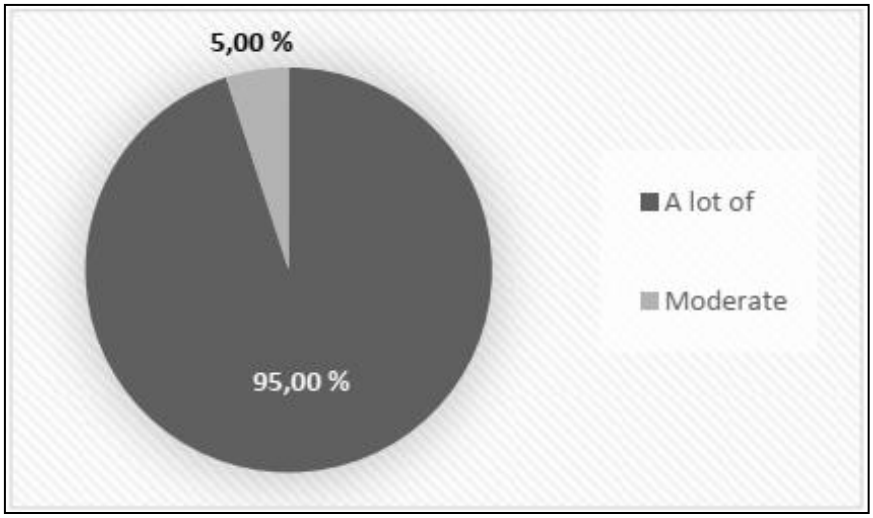

Figure 4: Recommendation of the utilization of the light board tool in other courses of the career. 95 % of the persons determined that it would be very relevant to contemplate its implementation in future opportunities.

DISCUSSION

The partial or total virtualization of higher education is a relevant aspect that, in the last decade, has boomed in university students' teaching and learning processes (Estrada Molina *et al.*, 2017; Imbernón *et al.*, 2011). Currently, online university degrees are more common and an excellent option for people who want to opt for a degree or a specialization in their area of knowledge but do not have the time to take a traditional one (Poveda Pineda & Rodríguez Hernández, 2014).

In 2020, humanity faced one of the most significant pandemics of the last 100 years, forcing many changes in what was considered normal (Iriarte *et al.*, 2020). Teaching, and in particular university teaching, was one of the affected areas that quickly had to evolve and migrate from the traditional face-to-face method to a methodology that comprised ICT and the virtualization of education during 2020 and 2021 (Poveda Pineda & Rodríguez Hernández, 2014; Iriarte *et al.*, 2020; Ruiz González & Jiménez Guerra, 2022).

These circumstances represented a great challenge for teachers worldwide since many were not prepared to go from classroom to virtual environments in such a short time (Luetkemeyer, 2021; Ruiz González & Jiménez Guerra, 2022; Silva-Cutiño & Rodríguez-Almeida, 2014). The previous meant the search for innovative strategies and tools for the development of the study topics of the distinct areas of knowledge, plus the expeditious and adequate training in their employment (Luetkemeyer, 2021; Torres Rodríguez & Anta Vega, 2006; Izquierdo Lao & Pardo Gómez, 2007).

The ICT became new allies in the teaching and learning processes. They allow devising strategies such as synchronous virtual classes, explanatory videos, and discussion forums on various platforms (Silva-Cutiño & Rodríguez-Almeida, 2014; Arshad & Ahmed, 2015; Lupu, 2017).

However, some courses contain mathematical content and represent a challenge for the professor. In addition, the virtualization of lessons that traditionally involved a blackboard has represented a problem both for explaining the topics and for adequate learning by students (Torres Rodríguez & Anta Vega, 2006; López *et al.,* 2018).

A modern tool that has helped to solve this virtualization obstacle is the light board. It consists of a device like a blackboard, which, through black light and fluorescent ink markers, favors the explanation of topics in real-time or the realization of videos, with which the individual can feel as if he was in class in front of the blackboard (Skibinski *et al.,* 2015; Fung, 2017; López *et al.,* 2018).

The pharmacy career taught by the UCR has within its curriculum courses in which mathematical topics are essential in training new pharmacists. Examples of them are the Pharmaceutical Physicochemistry II and Biopharmacy and Pharmacokinetics courses. The first one analyzes contents related to the colligative properties of substances and the preparation of isotonic solutions for clinical applications. The second one includes the mathematical equations that describe the pharmacokinetic models to which the drugs administered by the diverse routes of administration are adjusted (for example, the oral route and the intravenous bolus). The preceding motivated the teaching staff to seek practical and friendly strategies for developing these topics that require blackboard utilization to avoid hindering the students' learning process. The light board became an ally, allowing the production of at least 19 explanatory videos on the topics. **Figure 5** shows a sequence of photos taken from one of them (in which the derivation of the pharmacokinetic equation that describes the behavior of drugs after oral administration of a drug was explained).

Because this instrument had never been contemplated in these courses, it was decided to consult the student population (N = 80) about their experience with it. Besides, its relevance in learning mathematical topics during 2020 and 2021 was established.

One of the main concerns of the teaching staff was the acceptance that this new strategy could have as input for studying the topics of the subjects. All the students (**Table 1**) were willing to invest time using the explanatory videos done with the light board help to complement to their study strategy, dedicating at least one hour. The paradigms change is not always well received, often showing resistance to the adaptation of people (Rigler Jr, 2016; Vivolo, 2016). Nonetheless, probably because of the technology's progress in recent years, these strategies are well received and accepted by university students (Vivolo, 2016).

It is necessary to evaluate and validate the relevance and usefulness of a change every time it is carried out or a modification is included in the teaching and learning processes (Yao *et al.,* 2018; Heydari *et al.,* 2019; Gálvez-Peralta *et al.,* 2018). All the students surveyed determined this a valuable method for learning the mathematical content developed in the courses where this strategy was implemented (**Figure 1**). Whenever it seeks to innovate in the educational process, efforts should be directed to achieving success in the learning of students who will be affected by the implemented changes so that, when an improvement is successfully implemented, this must be documented (Perrow, 2018; Cock, 2022).

Any new didactic strategy implemented as support must be clearly defined and have specific objectives to succeed in the intended learning (Perrow, 2018; Varier *et al.,* 2017). The changes in the teaching methodologies must contribute to the ordering of the thematic contents, favor their understanding, offer an option to improve their explanation and facilitate their study and learning (Luetkemeyer, 2021; Estrada Molina *et al.,* 2017; Tashkeyeva *et al.,* 2019).

A large majority of the pharmacy students who used videos in which mathematical topics were developed through the light board were pleased with this approach since they considered that the study of these topics was orderly, which allowed them a clear understanding by being explained in a better way. Likewise, their study was more accessible, favoring better learning. Given the need for the virtualization of education due to the pandemic, one of the most relevant challenges for teachers is ensuring students' complete understanding (González Aldana *et al.,* 2017; Ruiz González & Jiménez Guerra, 2022; Tashkeyeva *et al.,* 2019). As our results show, the light board became a tool that made it possible to meet this goal (**Table 2**). Moreover, the pharmacy students of the UCR qualified very positively to employ the light board to develop mathematical topics (**Figure 2**). This qualification reaffirmed the importance of optimal learning of the contents for them in their training as future professionals, the goal of those who choose a university degree (McCartney *et al.,* 2021; Imbernón *et al.,* 2011; Perrow, 2018).

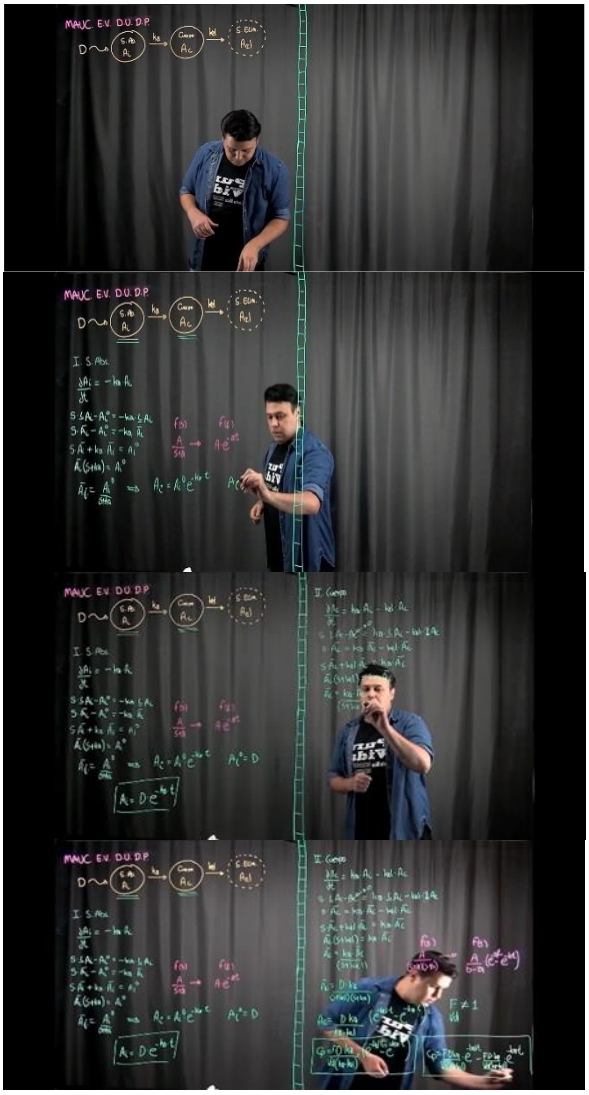

Figure 5: Visual example of the use of the light board as a didactic tool in the virtualization of education.

The proposed teaching strategies should maintain the student's interest in learning about an area of knowledge and even increase it over time (González-Moreno, 2017). Our results revealed that most of those who used the videos experienced an increase in their interest in studying the topics developed with this instrument (**Figure 3**), thus, validating the relevance of dealing with mathematical issues using didactic inputs like this one.

The vast majority considered that this device should be implemented in other courses like those where it was applied (**Figure 4**). University teaching demands new learning techniques daily that adjust to current populations' technological requirements so successful experiences are implemented. These should be established as possible inputs in the subjects that university students must attend to optimize their professional training (Poveda Pineda & Rodríguez Hernández, 2014; Iriarte *et al.*, 2020; Ruiz González & Jiménez Guerra, 2022; Silva-Cutiño & Rodríguez-Almeida, 2014).

CONCLUSIONS

The pandemic caused by COVID-19 was a promoter of the virtualization of university education. This situation demanded that teachers adjust to a new reality that required innovation in conventional teaching and learning processes. The tool known as the light board allowed the teaching staff to adapt mathematical topics to the virtual context, offering a mechanism for the better ordering of these topics, greater clarity for the student's understanding, and an input for the optimal explanation of the contents. This strategy favored studying and learning complex contents such as those taught in the Pharmaceutical Physicochemistry II and Biopharmacy and Pharmacokinetics courses. Pharmacy students at UCR remarkably accepted the tool, rating it with a high score and even recommending its utilization in other courses of a similar nature.

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