Virtual simulations + Flipped classroom for Physiology learning. Pilot project.

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Abstract. In this study, the implementation of virtual simulations as a complementary tool in Physiology education under the flipped classroom approach was investigated. The main objective was to assess the perception of students from various health-related disciplines towards this innovative methodology. The results revealed a predominantly positive perception among the students. The simulations were deemed user-friendly and aided in the comprehension of theoretical concepts. Furthermore, it was observed that their usage fostered motivation, autonomy, and a heightened interest in learning. In conclusion, the utilization of virtual simulations in Physiology education, within the framework of the flipped classroom, proved to be effective in promoting active learning among health sciences students. These findings endorse the significance of integrating technological tools and innovative approaches into education, thereby enhancing students' motivation and confidence in their own learning process.

Keywords: Physiology, virtual simulations, teaching challenges, flipped classroom, Labster.

1 Introduction

In our pilot project, we proposed to test the use of virtual simulations as an innovative methodology for active learning and as part of the assessment in the Physiology course. The objective of this study was to investigate the utilization of simulations as supplementary material to facilitate flipped classroom-style lessons and to assess students' perception of their implementation.

2 Theoretical Framework

In recent years, the characteristics of students have undergone a significant change due to the access to social networks and technological tools, which has led them to process information in different ways (Prensky, 2010). Students have had technologies like mobile phones and tablets at their disposal for most of their schooling years. Because of these factors, there is an expectation that the teaching and learning process can become more active and engaging, motivating students to learn better (Hernandez de Menendez, 2020).

Furthermore, the subject of Physiology proves to be a discipline that students perceive as particularly challenging. Some of the reasons include the nature of the discipline, the traditional teaching methodology, and the requirement for higher-order cognitive skills that students are not accustomed to using (Michael, 2007).

Virtual laboratory simulations have been employed in science education to complement students' learning, as well as to increase engagement with their learning (Tsirulnikov, 2023). Existing research demonstrates that immersive simulations can offer an alternative approach that facilitates the achievement of learning outcomes and improves overall student learning (de Jong, 2013).

3 Methods

The strategy was implemented during the second semester of 2022 for students of Nursing, Chemistry and Pharmacy, and Medical Technology careers of the Universidad Andrés Bello, Chile. A total of 359 students were invited to participate in this study.

Eight simulations from the Labster platform were selected, each associated with the topics that would be discussed in the classes (Table 1).

Table 1. Selected Simulations and their distribution according to the content assessed in each summative evaluation.

Supplementary materials for	LABSTER PLATFORM SIMULATION USED
FIRST ASSESSMENT	Action Potential Lab: Experiment with a squid neuron
	Muscle Tissues: An overview
	Gross Function of the Nervous System: Let your brain learn about itself
SECOND ASSESSMENT	Endocrinology: Learn how contraceptives work
	Cardiovascular Function During Exercise: Learn how your body reacts to exercise
THIRD ASSESSMENT	Hematology: Introduction to Blood

	Introduction to Pulmonary Ventilation: Process of respiration and physiology of the respiratory system
	Renal Physiology: Find the mode of action of a diuretic drug

The simulations were available to the students prior to each theoretical class for a given period of time. Since each simulation included an assessment, the average grades obtained in the assessments were weighted and incorporated into the grade for the corresponding activity.

To analyze the students' perceptions of this methodology, a quantitative and descriptive approach was adopted, using data collected through a voluntary perception survey administered to the students.

Student perceptions were evaluated using an online survey designed in Microsoft Form and delivered through the institutional LMS. The survey consisted of 19 questions in a 6-point Likert scale format (Joshi et al., 2015), ranging from 1 ("strongly disagree") to 6 ("strongly agree"). The survey was conducted after the final summative assessment. The survey design included a final open-ended question, inviting students to provide any positive or negative perceptions regarding the use of the activities.

The survey data collected were recorded and analyzed anonymously. Results are presented as a percentage of responses for each question. For interpretation, response percentages from 4 to 6 were collectively considered as a positive outcome, while percentages from 1 to 3 were considered a negative outcome.

4 Results

Out of the total number of students, 85% engaged with the simulations, and 40% responded to the survey.

Figure 1 shows the response percentages for each of the 19 questions of the survey implemented.

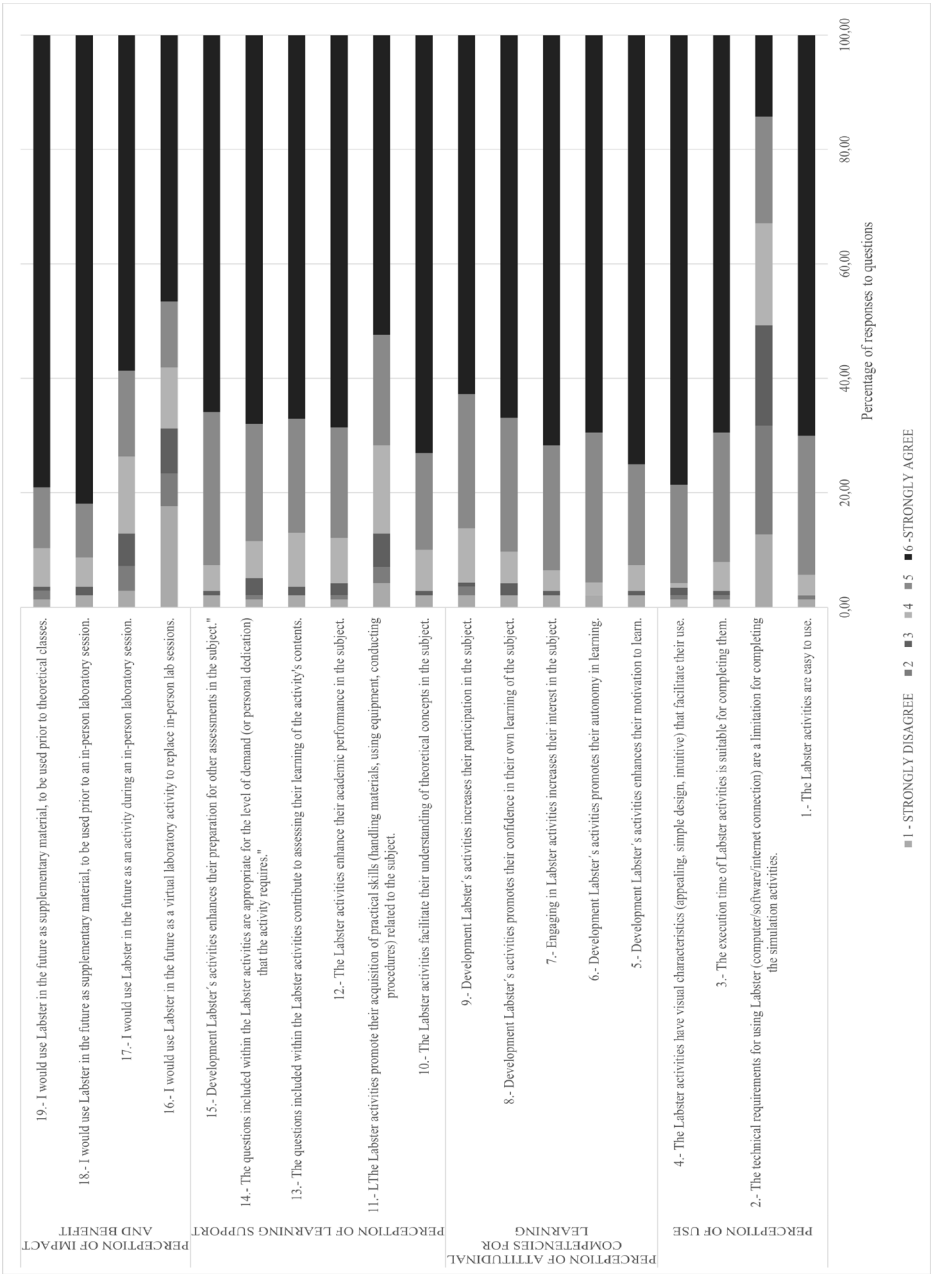

Fig. 1. Response Percentages for each Question in the Implemented Likert-type Survey.

In general terms, the survey was analyzed in relation to the frequency distribution of each response, and a descriptive statistical analysis was conducted for each component of the survey. Across the surveyed aspects, most of the questions garnered a higher number of responses considered 'positive.'

An in-depth analysis of specific questions in the survey reveals particularly interesting findings. Concerning the perception of using simulations, while 95-97% of students indicated that they are easy to use and have visual features that facilitate their utilization, 43% of students reported encountering technical requirements issues.

Regarding the perception of attitudinal competencies for learning, 95% of students mentioned that engaging with simulations enhanced their motivation to learn, fostering autonomy and boosting confidence in their learning.

Noteworthy is that 93% of students expressed willingness to use this type of methodology as supplementary material prior to their theoretical classes.

Regarding the analysis of open-ended responses (Fig. 2), comments convey a positive tone, highlighting the utility of the employed tool. However, many comments emphasize certain technical difficulties encountered with the platform.

"It was very good the idea of labster as it helps us to have more knowledge of the subject and acquire them in a creative, didactic and fun way."
"The activities helped me a lot in learning the course, and it was reflected in my grades. It's very good and easy to use, I think some classmates still had difficulty doing the assignments on their computers, so maybe it's not for all devices, but other than that it's good application."
"My experience with Labster has been good, the information is clear and concise, as supplementary material for theory classes and seminar development it is ideal, but I don't think it can replace a face-to-face (hands-on) lab."
"The labster helped me a lot to understand the contents of the course but the only thing I would improve is the use of the platform in terms of comfort, it sticks and sometimes it is difficult to handle the interface. It would also be good to improve some visual aspects of the 3D models of the platform, although I understand what it is showing us, it is not very pleasing to the eye."
"I loved the implementation of this platform, personally it has helped me to better understand the things we see in class, it is more playful way to learn and study."
"I found it was a better way to understand the subject, plus it complements in a very good way the knowledge delivered in class. It was a very dynamic and entertaining way to learn."
"My internet connection is not the best, so I had problems during the development, and it was stuck but other than that I think it was a good tool".
"The labster really helped me retain my concentration."
"The labster helps a lot to better understand the concepts of the subject".
"The labster is a very good activity that complements the knowledge already acquired before. I consider the labster to be much more interactive and entertaining (especially for people who have kinesthetic learning)."

Fig. 2. Comments provided by students in response to the final open-ended question of the administered survey.

5 Discussion

The high participation of student allows us to assert that the simulations have been an attractive and interesting tool for a first approach to the contents of the subject. Additionally, the perception of different aspects reaffirms that students perceived this innovation as an effective instrument in their learning process. Given that, in previous course offerings, supplementary materials were provided on a non-mandatory way, integrating them into the assessment system appears to encourage their utilization by students.

Nevertheless, we must analyze the technical limitations of the simulations to prevent them from becoming obstacles to student learning.

6 Conclusions

The analysis of the obtained results demonstrates that our experience, utilizing simulations, positively promotes the improvement of attitudinal aspects that are essential to promote in students as part of the teaching-learning process, such as motivation, autonomy, interest, and confidence in their own learning.

7 Limitations and Future Research

Although the simulations were well-received by the students in terms of their use, we must address the comments regarding any technical limitations they might present. It is important to ensure that these limitations do not become an impediment to their effective utilization.

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