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UNIVERSITY PEDAGOGY FOR EMERGENCY REMOTE TEACHING OF CARDIAC PHYSIOLOGY DURING THE COVID-19 PANDEMIC

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RESUMEN

Durante la pandemia de COVID-19, las instituciones de educación superior adoptaron la enseñanza remota de emergencia. En consecuencia, los profesores universitarios tuvieron que buscar herramientas de enseñanza digitales. Sin embargo, el uso de tales sistemas debe basarse en conceptos educativos sólidos, a fin de garantizar el éxito del proceso de enseñanza-aprendizaje. El objetivo de este trabajo es compartir los procedimientos utilizados para la enseñanza remota de la fisiología cardíaca en curso el área de la salud, presentando las justificaciones didácticas y pedagógicas para su uso. Además, se evaluó el aprendizaje y las percepciones de los estudiantes sobre las estrategias de enseñanza y evaluación utilizadas. No hubo diferencia entre las calificaciones de las pruebas obtenidas por los estudiantes en la enseñanza remota de emergencia y las de los estudiantes en la enseñanza presencial, el año anterior. Las opiniones positivas de los estudiantes participantes mostraron que las estrategias condujeron a una mejor organización de su estudio fuera de las clases, brindando una sensación de seguridad sobre lo aprendido. Las estrategias de enseñanza y evaluación permitieron alcanzar los objetivos previstos, con la asimilación de los conceptos y procedimientos teóricos permitiendo a los estudiantes ser protagonistas de su formación, en un proceso educativo donde la responsabilidad fue compartida entre los docentes y los estudiantes.

Palabras clave: metodología, evaluación, juego serio, aula invertida, cuestionario

ABSTRACT

During the COVID-19 pandemic, higher education institutions adopted emergency remote teaching. Consequently, university lecturers had to search for digital teaching tools. However, the use of such systems must be based on sound educational concepts, in order to ensure success of the teaching-learning process. The purpose of this work is to share the procedures used for remote teaching of cardiac physiology in a course in the health area, presenting the didactic and pedagogical justifications for their use. In addition, evaluation was made of learning and of students' perceptions of the teaching and assessment strategies used. There was no difference between test grades obtained by students in emergency remote teaching and those from students in presential teaching, the year before. The positive opinions of the participating students showed that the strategies led to better organization of their study outside of classes, providing a sense of security about what had been learned. The teaching and assessment strategies enabled the intended objectives to be achieved, with assimilation of the theoretical concepts and procedures enabling the students to be protagonists in their education, in an educational process where responsibility was shared among the teachers and the students.

Keywords: methodology, assessment, serious game, flipped classroom, quiz

Footnote: This study is part of LTC PhD thesis in development at Dentistry Graduate Program of Piracicaba Dental School.

Introduction

The COVID-19 pandemic led many countries to introduce a range of measures to limit transmission of the virus, including social distancing, hand hygiene, use of face masks, and suspension of presential teaching [1]. Classes had to shift to the mode denoted emergency remote education, a term used to differentiate it from planned distance learning for online environments [2, 3]. The challenges faced by teachers were the lack of experience in incorporating digital technologies in their teaching practice, the need to rapidly learn how to safely use such them in their classes, and the promotion of student learning, motivation, and engagement [4].

These challenges emerged at a time when there was already an increasing search for teaching methods that could replace the predominant use of taught classes and memorization of concepts. For meaningful learning, it is necessary to relate new information to relevant aspects of the student's daily life and previous knowledge', in addition to stimulating the active participation of the student in the learning process [7]. The use of active methodologies in university education can make a significant contribution, provided they are accompanied by periodic assessments that ensure better understanding of the evaluation criteria and procedures adopted during the proposed activities [8]. For this purpose, and to promote student engagement [9], in the presential classes concerning cardiovascular system physiology, the use of educational games and formative assessments was considered useful by the students, since it increased learning and reduced anxiety and stress before tests [10].

During remote teaching, teachers sought update and train in teaching practices. The university pedagogy is essential in order to avoid the search for teaching techniques being restricted to procedures. For this purpose, the epistemological field of university pedagogy can make a significant contribution, offering ways to organize pedagogical activities that are based on clear foundations of the courses taught, taking account of the teaching concept, objectives, and methodology, with evaluation of the links between the course pedagogical activities and the training initiatives of the teachers [11].

The aim of the present work is to share the strategies used in remote emergency teaching of cardiac physiology, in a course in the health area, justifying the use of the strategies employed in light of the concepts of university pedagogy, with evaluation of the students' learning and opinions.

Characterization of the emergency remote teaching

This study was approved by the institutional Research Ethics (CAAE 10859119.0.00005418). Presentation will be made of part of the sequence of classes, teaching strategies, and learning assessments used in the emergency remote teaching of cardiac physiology in the basic discipline of the 2nd semester of FOP-UNICAMP, taught in 2020, as indicated in the Figure 1. The strategies presented in this paper emerged from conceptual theoretical studies developed during the professional activities of the participating professors and monitors, together with their students.

All the activities and procedures constituted part of the discipline, regardless of the present research. To evaluate if remote teaching influenced the level of learning, the scores obtained in a test, by 44 and 73 students (presential teaching), who gave their free and informed consent respectively in 2020 and 2019. The activities developed for teaching the topics of basic cardiac physiology and the cardiac cycle will be described, indicating in underlined text the didactic and pedagogical reasons for use of the teaching and assessment strategies described. indicating in underlined text the didactic and pedagogical reasons for use of the teaching and assessment strategies described.

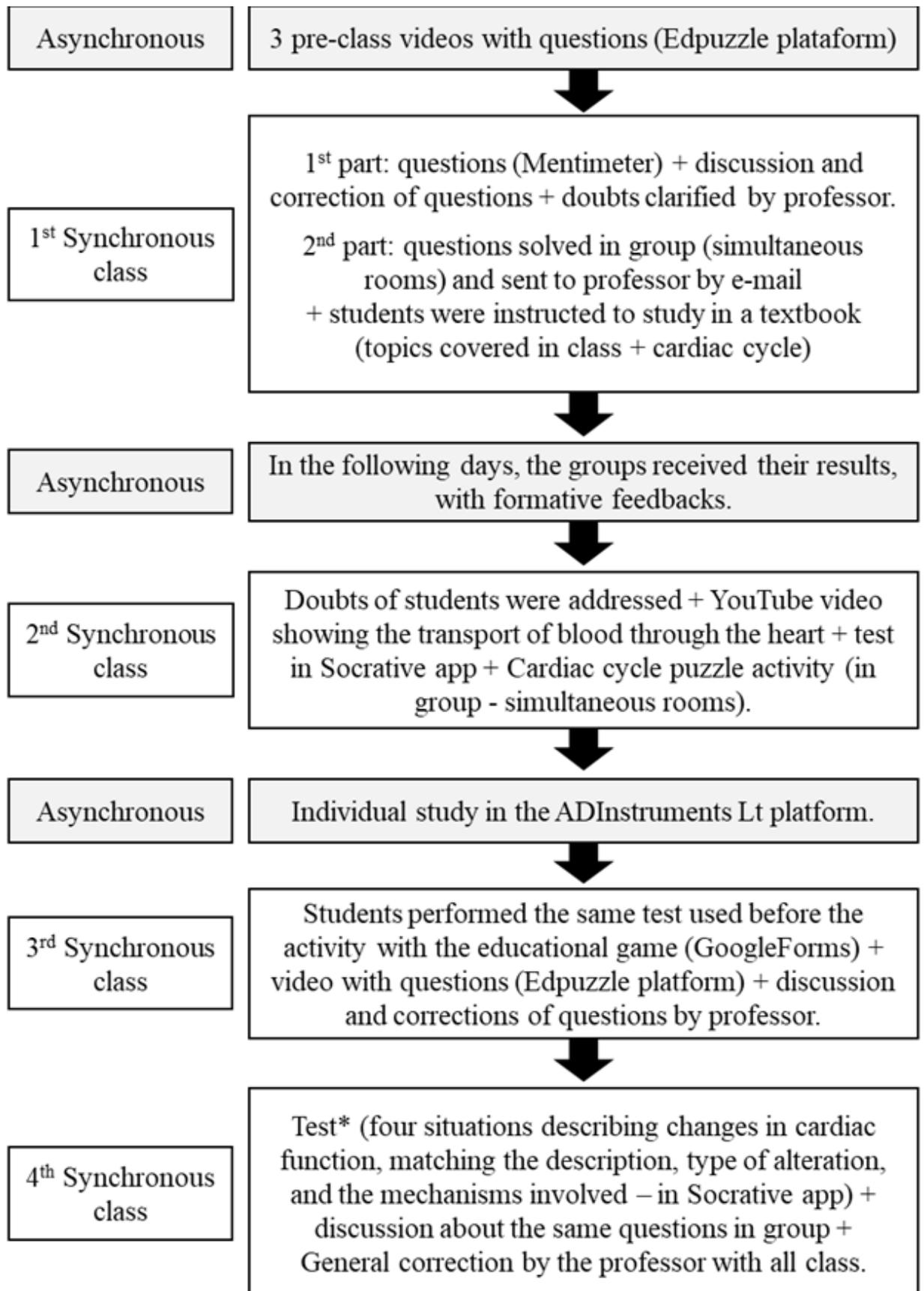


Figure 1. Synchronous and asynchronous teaching strategies and learning assessment used in the emergency remote teaching of cardiac physiology in Dentistry course of Piracicaba Dental School, University of Campinas. *Test applied in face-to-face teaching, before pandemic, that was also used in this study, in order to compare emergency remote and face-to-face learning.

Basic cardiac physiology – adapted flipped classroom, diagnostic and formative assessments

In order to actively stimulate understanding of information received in oral explanations, promote involvement of the students in their own learning, and reduce their difficulty in maintaining attention during lengthy online classes, pre-class videos were recorded using GoogleMeet, where the professor presented the content using PowerPoint slides. The first video (10 min), introducing the topic, presented questions about stress in dentistry and hypertensive crisis situations in the dental consulting room. This contextualization was necessary to awaken the students' interest in the topic to be studied, since neuroscience recognizes that the student learns from perception of the significance and potential application of the new knowledge during professional or personal life [12]. Also presented were the learning objectives, which should be defined considering what the student should be capable of explaining or doing, applying the knowledge acquired. However, this is often so evident to the professor that it may be forgotten, or it may be considered unnecessary to indicate its importance to the students. It is also possible that the professor may not understand the questioning of the student about the reason for learning a topic, which may be interpreted as a lack of interest, when in fact the student is searching for the rationale of what is intended to be taught and learned.

In the first video, the automaticity of heart pacemaker cells was also described. The second video (2 min) concerned the transmission of electrical stimuli by the cardiac conduction fibers. The third video (9 min) described the plateau action potential and cardiac muscle contraction.

Included in the pre-class videos were questions to enable the students to determine whether they had understood the information provided, with the videos not being continued until the questions were answered. Before providing an answer, the student was able to review the video. These videos were made available on the free Edpuzzle platform, for access up to one day before the class. A participation grade was awarded to the students who watched the videos in full and answered the questions, regardless of whether the answers were correct, using the report provided by the digital platform. The use of questions during the videos enabled the students to check their understanding, such that they did not just passively receive information [13]. This process of checking learning, known as formative or procedural assessment, allows both the student and the teacher to adjust their actions [14]. In this way, content that has not been learned can be identified, revisited, and actually learned, according to a teaching strategy that avoids discovering what has not been learned only after the application of a test at the end of the discipline [15]. In this way, the professor analyzed the students' answers, identifying the points of greatest difficulty, which could then be addressed in the synchronous class.

In the first part of this class, the questions in the pre-class videos were answered individually by the students, using the free Mentimeter application. The answers were discussed and corrected, one by one, with any doubts being resolved using the same slides presented in the pre-class videos, or new slides, enabling the professor to clarify the errors and points of greatest difficulty that had been identified in analysis of the report concerning the videos. In the next step, explanation was provided concerning the topic of autonomic control of cardiac activity, which had not been addressed in the pre-class videos. Therefore, the above strategies were an adaptation of the flipped classroom. This methodology considered that the previous contents needed to have been assimilated, so that the students understood how the autonomic nervous system controls the cardiac function. Hence, the pre-class video questions answered and discussed in the first part of the synchronous class represented a diagnostic assessment, before presentation of new content. This assessment consisted of checking whether the student had previously assimilated the knowledge necessary to understand the new information, with the teaching-learning process proceeding according to the notions of proximal development zone in the education process [16]. The use of the questions during the discussion made the class more dynamic and engaged the students.

In the second part of the class, groups of students were allocated to simultaneous rooms, where they performed an exercise in which they were asked to analyze records of action potentials, identify those that corresponded to skeletal, smooth, and cardiac muscles, and explain why summation of contractions occurs in skeletal muscle, but not in cardiac muscle. The students also answered questions about the intrinsic heart rate and autonomic control of cardiac chronotropism. This and next group activities involved 16 groups of 5-6 students, with mixing of students with different performances, as indicated by the grades achieved in a previous discipline. The groups were instructed to provide

consensual answers and solutions in the proposed activities, such that they could mutually assist each other. Explanations were provided concerning the nature of collaborative learning and how scientific studies have demonstrated the positive results obtained by team learning, with students alternating in the roles of providing and receiving assistance [17].

The completed exercise was sent to the professor by e-mail. In the following days, the groups received their results, with formative feedbacks. The formative feedbacks consisted of comments identifying what had been understood by the group, together with indication of additions or corrections that should be made by the group. The interactions among the students, monitors, and professor occurred by e-mail and by written and audio WhatsApp messages. Also, monitors forwarded the most frequent doubts to the professor, allowing interventions to be made with all the students. The group exercises and corrections with formative feedback, constituted formative assessments necessary for accompanying the evolution of the teaching-learning process.

For the next class, the students were instructed to study the topics covered so far, as well as the cardiac cycle, using a textbook. It was explained that this individual study was needed so that all the members could contribute to the group activity to be performed in the next class. In order to encourage this study, it was informed that there would be a test, with grades awarded, at the beginning of the subsequent class.

Cardiac cycle – serious game, interactive study, and formative assessments

At the start of the second synchronous class, doubts of students were addressed. This was followed by presentation of a YouTube video showing the transport of blood through the heart. The students then completed a test, using the free Socrative application, consisting of five multiple choice questions about the content (cardiac cycle) studied using the textbook. Before the start of the test, the students were informed that marks would not be awarded for correct answers, but instead for completion of the test. The aim of the home study and the test applied before the game activity was to assist the first-year students in developing academic self-regulation [18]. In the case of the cardiac cycle topic, no oral explanation of the content was provided, since the objective was to develop the topic using the game, as an active teaching methodology. This approach was based on the presupposition that when the student discovers and actively tries to understand information, it is better understood and remembered [7], compared to an oral explanation about the same topic.

In the next stage, the groups received a link to access the digital version of the cardiac cycle puzzle [19, 20]. One of the students projected the game onto the screen and the positions of the tokens in the tables were determined following discussion. Afterwards, they answered open questions, using the Socrative application. When a group had doubts, the professor or monitors were called to the room, using a WhatsApp message, and assisted the students by means of questions. No direct answers were provided, in order to provide a challenge and encourage reasoning and the integration of information and concepts [10]. The use of educational games is an example of the active methodology known as gamification, where serious games are developed for educational purposes, or game elements are used in teaching [21].

After correction of the answers for each group, the students were instructed to study the topics used for the evaluation performed in the next class. For individual study, an interactive lesson was provided on the ADInstruments Lt platform [4], which included text explanations, videos, and exercises with checking of the answers, so that the students could study and assess their learning, prior to the next class. The interactive lesson enabled the students to complement their textbook study, also providing a type of formative assessment.

Analysis of the learning process

In the next synchronous class, the test used before the activity with the educational game was applied again, so that the students could identify what they had learned from individual study and the group activity. The Google Forms platform was used, with the questions and alternatives of the same question being randomized. The students then individually watched a video with questions, on the Edpuzzle platform, involving the understanding of cardiac fibrillation and cardiac arrest. The tests were then marked, with discussion of the incorrect answers, so that the mistakes could be used to assist learning. In

this activity, there was time for individual analysis, followed by another collective activity that permitted the exchange of experiences and knowledge concerning the topic.

In other synchronous class, by using the Socrative platform, the students were individually asked to analyze four situations describing changes in cardiac function, matching the description, type of alteration, and the mechanisms involved (bradycardia, tachycardia, myocardial infarction, and cardiac fibrillation). In order to compare the students' learning in face-to-face with online teaching, the grade obtained in this individual test that was compared to the grades obtained by other students who had face-to-face teaching, in the year before. The situations and questions were the same. There was no significant difference in the scores obtained in this same individual test, by the students who had emergency remote (8.96 ± 0.30) and presential teaching (9.25 ± 0.21 ; $p > 0.05$) in the year before.

Just after, this individual test, students discussed the same situations and answer the same in their groups. The situations and the information to be matched were sent in a PowerPoint file, one student /virtual room opened the file and the group discussed the correct matches for completing the task. General correction was provided by the professor with all class.

These activities constituted summative assessments that enabled determination of the students' understanding of cardiac physiology, applying knowledge in practical situations presented in videos or in descriptions of clinical situations. These strategies avoided evaluation of the memorization of concepts or processes, instead enabling assessment of the students' understanding of them and their use. The assessments were short and were applied on different days and in different formats, in order to reduce the stress of the tests and avoid situations where a mistake in a test might compromise the performance of the student.

Students' perceptions

For analysis of the students' perceptions of the strategy, they were requested to answer the question: Did the use of different formative assessments alter, in any way, your mode of studying, the organization of your time, your interest in the topics studied, or any other aspect of your study routine? Out of the 44 students participating in the study, 42 answered "yes", and 2 answered "no". The last two students reported that they had maintained the same mode of studying. The main points mentioned by the students who answered "yes" were that they organized their study routine better, felt positive about the ability to identify what they knew or did not understand, and felt responsibility when preparing to help the group in the activities, as shown by the justifications transcribed below:

"Definitely! Performing the tests in the class, working as a team, generated discipline and encouraged responsibility, motivating me to always be informed about the content, so that I could contribute to my group and perform the tests."

"Yes, because as a result I didn't allow material to accumulate and I managed to accompany the classes without delay in study of the material. It changed my way of organizing time, and although I sometimes became tired, I believe that it is a good teaching technique."

In order to evaluate the opinions of the students regarding the influence of the teaching and assessment strategies on their preparation for the assessments this question was answered: Did performing different activities and tests make you feel more prepared to for the assessments? All the participating students replied that they felt better prepared for the evaluations, indicating that the activities enabled them to identify what they knew or did not understand, and that reviewing the topics in different ways helped them to remember the content at the time of the assessments, as shown by the following answers:

"Yes, because with the different activities, I unconsciously studied a little every day, so I felt more secure in the final assessment, because the content had already been assimilated in various ways. For me, it worked very well."

"Yes, all these constant activities helped me at the time of the assessment, because their diversity made the content seem fresh and consolidated."

Concluding remarks

During emergency remote education implemented due to the COVID-19 pandemic, university professors faced new challenges, including low attendance and lack of attention of students during

classes [22]. If the student is not induced to think critically about the material presented, with no perception of its relationship with future or daily professional activity, interest will be lost in the class, in studying, or in the proposed teaching activity [23]. In addition, it is essential that students should be able to perceive what they understand and what remains to be understood [14]. They should be encouraged to review their study routine, feeling secure in presenting their doubts, as well as be able to make mistakes without fear of judgment. In emergency remote education, new difficulties are related to the effort required to maintain attention on the screen of a device, often without interaction with colleagues or the professor, as well as common issues related to internet connections, equipment, suitable places for study, and family circumstances.

The present work describes adaptations in teaching practices, defined based on university pedagogy. The opinions of the students showed their belief that the teaching and assessment strategies used had positive effects on the organization of their study and in preparation for the learning assessments, indicating that engagement and learning had been achieved. The procedures used here assisted the students in assimilating theoretical conceptual knowledge, enabling them to become protagonists in their training by means of a shared process of educational co-responsibility involving professors and students.

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