

EDUCATION RESEARCH

Student assessment of online tools to foster engagement during the COVID-19 quarantine

Karine Ramires Lima, Ben-Hur Souto das Neves, Caroline Cadore Ramires, Marisele dos Santos Soares, Victória Ávila Martini, Luiza Freitas Lopes, and Pâmela Billig Mello-Carpes

Physiology Research Group, Federal University of Pampa, Uruguaiana, Rio Grande do Sul, Brazil

Submitted 6 July 2020; accepted in final form 22 August 2020

Lima KR, das Neves BS, Ramires CC, dos Santos Soares M, Martini VÁ, Lopes LF, Mello-Carpes PB. Student assessment of online tools to foster engagement during the COVID-19 quarantine. *Adv Physiol Educ* 44: 679–683, 2020; doi:10.1152/advan.00131.2020.—As a result of the installation of the COVID-19 (coronavirus disease 19) pandemic, online education has become an important teaching alternative, and new challenges about how to teach were found. Here we report our experience in offering an online course to review Human Physiology. We proposed synchronous and asynchronous activities using different online tools to address topics considered key to understanding the different systems of human physiology. The students considered important the use of this type of methodology, which uses different online tools to help understand the Human Physiology contents. The students highlighted the use of the Lt platform, Zoom, Mentimeter, and YouTube as the preferred online tools to use in physiology learning.

active learning; asynchronous activity; online course; pandemic; synchronous activity

INTRODUCTION

Considering the current moment of the COVID-19 (coronavirus disease 19) pandemic, social distancing was implemented and the academic calendar for undergraduate courses at most public universities in Brazil was suspended (1), leaving many students without face-to-face teaching activities during this period. The challenge now is to find new ways to teach, and using online education to maintain students' contact with the university seems to be the best option.

Offering online courses in this period is important to introduce students to this teaching methodology and, in addition, promote the maintenance of the students' pedagogical routine and contact with the university (6). Indeed, online education can be important to contribute to the teaching-learning process. However, it is a challenge, requiring that the educator create an interactive environment that enables significant learning and, at the same time, dedication and commitment of the student (6).

Therefore, teachers, more than ever, need to use tools that stimulate and motivate the students to maintain a study routine (8). In the same way, the structure of online learning should be created considering some effective pedagogical principles, such as involving students by providing them with the interaction between them and with the educators, as well as promoting the facilitation of active learning and offering educational support (9).

In this sense, suggestions include synchronous meetings (in real time) in a virtual classroom using video conferencing platforms, such as Zoom or Google Meet (8), as well as asynchronous activities that can be organized in a teaching platform, like Moodle or Google Classroom, and the use of web-based applications that permit interactive activities, such as quiz and concept maps (Mentimeter, Socrative, Lucidchart) to improve engagement in online activities (2).

There are several free online tools that can be used for the teaching-learning process; however, little is known about the students' preference for them. Therefore, in our first experience in offering an online course, we choose some of them to offer different activities during an online review course of Human Physiology. Here we describe the course proposal and the students' perceptions about it, identifying the students' preferred online tools to use in the review of physiology content.

MATERIALS AND METHODS

Planning. The web course aimed to reinforce specific topics from different systems studied in the discipline of Human Physiology for students who had previously taken the physiology face-to-face course. We selected key topics, which are considered important to understand broader concepts of physiology. For example, in cellular physiology, we choose membrane transport, which is important to comprehend other concepts, such as intestinal absorption, renal transport, and others. The course was organized by teaching group: one professor PhD in Physiology, five graduate students in the Biological Sciences area (Biochemistry/Physiology), and six Physiotherapy and Nursing undergraduate students. The course proposal included activities performed during the month of May 2020, using active methodologies, and totaled ~30 h. This proposal was approved by the Institutional Education Committee (Institutional Review Board no. 10.069.20).

Participants. The course was free, and the dissemination took place on the social networks of the promoter group. The limit of 50 students was stipulated, and applications were performed by completing an online form. Students should be regularly registered in an undergraduate course at Federal University of Pampa/Brazil, and have prior approval in the Human Physiology or equivalent course. We received 80 applications, and the first 50 students who met these criteria were accepted.

Course design. The course was designed to actively involve the students. For this, students should review the content using literature (books and papers) or other sources and test their knowledge through the asynchronous activities proposed. Since the objective was not to review all of the physiology contents, we selected a theme considered as a key topic for understanding the physiology of each body system. The synchronous activities consisted of online meetings, twice a week (Tuesday and Friday), to promote real-time interaction between course participants, the teacher, and student teaching assistants. Asynchronous

Correspondence: P. B. Mello-Carpes (pamelacarpes@unipampa.edu.br).

Table 1. *Online tools used during the web course*

Zoom (https://zoom.us/)
Used in all synchronous activities to online meetings. We used a paid version, but there is a limited free version.
Mentimeter (https://www.mentimeter.com/)
Used in all synchronous activities to interactive online quizzes. We used a free version, but there is a paid version.
Lt Platform by ADInstruments (https://www.adinstruments.com/lt)
Used in some asynchronous activities to provides contents of Human Physiology. This platform allows the preparation of activities, leading to interactive learning with immediate feedback to the student. It is a paid platform, but it is available for free during the COVID-19 pandemic. We used it during this free trial.
Socrative Student (https://www.socrative.com/)
Used in some asynchronous activities for the preparation of online quizzes with immediate feedback to the student. We used a free version, but there is a paid version.
YouTube (https://www.youtube.com)
Used in some asynchronous activities to simplified explanations of some content using videos.
Facebook (https://www.facebook.com/groups/140687446092701) and Instagram (https://www.instagram.com/gpfisunipampa/)
Used in some asynchronous activities for discussion and dissemination of topics studied in the course among course participants and with other people.
Lucidchart (https://www.lucidchart.com)
Used in an asynchronous activity to allow the elaboration of concept maps/diagrams.

activities were previously prepared by our teaching group, using different online tools (Table 1). These tools were used according to the proposed activities for each review topic (Table 2). All tools allowed teachers to control the progress of each student's activities.

Initially, at an online meeting, the students received the proposal of asynchronous activities for the first system to be reviewed, which should be done for the next meeting. All information about the learning objectives, topic to be studied, and activities that should be completed

Table 2. *Asynchronous activities proposed for each topic of Human Physiology*

Topic Addressed	Proposed Activities
1. Cell physiology: Transport and bioelectric potential of the cell membrane	1) Interactive lessons using Lt Platform (ADInstruments) 2) Drawing of the cell membrane by the student and send to the course e-mail 3) Analysis of an infographic about the interaction of the coronavirus in the cell membrane and discussion in the Facebook group
2. Endocrine physiology: Mechanisms of hormonal action	1) Analysis of a video (from TED Education) about the topic and discussion in the Facebook group 2) Interactive lessons using Lt Platform (ADInstruments) 3) Analysis of scientific journals reading about the role of the coronavirus on the endocrine system, and the influence of factors such as diabetes and stress, followed by discussions on Facebook group
3. Nervous physiology: Synaptic transmission	1) Interactive lessons using Socrative Student 2) Elaboration of a content summary by student and publication on the social networks (Instagram page/Facebook group) 3) Participation in an online seminar about mental health during the pandemic, "How our brain reacts to a pandemic," taught by the course's professor
4. Cardiovascular physiology: Blood pressure regulation mechanisms	1) Review of the content using indicated YouTube videos 2) Interactive lessons using Lt Platform (ADInstruments) 3) Interactive lessons using Socrative Student 4) Questions about the relationship of cardiac patients with the coronavirus to answer and discuss in the synchronous meeting
5. Respiratory physiology: Lung volumes and capacities	1) Interactive lessons using Lt Platform (ADInstruments) 2) Elaboration of an informal video by student and publication on the social networks (Instagram page) 3) Questions about a clinical case addressing the main changes in spirometry caused by coronavirus to answer and send to the course e-mail
6. Digestive physiology: Mechanism of nutrients absorption	1) Elaboration of concept map by student (app suggested: Lucidchart) and send to the course e-mail 2) Draw of the small intestine cells by student, considering the transport of carbohydrates, proteins, lipids, water, and sodium and chloride ions, and send to the course e-mail 3) Analysis of scientific journals, reading about taste and smell losses caused by coronavirus and discussion in the Facebook group
7. Renal physiology: Filtration, reabsorption, secretion, and excretion mechanisms	1) Review of the content using YouTube videos 2) Interactive lessons using Lt Platform (ADInstruments) 3) Resolution of a clinical case on renal function and diabetes mellitus 4) Analysis of scientific journals reading about the relationship between coronavirus and ACE2 inhibitors, angiotensin II, and SARS, followed by discussion in the synchronous meeting

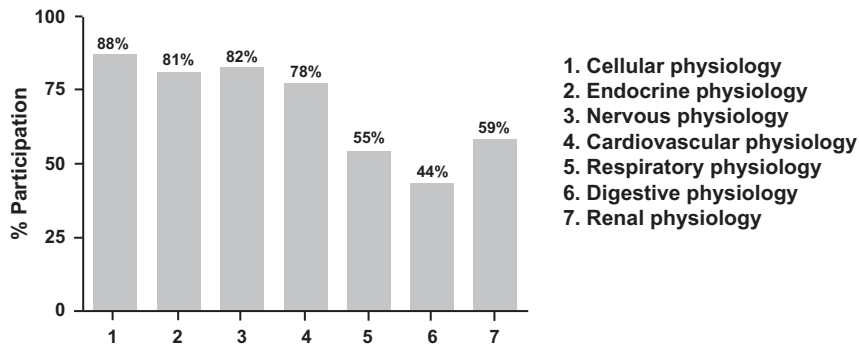


Fig. 1. Percentage of students who completed the activities proposed in each topic of the Human Physiology course ($n = 50$).

were given on a website created for the web course (<https://gpfisunipampa2.wixsite.com/cursowebfisio>). In the following synchronous meeting, the content was revised again using an interactive online quiz. In this way, we were able to maintain student interaction, evaluate their understanding of the content, and start moments of discussions. At the end of the meeting, the activities of the next topic were proposed to be done for the next meeting. This dynamic was repeated in each meeting. Despite the focus of the course being a content review, all topics had activities that related the respective physiological system with COVID-19, a subject of great relevance at the moment.

Course evaluation. We evaluated the percentage of students who completed the activities proposed for each topic of Human Physiology. In addition, we evaluated the percentage of students who completed all course activities. Furthermore, we also verified the students' perceptions about the course through an online questionnaire on the GoogleForms platform. Quantitative results were analyzed using the percentage of responses (%) or mean and standard deviation.

RESULTS

Students ($n = 50$) from different undergraduate courses participated in this course: Physiotherapy (50%; $n = 25$), Nursing (26%; $n = 13$), Pharmacy (8%; $n = 4$), Physical Education (8%; $n = 4$), Medicine (4%; $n = 2$), Nutrition (2%; $n = 1$), and Biological Sciences (2%; $n = 1$). Students were from different years (2nd to 5th year), with most of them from the second (26%; $n = 13$), third (28%; $n = 14$), and fourth (18%; $n = 9$) year. Of these, 84% ($n = 42$) were women and 16% ($n = 8$) were men, with average age of 21 ± 2 yr old.

Initially, we evaluated the student's participation considering the completion of the activities proposed for each topic studied. It is notable that the first topics had a better engagement,

completing ~88% of the proposed activities, with a decline in students' participation from *topic 5* (Fig. 1). Considering the 50 selected, 58% of students ($n = 29$) completed at least 70% of the total course, 16% ($n = 8$) completed at least 60%, and 6% ($n = 10$) completed at least one-half of the proposed activities. Of these students, 40 answered the questionnaire, and their perceptions about the course will be presented and discussed. The characteristics of the students were similar to those previously mentioned. The drop out of the 10 students was not related to factors such as the undergraduate course or academic year, since these students are from different undergraduate courses (Physiotherapy, Nursing, and Physical Education) and in different academic periods, from the second to the fourth year.

Our course proposed synchronous and asynchronous activities using different online tools. Most students (90%; $n = 36$) had not previously participated in another web course with a similar methodology. However, 82.5% ($n = 33$) of them liked this method. The students (85%; $n = 34$) liked the idea of reviewing the content using the different online tools and reinforcing the content on Zoom with explanations by the teaching group; 87.5% ($n = 35$) of them considered Zoom meetings important to understand the content.

About the different online tools used in the course, we asked students to select the ones that they liked more (Fig. 2). The LT Platform by ADInstruments was selected by all students (100%; $n = 40$), followed by Zoom's interactions (77.5%; $n = 31$), Mentimeter web quizzes (60%; $n = 24$), and YouTube videos (57.5%; $n = 23$). The Lucidchart suggested by the construction of concept maps was selected by only 20% of the students ($n = 8$), but it is important to consider that this tool was used only in an isolated activity, and the use of the app was not mandatory.

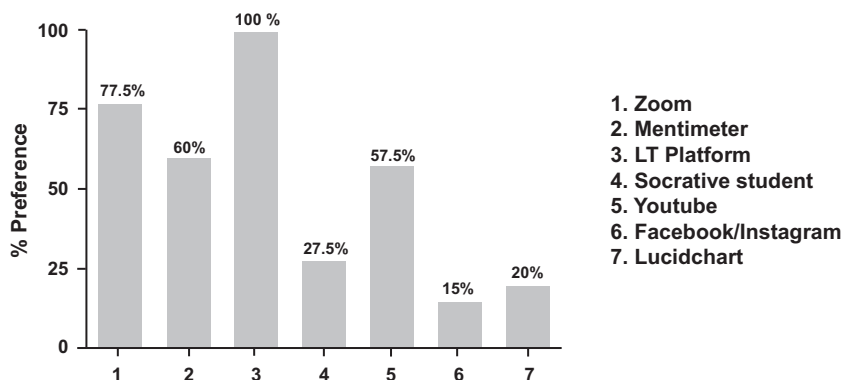


Fig. 2. Students' preference of online tools used during the web course ($n = 40$).

Interactions on social networks (Facebook/Instagram), despite being widely used during the course, were rarely mentioned by students (15%; $n = 6$); still, some students (15%; $n = 6$) mentioned that they would not select its use (in future courses). Despite this, most students would select the use of all tools used (55%; $n = 22$).

We asked students if they had difficulties in developing the activities proposed using these tools. They indicated that they had difficulties that were, in part, more related to content and the methodology than access to platforms. However, when we asked how difficult they consider the activities to be, the students indicated a medium to low level of difficulty. The students also reported that, if this type of method, which uses different online tools, was used to complement the understanding of the Human Physiology contents during face-to-face classes, it would be very helpful (67.5%; $n = 26$). The students reported that they liked the interactivity and dynamics of the course, and that the use of online tools offered autonomy to perform asynchronous activities previously prepared according to the students' necessities. Students also mentioned that they consider the demand for asynchronous activities very high for some studied topics. Moreover, the short time of synchronous meetings (1 h) was also mentioned.

In addition, the results highlighted that our course served as a motivation to students during the quarantine period. Most students (80%; $n = 32$) considered that the dynamic of the activities was important to increase their frequency of studies during the quarantine period. According to the students, as well as reviewing the physiology content, they learned a lot about the relationship of physiological systems and COVID-19.

Finally, we asked for students to attribute a grade for the web course, considering a scale from 0 (bad) to 10 (excellent). The average grade was 9.15 ± 1.23 , which confirms once again that our course was well accepted by students.

DISCUSSION

Educational institutions have been proposing alternatives to overcome the critical pandemic period of COVID-19 (3, 10, 11). In this sense, our results reveal that the availability of an online course related to physiology is a possible and easily accessible alternative when the face-to-face activities in the classroom are not possible. It is important to highlight that our course was designed to review key topics of human physiology. This is, the students already had previous knowledge about the contents, and the objective was to reinforce the concepts and relate physiology to current issues, such as COVID-19. In this sense, it should be considered that this may have had a major impact on the student's view of the virtual course, since they were learning the material for the second time. Anyway, it is important to know that this type of course was considered important, and the students liked the idea of reviewing the content using the different online tools.

Although students' participation throughout the course started with a high degree of engagement, there was a noticeable drop from the fifth topic. This reduction in engagement can be related to the nonexecution of some proposed activities in the different topics or to the withdrawal of some students throughout the course. It is important to note that we did not observe any relationship between this drop-in engagement and the online tools

used in each topic, considering that Lt, for example, which had a good evaluation by students, was used in topics 5 and 7, which had a lower rate of completion of activities.

If, on the one hand, it is difficult to change the way of teaching (12), namely, changing traditional face-to-face activities by online ones, on the other hand, it is also difficult to change the way of learning. Thinking about it, we sought to use multimodal activities to stimulate students. The use of varied strategies both in synchronous and in asynchronous activities has been recommended to overcome barriers imposed in social isolation (4, 10). We propose that students should study and carry out activities before online meetings. In this sense, methodologies similar to this, such as flipped classroom, in which previous activities are proposed as preparation before class, while time in the traditional classroom is reserved for debate on problems encountered, have demonstrated benefits to learning (7, 14). In our experience, students considered that Zoom meetings using the Mentimeter for interactive quizzes helped them to better understand the content previously studied. In asynchronous activities, the students highlighted their preference for the Lt Platform by ADInstruments and the availability of videos on YouTube.

A surprise for us was that, among the tools used, the interactions on social networks were mentioned less as being liked by students. In the activities in which we propose these interactions, the execution, sharing of videos, drawings, or comments about some themes were necessary. We understand that not all students are used to learning in this way (which requires greater engagement, creativity, and critical sense for debates), so this may have been one of the factors for the feedback received. However, in other studies (5, 13), we report that the use of a social network can be a useful tool for increasing student interest in physiology and facilitate their learning.

This was our first experience in offering an online course. Our intent was to use different free teaching tools available on the internet to help students understand Human Physiology content. We observed the students' preference for some of these tools, and our results will be useful for planning future online courses, especially in the current moment that we are experiencing due to the COVID-19 pandemic.

Conclusions. Here we report our experience in offering a web course to review key topics of Human Physiology. To promote dynamic learning, we use different online tools for teaching, including synchronous and asynchronous activities. The course was well evaluated by students and highlighted the use of the Lt platform, Zoom, Mentimeter, and YouTube as the preferred online tools to use in physiology learning.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

K.L., B.S.N., C.C.R., M.d.S., V.A.M., L.F.L., and P.B.M. conceived and designed research; K.L., B.S.N., C.C.R., M.d.S., V.A.M., L.F.L., and P.B.M. performed experiments; K.L., B.S.N., C.C.R., M.d.S., V.A.M., and L.F.L. analyzed data; K.L., B.S.N., C.C.R., M.d.S., V.A.M., L.F.L., and P.B.M. interpreted results of experiments; K.L. prepared figures; K.L., B.S.N., C.C.R., M.d.S., V.A.M., L.F.L., and P.B.M. drafted manuscript; K.L., B.S.N., C.C.R., M.d.S., V.A.M., L.F.L., and P.B.M. edited and revised manuscript; K.L., B.S.N., C.C.R., M.d.S., V.A.M., L.F.L., and P.B.M. approved final version of manuscript.

REFERENCES

1. Aquino EML, Silveira IH, Pescarini JM, Aquino R, Souza-Filho JA, Rocha AS, Ferreira A, Victor A, Teixeira C, Machado DB, Paixão E, Alves FJO, Pilecco F, Menezes G, Gabrielli L, Leite L, Almeida MCC, Ortalan N, Fernandes QHRF, Ortiz RJF, Palmeira RN, Junior EPP, Aragão E, Souza LEPF, Netto MB, Teixeira MG, Barreto ML, Ichihara MY, Lima RTRS. Social distancing measures to control the COVID-19 pandemic: potential impacts and challenges in Brazil. *Cien Saude Colet* 25, Suppl 1: 2423–2446, 2020. doi:10.1590/1413-81232020256.1.10502020.
2. Banna J, Grace Lin M-F, Stewart M, Fialkowski MK. Interaction matters: Strategies to promote engaged learning in an online introductory nutrition course. *J Online Learn Teach* 11: 249–261, 2015.
3. Compton S, Sarraf-Yazdi S, Rustandy F, Radha Krishna LK. Medical students' preference for returning to the clinical setting during the COVID-19 pandemic. *Med Educ* In press. doi:10.1111/medu.14268.
4. Dahlstrom-Hakki I, Alstad Z, Banerjee M. Comparing synchronous and asynchronous online discussions for students with disabilities: The impact of social presence. *Comput Educ* 150: 103842, 2020. doi:10.1016/j.compedu.2020.103842.
5. da Silva de Vargas L, de Lara MVS, Gonçalves R, das Neves BH, Mello-Carpes PB. The use of Facebook as a tool to increase the interest of undergraduate students in physiology in an interdisciplinary way. *Adv Physiol Educ* 38: 273–276, 2014. doi:10.1152/advan.00015.2014.
6. Evans DJR, Bay BH, Wilson TD, Smith CF, Lachman N, Pawlina W. Going virtual to support anatomy education: a STOPGAP in the midst of the COVID-19 pandemic. *Anat Sci Educ* 13: 279–283, 2020. doi:10.1002/ase.1963.
7. Gopalan C, Klann MC. The effect of flipped teaching combined with modified team-based learning on student performance in physiology. *Adv Physiol Educ* 41: 363–367, 2017. doi:10.1152/advan.00179.2016.
8. Kaup S, Jain R, Shivalli S, Pandey S, Kaup S. Sustaining academics during COVID-19 pandemic: The role of online teaching-learning. *Indian J Ophthalmol* 68: 1220–1221, 2020. doi:10.4103/ijo.IJO_1241_20.
9. Martin F, Bolliger DU. Engagement matters: student perceptions on the importance of engagement strategies in the online learning environment. *Online Learn J* 22: 205–222, 2018. doi:10.24059/olj.v22i1.1092.
10. Petzold AM. Letter to the Editor: Resources and recommendations for a quick transition to online instruction in physiology. *Adv Physiol Educ* 44: 217–219, 2020. doi:10.1152/advan.00049.2020.
11. Rose S. Medical student education in the time of COVID-19. *JAMA* 323: 2131–2132, 2020. doi:10.1001/jama.2020.5227.
12. Silverthorn DU, Thorn PM, Svinicki MD. It's difficult to change the way we teach: lessons from the Integrative Themes in Physiology curriculum module project. *Adv Physiol Educ* 30: 204–214, 2006. doi:10.1152/advan.00064.2006.
13. Sosa PM, Carrazoni GS, Gonçalves R, Mello-Carpes PB. Use of Facebook groups as a strategy for continuum involvement of students with physiology after finishing a physiology course. *Adv Physiol Educ* 44: 358–361, 2020. doi:10.1152/advan.00024.2020.
14. Tune JD, Sturek M, Basile DP. Flipped classroom model improves graduate student performance in cardiovascular, respiratory, and renal physiology. *Adv Physiol Educ* 37: 316–320, 2013. doi:10.1152/advan.00091.2013.

