Television format or research project? Team work and the opportunity of choosing classroom-led activities reinforce active learning

Begoña M. Escribano, Estrella I. Agüera, and Pura Tovar
Department of Cell Biology, Physiology and Immunology, University of Cordoba, Cordoba, Spain
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RECENTLY, we have been having some doubts as to whether the new information and communication technologies presented through the internet may be altering the way in which the student’s brain processes the information received. Access to the internet permits students to obtain abundant information quite rapidly, but the result is superficial learning that lacks reflection and is often plagued with mistakes.

As instructors, university lecturers face the challenge of designing new activities that engage students in active learning and help to develop skills to guide their self-learning in the subject of physiology. We agree with many authors that meaningful learning requires multiple opportunities for the student to be actively engaged in the reasoning and application of concepts (2, 5, 6). Thus, we believe that the best learning performance could be reached by the implementation of activities based on the guided use of the new communication and information technologies as, currently, all students can be considered digitally competent. Therefore, in the belief that voluntary participation in an active learning exercise leads to a better understanding of physiology (1), two different activities were designed. Students had the opportunity of choosing either one of them. We also decided that these activities should be carried out in work teams since knowing how to work in a team has become one of the skills most demanded by the working world.

Context of the Activities

At present in vogue are entrepreneurial training courses on “emotional intelligence” in which the owners of commercial firms or leaders of work groups learn to discover and extract from their workers those intrinsic qualities that permit them to be placed in an appropriate position within a work team. At the same time, the workers can perceive in themselves those capabilities of which they were not aware and that make them unique and indispensable within a team.

Activities were designed to complete classroom-led activities in the subject “Physiological adaptations to the environment” and its multidisciplinary coupling (4, 8). This discipline is a compulsory subject in the third year of biology at the University of Córdoba (UCO) in Córdoba, Spain, and is taught during the first quarter of the academic year. The rules for completing the activity were given on the first day of class and recorded in the teaching guide of the subject (3), which, in turn, is available online in the e-learning platform Moodle of the UCO. Activities were assayed with a class of ~65 students (large group). All students agreed to allow the results of the activities to be used for publication in Advances in Physiology Education.

Design of the Activities

Activity 1: developing a research project. Each team was formed freely by the students themselves. Group size was limited to five students. Once the groups choosing this activity were constituted, the following schedule was performed:

First, the lecturer delineated the basic contents of the activity. This was specified as the introduction or antecedents, objectives, materials and methods, dissemination of the possible conclusions of the project, and references.

Next, the work team freely selected the topic to be addressed and communicated it to the lecturer. The topic selection involved the use of databases, online publications, and other resources in the network through the digital library of the UCO.

The references consulted were the basis for designing a research project. It is a matter of going “one step further” than what has been described in the reference articles, without giving any type of result since what was being sought was the design of a possible future work project. Another possibility would be to reproduce the material and method in other species in the same habitat or in a similar species with a different habitat. In this case, the project’s objective would be to highlight the relationship already described in the theory classes between the habitat and physiological adaptations. Topic examples selected by the students were: ultrasonic role in reproduction, nutrition, election of partner, and tadpole care in the frog Anolops tormotus; adaptation in the orientation to dry climate of the ant Rossomyrmex minuchiae; radiation effects in tardi-grades; ultraviolet vision in the Arctic hare; is the lipid membrane different between bat species? and is it also different between healthy bats and bats with white nose syndrome?; vision adaptation in three penguin species of different water density habitats; osmotic adaptations of red blood cells to the dehydration in Camelus dromedaries and the oryx gazelle; and cold adaptations in the real penguin and influence of temperature on their internal morphology.

The written work was presented to the lecturer for his/her evaluation.

Oral defense of the work by every team took place in front of the teacher and the rest of their classmates during a 20-min maximum period. For this, a PowerPoint presentation was used. Projects were defended by one or more students of the team.

After their presentation, the team had to answer critiques formulated by their classmates and the lecturer. Finally, every team had an opportunity to comment on the difficulties found in carrying out the work. They could also give their opinions on the efficacy of the activity for the learning process.
Activity 2: developing a television program named “Technopolis.” Activity 2 was also based on a work team formed by a maximum of five students. Groups that selected this activity performed the following schedule:

First, the teacher recommended that students use as a guide the original format of the television (TV) program “Technopolis” (http://www.canalsuralacarta.es/televisi/programa/tecnopolis/41). This TV program addresses, by means of documentaries, a series of scientific topics that target care of the environment and animals as well as people’s health through exercise and suitable eating habits. The program also brings science nearer to the family with the setting up of simple experiments.

The contents of the project were given as two reports (examples: migratory birds or deep sea fish), one interview (example: cetaceans as an interview to a marine biologist or tardigrades to a zoologist, an ecologist, and an astronomist), and demonstrations of simple experiments [how whales filter the plankton that they consume with a simple funnel and filter paper, or “Allen’s” rule with the making of two ears corresponding to a desert fox and an Arctic fox from a flimsy piece of paper with a pattern of lines simulating the ear’s capitalization (desert fox) or the simulation of an ear made with a ball of cotton wool (Arctic fox)], all interpreted by the students. The activity was to be presented in video format with a 15-min duration.

Next, the work team freely selected the topics of the contents and communicated them to the lecturer. The topic selection involved the use of the internet and audiovisual technology. When completed, the work in video format was presented to the lecturer and the rest of the class.

After the video projection, the team had to answer critiques formulated by their classmates and the lecturer. Finally, every team had an opportunity to comment on the difficulties in carrying out the work and on the efficacy of the activity in learning.

Completion of Activities

Both activities were set up in tutorials requested by the students. In the case of activity 2 (TV program), the object of the tutorials was to comment on the topics to be addressed in each project and to confirm the correct organizational development of the show topic. At the moment of final editing, the TV program groups put the video together without any help, demonstrating that they really were digitally competent.

The tutorials requested by students doing activity 1 (the research project) were more numerous, demanding, and required more assistance from the lecturer in the selection of the topic to be dealt with, the search for references, and in the designing of hypotheses, objectives, and writing them up.

None of these groups required any assistance for the PowerPoint presentation of the research project.

Evaluation of the Activities

With the assessment of the activities within the group, the lecturer evaluated the acquisition of the skills, as shown in Table 1 and described in the teaching guide of the subject (3). The final assessment for each team was the arithmetical average of the total of the scores for each of the items and reflected the second of the objectives proposed for teaching students to work in a team.

Gains from the Activity Assignment

It has been suggested that the low retention of experienced students in physiology probably relates to the passive didactic lecture style of teaching in elementary physiology courses (7). By carrying out activities guided by the lecturer, students involve themselves in active learning. The bibliographic investigation inherent to the activities proposed permitted students to detect errors in concepts badly acquired in class and thus to reinforce those concepts. This type of active learning was observed in the tutorials carried out by the students with the lecturer.

Also, working in a team (signifying a final common score for the whole group) permitted students to allocate the tasks in accordance with individual abilities within the group, promote their self-esteem, work in an atmosphere of mutual trust, organize the work for a common end, edit its result in keeping with the lines marked by the group, defend the topics selected, and, finally, discover the abilities and skills in themselves that make them indispensable for the good functioning of the group. During the stage of the presentation to the class of the activities, in which every team had an opportunity to comment on the difficulties in carrying out the work and on the efficacy of the activity in learning, the different groups highlighted that initiating the activities had been difficult but that once they were established, they had found out how to solve those difficulties and, above all, had learned to work in a team. In short, they thought that the activities of this subject should be suggested again the next year.

“The excellent work team that we set up has made it possible for only five people to work as well as twenty” or “Thanks to our teachers for encouraging us to create this work” are two of

Table 1. Scoring system for the evaluation of the skills acquired

<table>
<thead>
<tr>
<th>Evaluation Item</th>
<th>Skill Acquired</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Originality and current importance of the selected topics</td>
<td>Digital competence and ability to filter information</td>
<td></td>
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<tr>
<td>Structure and arrangement of contents: introduction, objectives,</td>
<td>Ability to order information</td>
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<tr>
<td>materials and methods, and dissemination of possible conclusions</td>
<td>Digital competence and ability to filter information</td>
<td></td>
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<td></td>
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<tr>
<td>References</td>
<td>Use of TICs</td>
<td></td>
<td></td>
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<tr>
<td>Creativity of the visual presentation (only activity 1)</td>
<td>Use of TICs</td>
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<tr>
<td>Creativity of the video edition (only activity 2)</td>
<td>Communication ability</td>
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<td>Clarity of the oral presentation</td>
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<tr>
<td>Work team</td>
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Scores ranged from 1 (minimum score) to 5 (maximum score). The arithmetical average of the total of the scores for each item reflected the final marking of the work in a team. TICs, communication and information technologies.
the students’ comments. We only hope that the acquisition of these learning habits will be a long-term exercise.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS

Author contributions: B.M.E. and P.T. conception and design of research; B.M.E., E.I.A., and P.T. performed experiments; B.M.E. and P.T. analyzed data; B.M.E. and P.T. interpreted results of experiments; B.M.E. and P.T. drafted manuscript; B.M.E., E.I.A., and P.T. edited and revised manuscript; B.M.E., E.I.A., and P.T. approved final version of manuscript.

REFERENCES