

The inclusion of undergraduate students in physiology outreach activities improves their physiology learning and understanding skills

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THE TRADITIONAL TEACHING METHOD USING EXPOSITIVE CLASS has limitations, as the only way of knowledge transmission relies on the relationship between teacher/professor and student, and because of this, several ways of teaching and elucidation of the contents have been discussed (1, 2). The motivation to research new teaching methods is also stimulated by the poor results in traditional methods for promoting active learning and students' creativity (5). Most of new teaching methods consider the students' active learning. In the active learning, the teacher/professor plays the role of guide to the students, and they will become part of the knowledge construction process and not just a receptor (8).

Universities are places where the knowledge is produced; additionally, a university has the potential to transform social realities. The university outreach activities are a form of articulation between the knowledge production and transmission by means of an educational, cultural, and scientific process (6). In this sense, the involvement of undergraduate students in these types of activities could contribute to their formation.

Here, we set out to determine the contributions of involvement of undergraduate students in outreach activities on their perception about their physiology learning and understanding skills.

DESIGN OF THE ACTIVITIES

We proposed the involvement in an outreach activity to the students in the Human Physiology course from the Nursing and Physiotherapy schools of the Federal University of Pampa (Uruguaiana, Rio Grande do Sul, Brazil). The activity should have been organized by the students during the semester and performed in scheduled dates. Other activities of the regular curriculum (exams, reports, laboratory activities) were performed as usual, and the outreach activity was included in the program of students' practical activities. The Institutional Outreach Committee at University of Pampa approved this proposal (Institutional Review Board no. 10.035.14).

Eighty-one undergraduate students, 17 males and 64 females, aged 23 ± 6 yr, divided into small groups (6–8 students, assigned according to their preferences) participated in the activity. Each group proposed one different activity to promote physiology dissemination in different places and for the different public. The preparation of the activity was divided into organizational steps (Fig. 1). Each step had a deadline, and the conclusion should have been informed by the Moodle (Modular Object-Oriented Dynamic Learning) teaching-learning

platform. We used Moodle because this platform is free and recommended in our university, but e-mail lists or any other online instrument could replace it. The professor and tutors of the course followed each step, making comments and suggesting changes and corrections, if necessary.

After providing their agreement, the students had ~2 mo to prepare the actions, considering the six stages:

Step 1: Organization of Groups and Selection of Physiology Themes to Work in the Outreach Activities

The choice of physiology topics should have been based on the curricular program of the course. The deadline for online submission was 10 days after the presentation of the activity proposal in the class.

Step 2: Submission of a General Proposal of Activities

This should have included an idea about the methods to develop the theme considering the place and the target audience: age, characteristics, and others. The feasibility was evaluated by the professor, and activities were performed only after presentation of an agreement letter from the venue chosen for development of the activities (a reference document was provided by the professor). The deadline for online submission was due 20 days after the presentation of the activity proposal in the class.

Step 3: Submission of a Detailed Proposal of Activities

This detailed proposal should have described 4 h of activities, including the objectives, materials that would be used (flyers, audiovisual material, practical activities, and others), and the expected results. The deadline for online submission was 30 days after the presentation of the activity proposal in the class.

Step 4: Execution of the Activities

The execution of the activities was performed in the specific places and considering the different public previously informed. During the activities, conducted in a single day lasting ~4 h, the students should have registered their impression about the impact of the activities. The deadline for online submission was 40 days after the presentation of the activity proposal in the class.

Step 5: Report of the Activities

The reports included students' perceptions about the impact of the activities with the target public. In the present paper we did not report a direct evaluation by the public, considering that students proposed many different actions. We previously report the impact of similar actions considering high school

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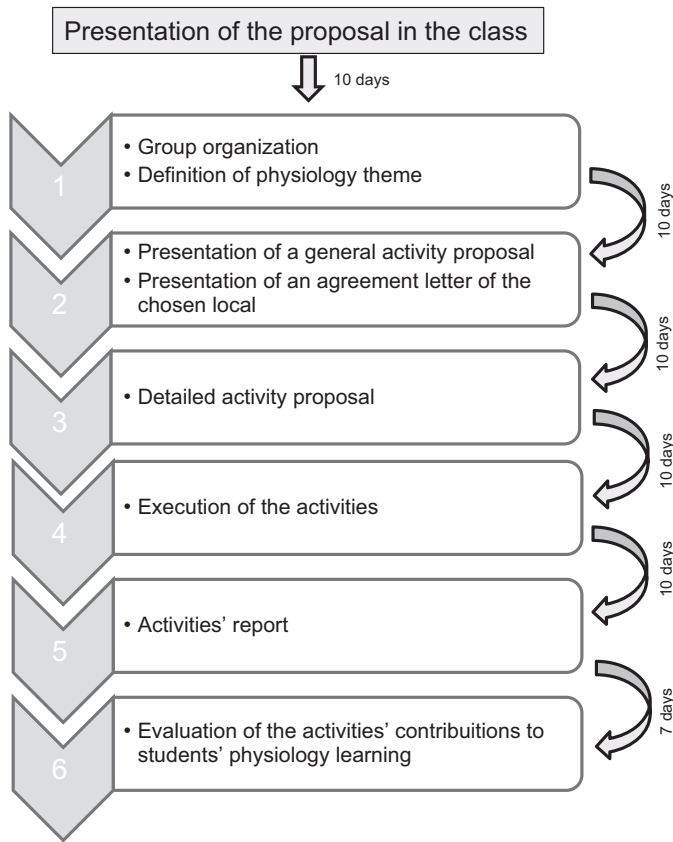


Fig. 1. Scheme of the activity organizational steps.

students (3) and showed that activities performed by undergraduate physiology students promote the interest in physiology and science among adolescents. Therefore, we believe that this type of activities should bring benefits to audience. The deadline for online submission was due 50 days after the presentation of the activity proposal in the class.

Step 6: Evaluation of Activities by Physiology Students Through an Anonymous Questionnaire

The questionnaire included questions to verify the students' perceptions about the contribution of the activities to their

physiology learning (Table 1). The evaluation was completed during a physiology class 1 wk after the conclusion of *step 5*. The data from this questionnaire were converted in percentage to show the frequency of each response in a clearer way.

Activities Proposed by the Groups of Students

The groups of students proposed activities to be developed with different publics (including children, adults, and seniors) and places (including schools and public parks). Each group proposed one of the activities listed below.

What is physiology? This activity was development with secondary school students (11 ± 2 yr old). The concept of physiology, with emphasis on human physiology, and its presence in daily life was explained to school students. A conversation using an explanatory poster was made, and a booklet with contents about the theme was distributed to students.

Cardiorespiratory alterations induced by physical activity. This activity was developed with secondary school students (11 ± 2 yr old). The basic conceptual aspects of circulatory and respiratory systems and their physiological adaptations were addressed during and after a session of aerobic exercise. Physiological measurements were performed in a student volunteer at rest, during exercise, and after exercise. From the results, a discussion about the observed alterations and why they occur and about the benefits of physical activity was conducted. At the end, each student received an explanatory folder to take home.

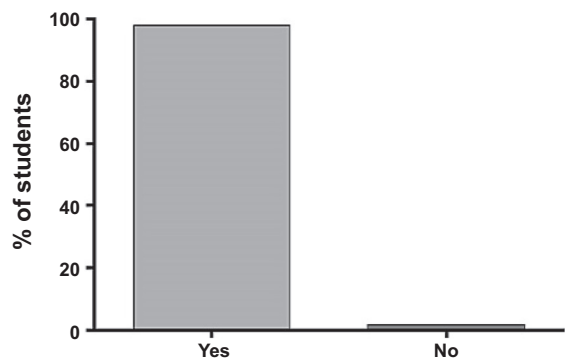
Understanding memory and learning. This activity was developed with secondary school students (12–15 yr old). A short explanation on this issue was made, using anatomical models of parts of the brain, followed by a conversation and distribution of educational pamphlets on learning and memory and the benefits of physical activity for these functions.

Sensory garden. This activity was developed with children from secondary school (8–10 yr old), with the main objective to explore the human body theme and demonstrate the importance of senses. A lecture on the human body was made using simple language, addressing aspects of the anatomy and physiology of sensory perception adapted to the age of children. Practical activities involved sensory stimulation, arousing a set of sensations through experience with different textures to stimulate the touch, hear quotidian sounds to stimulate the

Table 1. *Questionnaire used to assess students' opinions about the proposed activity*

Question	Answers
1. Did you think that the development of the outreach activities contributed to your learning?	() Yes () No
2. Did you think that the activities were important to your understanding of physiology?	() Yes () No
3. Did you think that the activities increased the public understanding about physiology?	() Yes () No () Partly
4. Did you think that the public perceived the presence of physiology in their daily lives?	() Yes () No () Partly
5. What do you think was the main difficulty in the development of the activities?	() The choice of a theme () The choice of a relevant public () Develop teamwork and prepare the activities () The lack of the necessary prior knowledge on the chosen topic () I did not find difficulties If it was the case, how were the difficulties overcome? _____

A Did you think that the development of the outreach activities contributed to your learning?



B Did you think that the activities were important to your physiology understanding?

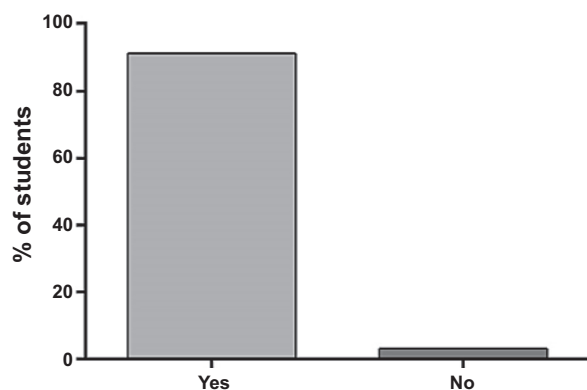


Fig. 2. Students' responses concerning their perception of activity contribution to themselves ($n = 81$).

hearing, and smell different aromas (using herbs and fruits) to stimulate the smell and the taste; the relationship of these senses was discussed.

Lecture on the digestive system. This activity was developed with secondary school students (11 ± 2 yr old). The actions addressed aspects related to the physiology of the digestive system, such as proper nutrition, care to prevent hypercholesterolemia and hypertriglyceridemia, and others. In the end, an educational flyer was distributed to students to stimulate them to share the information with their family.

Transport through the cell membrane. This activity was developed with secondary school students (12–15 yr old). Through a practical activity developed in the biology laboratory of a public school, the process of osmosis was demonstrated (using salt, sugar, and potatoes). Through discussions, the mechanisms of transport of molecules and ions through the cell membrane were studied.

Physiology of urinary system. This activity was developed in a public park and demonstrated to the general population with predominant participation of adults. To inform about general functions of the urinary system, related pathologies such as urinary incontinence, dehydration, and others, practical dem-

onstrations using models of different urine concentrations, and explanations using informative leaflets were developed.

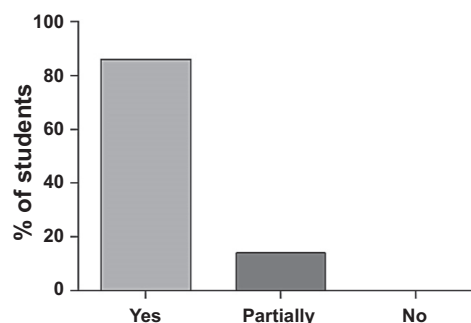
Walking for a healthier heart. This activity was developed in a public park and demonstrated to the general population with predominant participation of adults. In the park, measurements of blood pressure and heart rate were made, followed by guidance regarding the benefits of physical activity for the cardiovascular system and muscle strength. Information about hydration, appropriate clothing, and shoes for physical activity practice and others were also given.

RESULTS

Most of the students (98%; $n = 79$) considered that the proposal contributed to the development of their learning of physiology (Fig. 2A), and 91% ($n = 74$) affirmed that the activities were important to their understanding of physiology (Fig. 2B). Additionally, students' responses allowed us to verify that activities like those proposed motivate students and stimulate learning in a pleasant way, giving social importance and applicability to the physiology contents, demonstrating that a pedagogical choice made by the professor can influence students' learning and promote positive results in their formation (4).

Furthermore, 86% of students ($n = 70$) considered that this type of educational approach not only contributes to their own

A Did you think that the activities increased the public's understanding about physiology?



B Did you think that the public perceived the presence of physiology in their daily life?

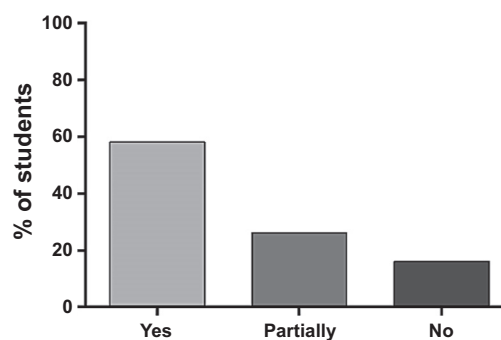


Fig. 3. Students' responses concerning their perception of activity contribution to the public involved ($n = 81$).

learning but also increases the understanding of physiology among people in the community (Fig. 3A). We observed that 58% of students ($n = 47$) affirmed that with the proposed activities the public could recognize the presence of physiology in their daily life (Fig. 3B). Considering perception of 26% of the students ($n = 21$), the public could only perceive the presence of physiology in their life partially, and 16% of the students ($n = 13$) affirmed that the public could not perceive the presence of physiology in their life (Fig. 3B). Therefore, actions to disseminate physiology should be encouraged.

The results show that the involvement of undergraduate physiology students in outreach activities is an important way to improve their learning and understanding of physiology and contributes to physiology dissemination in the community. Apart from the cognitive gains, in this type of activity students can learn to work as a team, experiencing collaborative learning, since they collectively organize the information to be presented to a broader audience (7). It is important to highlight that this type of activity requires continuous monitoring of a professor and tutors to avoid the dissemination of misleading concepts to the general public. In the present case, this monitoring was made continually using Moodle and occasional presence meetings.

Regarding the difficulties in carrying out the activities, 37% of students ($n = 30$) reported no difficulties in the organization and execution, 19% ($n = 15$) considered the difficulty that they had in developing group work and preparing the activities a limitation, and 17% ($n = 14$) highlighted their lack of previous knowledge of anatomy, histology, physiology, and other contents that they considered important to plan the activities. They also related that this difficulty was overcome with the help of the professor and tutors. Finally, 11% of students ($n = 8$) related the choice of a relevant public as a difficulty and 16% of students ($n = 13$) related the choice of the theme to work.

CONCLUSIONS

Our results permit us to affirm that activities of outreach during undergraduate students' formation promote a better understanding of physiology contents and improve the students' learning. We expect that this proposal inspires and motivates students to look for knowledge application and significance in their daily life and helps other professors to promote similar activities. Additionally, we believe that this activity contributes to the development of necessary skills and competencies for students.

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DISCLOSURES

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

AUTHOR CONTRIBUTIONS

C.D.C.A., B.-H.S.d.N., and P.B.M.-C. conception and design of research; C.D.C.A., B.-H.S.d.N., and P.B.M.-C. performed experiments; C.D.C.A., B.-H.S.d.N., and P.B.M.-C. analyzed data; C.D.C.A., B.-H.S.d.N., and P.B.M.-C. interpreted results of experiments; C.D.C.A. and P.B.M.-C. prepared figures; C.D.C.A., B.-H.S.d.N., and P.B.M.-C. drafted manuscript; C.D.C.A., B.-H.S.d.N., and P.B.M.-C. edited and revised manuscript; C.D.C.A., B.-H.S.d.N., and P.B.M.-C. approved final version of manuscript.

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