STUDENT'S OPINION ON A PROBLEM-BASED LEARNING METHOD OF TEACHING COMPARATIVE ANIMAL PHYSIOLOGY

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ABSTRACT

The purpose of this study is to verify the opinion of students in relation to a learning methodology, where emphasis is not placed on the accumulation or memorization of specific knowledge, but in the use of deduction to solve problems related to a particular subject. This study was carried out with undergraduate students of the course "Comparative Animal Physiology" (classes of 10 to 15 students each), from the Federal University of Santa Maria, Southern Brazil. During each class the students discussed the answers to a given question, provided by the teacher, with the aid of available references; after which a written report of their conclusions had to be done. The evaluation of the students was based on these reports. At the end of the semester, the students (44 on the whole) answered (anonymously) a questionnaire to evaluate this method, with relation to lectured-centered classes. According to the students, if compared with lectures, this method offered a restrict vision of the subject, but it is more interesting and improves their performance. There is no difference between these methods in relation

to elucidation of doubts. The students did not think that too much time was lost translating English texts. Most students prefer this system instead of lectures, and the evaluation methodology was unanimously approved. Based on these results, it can be concluded that this method can be used to teach Comparative Animal Physiology with good results.

RESUMO

O objetivo deste trabalho foi verificar qual a opinião dos alunos em relação a uma metodologia de ensino onde o que importa não é o acúmulo ou a memorização de determinados conhecimentos, e sim o raciocínio frente a problemas relacionados com a matéria e sua resolução. Este trabalho utilizou alunos matriculados na disciplina "Fisiologia Animal Comparada" (turmas com 10 a 15 alunos), da Universidade Federal de Santa Maria. Em cada aula os alunos discutiam a possível resposta a uma pergunta fornecida pelo professor, baseados na bibliografia fornecida, e entregavam posteriormente um relatório escrito com as conclusões obtidas. A avaliação dos alunos foi feita tendo como base os relatórios apresentados. No final dos semestres os alunos (44 no total) responderam por escrito (anonimamente) a um questionário de avaliação do método, comparando-o com um sistema de aula expositiva. Segundo os alunos, comparado ao sistema de aula expositiva, o método utilizado apresenta uma visão menos abrangente da matéria, mas desperta mais interesse pelo tema que está sendo visto e melhora o aproveitamento do aluno. Não há diferença entre os dois métodos com relação ao esclarecimento de dúvidas. Os alunos não acharam que perderam muito tempo na tradução de textos em inglês. A grande maioria prefere este sistema ao de aulas expositivas, e a metodologia de avaliação teve aprovação unânime. Os dados obtidos permitem concluir que este método pode ser utilizado no ensino de Fisiologia Animal Comparada com bons resultados.

INTRODUCTION

Recently graduated students from Brazilian universities have indicated that their undergraduate course does not prepare them for professional activities, teaching, or research (Perdigão, apud Xavier et al., 1986). Apparently, part of this failure is due to the traditional method of teaching, where classes are generally lecture-based (Ávila Pires, 1984) or centered around the teacher (Rangachari, 1991). This methodology is normally referred to as liberal traditional (Libâneo, 1984). This system generates a loss of self-affirmation and a passive behavior in undergraduate students, emphasizing the recalling of information in standardized examinations, without discussion of the subjects (Beraldo e Alvarenga, 1983; Libâneo, 1984; Moreira et al., 1991).

The main objective of most courses taught at Brazilian universities is the amount of information to be transmitted to the student, while the quality receives second priority. However, what students recall is not "what" was learned, but "how" it was learned. After graduation, he/she will use the same method, which unfortunately is based on a passive behavior of the student, and will have difficulty to cope with new problems (Moreira et al., 1991).

The aim of this study is to verify the opinion of the students in relation to a learning methodology where the main concern is not the memorization of specific knowledge, but the understanding and solving of problems related to the subject.

MATERIAL AND METHODS

This study used 48 students registered in the course "Comparative Animal Physiology" (classes with 10 to 15 students), from the Federal University of Santa Maria, during 1992 to 1994. These students were at the end of the undergraduate course in Biological Sciences. The course

has 60 h of theoretical class in one semester, distributed in 2 classes of 2 h each week.

In the first day of class of the semester students received an explanation of the methodology that would be used in this subject, being informed that the classes would not be lecture-centered, but would consist of generic questions (one each class) related to the topics that would be studied (examples in the table 1). Later, the students received all available references pertaining to the course and were divided into groups of 2 or 3 students to choose the subjects to be studied. After one hour of discussion the groups and the teacher decided what should be analyzed during the semester, considering time, class interest and the relationship with other courses (if the subject has been partially seen in other courses of the course). During this stage the teacher acted as mediator and the students received orientation pertaining to the importance of all topics before the final conclusion.

The questions were always delivered at the end of each class, and the students used approximately 90 min of the following class to study and discuss the available references (in Portuguese, Spanish or English, depending on the subject), in an attempt to obtain solutions to the questions. During the remaining time (30 min), the topics were discussed by the groups, with the teacher acting as a mediator when necessary. During the following class each group submitted to the teacher a written report, that should contain the main points previously discussed. The students' evaluation was based on these reports, without traditional written tests.

At the end of the semester the students (44 in total) answered anonymously to a written questionnaire to evaluate this method with relation to lectured-centered classes (table 2). The answers were analyzed by the chi-square method. The average class scores (expressed as mean $\pm$ SE) of the students that were submitted to this methodology were compared with those of students that received lectured-centered classes of the same course (and made by the same teacher) using the student's t-test. Both statistical tests

were made with the aid of the Microstat program (Ecosoft, Inc.). Minimum significance level was 95% ($\alpha < 0.05$).

Table 1 - Examples of questions presented to students and aspects to be discussed.

Subject	Question	Aspect to be discussed
nervous system	What is the relationship between the leap of a cricket, grasshoppers, and earthworm, the retraction of a tube polychaete, and the escape movements of a squid?	speed of conduction of nervous impulses: effect of fiber diameter and comparison between myelinated and non-myelinated fibers
mechanical senses	In the molting season a shrimp is maintained in an aquarium with iron file dust on the bottom. After molting, if a lodestone is laid on the top of the aquarium, the shrimp would swim with the abdomen turned to the top. How do you justify this behavior?	structure and functioning of statocysts
movement	Some insects flap their wings with a higher frequency than the action potentials that is received by the flying muscles. Explain.	insect flight muscles
temperature regulation	Why do some animals survive in environments with lower temperature than the freezing point of their body fluids?	tolerance to cold and freezing
energy metabolism	If you place a rat, a man, and an elephant in sealed boxes with the same proportional size relative to the animal, which would be the first to die due to and absence of oxygen?	metabolic rate and scaling
osmo-regulation	Is it possible to transfer an animal from freshwater to seawater and vice-versa?	osmoconformers, osmoregulators, euryhaline, and stenohaline animals

RESULTS

Forty four students responded to the questionnaire. According to the students, in relation to the lecture-centered classes, the method used

has a restrict vision of the subject, but is more interesting and improves their performance (independent of the grade). There is no difference between both methods with relation to the elucidation of doubts. The students did not think that too much time was lost translating English texts. Most students prefer this system to that of lectures-centered classes (table 3), and the evaluation methodology was unanimously approved (100.0 %). Students submitted to this methodology obtained significantly higher average class scores (9.35±0.05) than students that received lectures-centered classes (7.56±0.15).

Table 2 - Questionnaire answered by the students to evaluate the method.

Comparing the utilized method in relation to the lecture-centered class which do you prefer on the following items?
1 - Vision of the subject
( )the utilized method ( ) lecture-centered class
2 - Elucidation of doubts about the subject
( )the utilized method ( ) lecture-centered class
3 - Performance in the subject (independent of the grade)
( )the utilized method ( ) lecture-centered class
4 - More interesting vision of the subject
( )the utilized method ( ) lecture-centered class
5 - Do you think that too much time was lost translating English texts?
( )yes ( ) no
6 - Do you agree with the evaluation methodology?
( )yes ( ) no
7 - Which method do you prefer?
( )the utilized method ( ) lecture-centered class

DISCUSSION

Based on the results obtained, it could be verified that the method used was well accepted by students. According to the students, this method stimulated their interest in the subject and improved their performance, since the students must think about comparative animal physiology and obtain the answers. Studies of Xavier et al. (1986), Richardson and Birge (1995) (in this classes there were a previous theoretical presentation of the subject before the discussions), and Rangachari (1991), using comparable methodology, presented similar results. The good scores obtained by the students also demonstrated that the subject was well learned.

Table 3 - Comparison between problem-based method and lecture-centered class. Preferences of students expressed in percentage of the total.

item	problem-based method	lecture-centered class
vision of the subject	31.8 *	68.2
elucidation of doubts	47.7	52.3
performance	65.9 *	34.1
subject interest	75.0 *	25.0
general preference	93.2 *	6.8

* statistically different of lecture-centered class ($\alpha < 0.05$)

The evaluation system had an unanimous approbation by the students. Certainly this method reduces the stress of evaluation, considering that it is done throughout the semester and not concentrated in two or three tests. Besides, instead of the teacher to evaluate the students based only on their knowledge in a few subjects, he/she may have a better idea of what the students are learning, revising constantly their reports. The evaluation by

reports also develops the writing skill of students, which is important to their future, either as teacher or researcher. Nevertheless, without the collaboration of the students this system would not function properly, because nothing avoids that one the group members leaves the resolution of the answers to others, or that one group copy the report of another. Consequently, it would be interesting if all students be obliged to deliberate the main ideas of the subject. A comparable evaluation system was used by Richardson and Birge (1995), and the rating grade of the students was similar to others that have used a system of tests. Studies of Xavier et al. (1986) and Rangachari (1991) applied a system of tests to evaluate the students.

The students considered that the method used offered a more restrict view (amount of contents) of the subjects with relation to a lecture-centered class. A lecture-centered class allows a more ample vision of the topics (considering the scope of information transmitted), because the teacher has a better knowledge of the subject and can express himself/herself it in a more extensive way, emphasizing the more important aspects. However, most students that responded to the questionnaire agreed that their progress was qualitatively lower in lecture-centered classes. Methods similar to that used by Xavier et al. (1986) and Richardson and Birge (1995), where there was a theoretical presentation of the subject before the discussions, can solve this problem.

Since most Brazilian students have a poor understanding of English, the presence of a great amount of references in this language (including books) on comparative animal physiology, became a problem for approximately 40% of these students. Similar values were found by Xavier et al. (1986). This problem can be seen in two ways. Firstly, the teacher could obtain references in Portuguese, using translations. Alternatively, the teacher must be conscious that Brazilian students have a difficulty in the comprehension of English language and stimulate them to read references in this idiom, knowing that it is widely used in scientific journals. Brazilian students must be convinced of the necessity to understand English texts. Besides, Xavier et al. (1986) related that 80% of the students inducted that

they have improved their capacity to read English during the semester. Consequently, the same authors believes that the use of English references is important to prepare the students to overcome their difficulties, having educational objectives by itself.

Based on the obtained results it could be concluded that the problem-based method of teaching can be used to teach comparative animal physiology with adequate results. However, the use of this system in classes with more than 20 students deserves an additional study, since it would be difficult to produce a rewarding discussion among many students.

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