HOW DO CELL BIOLOGY STUDENTS LEARN EFFECTIVELY?

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ABSTRACT

The underlying structure for learning scientific approaches to cell biology and applying them is unknown to most second year university students and assumed by most instructors. In a large second year Cell Biology lecture course, students were surveyed to probe their ideas, attitudes and habits with respect to how they learn effectively. Successful students displayed hallmarks of expert learners with respect to their study strategies, organization and metacognition. Students who struggled tended to display characteristics of novice learners such as the inability to connect and organize information around important concepts, limited ability to transfer information into novel contexts and lack of metacognition. Here, we report our findings and the implications on our teaching practices.

THE COURSE

Cell Biology I: Structure and Function

- Biology 200 is a large multi-section introductory course designed to familiarize second year students with basic eukaryotic cell biology.
- Enrollment in the course is over 1100 students in five different lecture sections.
- In addition a one-hour tutorial per week includes frequent quizzes to provide students with feedback on their learning and give them practice with the kind of questions they will encounter on exams.
- Students take common exams that include problem-solving, short answers and essays.

METHODS

Survey

- Participation was voluntary. We adhered to the behavioural research ethics protocol for our university in this study.
- The survey was designed to capture students’ learning strategies and habits as presented in Table 1.
- Annual revisions to the survey were based on student responses. The multiple choice questions were crafted based on student responses to the open-ended questions.
- The survey was administered online at the beginning and towards the end of the 13-week course from 2003 to 2007.
- The total number of students who completed both the pre and post survey and gave consent was 781 in 2006 and we report that data set here.

Data Analysis

Quantitative data were categorized into three groups:

(i) all students
(ii) top 15% of students (grade average = 89.7±2.6)
(iii) bottom 15% of students (grade average = 53.2±8.6) in the class as we were able to establish statistical significance at this level.

Statistical Significance

Chi^2 test was employed in the statistical analysis to order to compare (i) all students, (ii) top 15% and (iii) bottom 15% of students’ pre and post responses as well as to compare top and bottom students post survey responses. \( p < 0.05 \) was considered to be statistically significant unless otherwise stated.

Short Answer Questions were analyzed with N’Vivo software.

RESULTS

Table 1: Survey questions with student responses in percentages. Those responses that differ statistically between the pre-survey and the post-survey are indicated by an asterisk.

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DISCUSSION AND CONCLUSIONS

- The goal of this study was to identify successful student learning strategies. From the responses we have been able to develop a profile of student learners that parallels characteristics of novice and expert learners.
- We intend to provide students with feedback on successful strategies for navigating university learning and give instructors information on what teaching practices will best scaffold student learning.
- Inherent in the conceptualization and analysis of this survey was the acceptance of the influence of the teaching-learning environment on the processes of learning and studying (Entwistle et al. 2004). The results of the survey suggest that: - students in this course are still in a transition phase to university learning - top 15% and bottom 15% of students by grade show significantly different approaches to learning - there are a variety of areas where instructors can more explicitly help students.

Implications for Teaching

- Students require explicit instruction on developing successful learning strategies.
- Students require time and practice in developing the metacognitive processes necessary for a novice to expert learning transition.

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