The Effects of Instructor Communication on Student Perceptions of Mathematics in Biology

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INTRODUCTION

Due to technological advances, biology has become an increasingly quantitative field. Biologists can now collect, store, and share vast amounts of data and analyze it using highly sophisticated mathematical tools. As a result of these changes, the preparation of future biologists requires reformed education in which students are active learners who can solve quantitative biological problems (1).

While many institutions have implemented change in undergraduate biology education, student views of mathematics in biology are often negative. However, research indicates that some conditions can promote positive student attitudes towards quantitative biology (2).

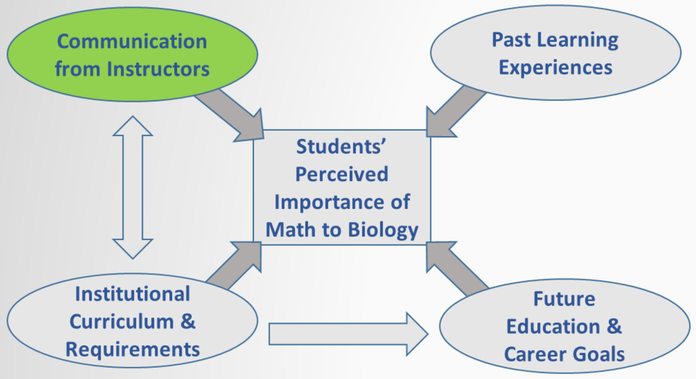


Figure 1. Proposed influences on student perceptions

To understand possible factors that influence student perceptions of math in biology, we developed a model (Fig. 1). Based on this model, we predict that communication from instructors about the role of quantitative reasoning in biology will promote positive student perceptions of math in biology.

METHODS

Student perceptions were measured using a survey containing Likert scale statements and free response questions. Before completing the survey, students read 1 of 2 course objective for Foundations of Biology 2 (Fig. 2). Responses of the two groups were compared with Mann-Whitney-U tests.

Traditional objectives

The goal of this course is to help students develop a working knowledge of molecular genetics, evolutionary processes, and ecological organization. To provide students with a solid foundation in these biological subject areas, this course will emphasize:

1. Describing the way the scientific method is applied to solve biological questions
2. Knowing about classical biological experiments to understand key discoveries
3. The importance of exploring biological phenomena to make predictions about similar observations

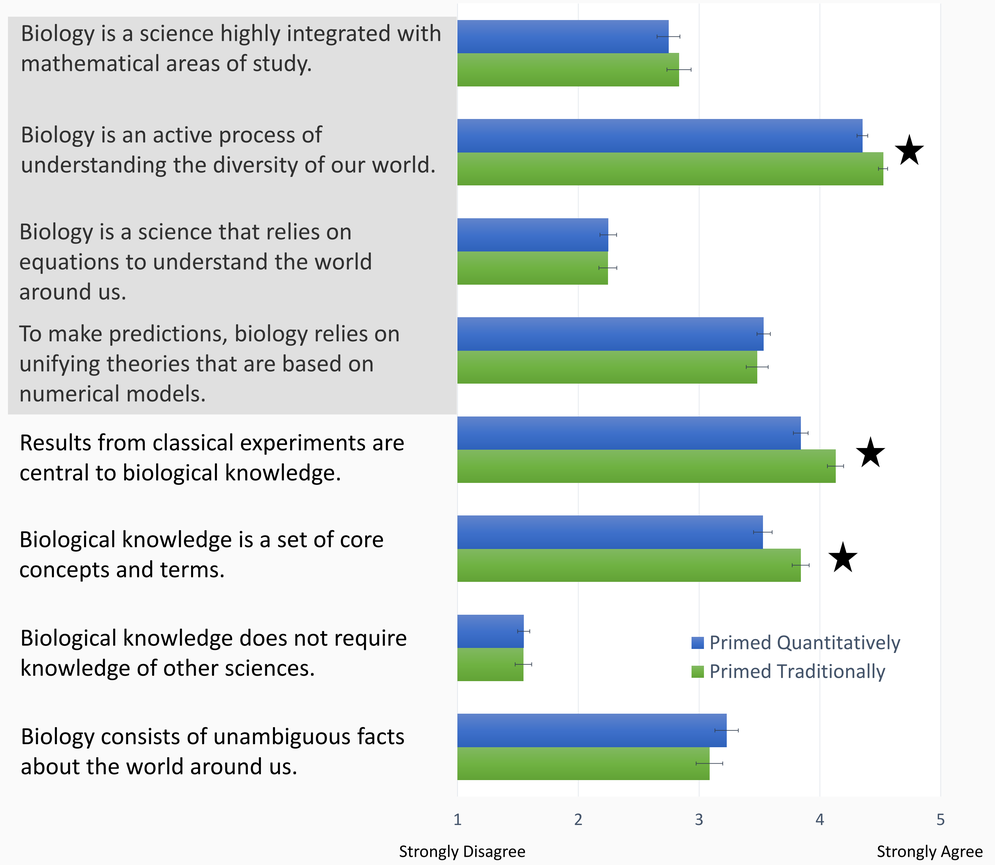
Quantitative objectives

The goal of this course is to help students develop a working knowledge of molecular genetics, evolutionary processes, and ecological organization. To provide students with a solid foundation in these biological subject areas, this course will emphasize:

1. Application of the scientific method and quantitative reasoning to solve biological questions
2. Using graphical and tabular displays of data to interpret experimental results
3. The important role of modelling in exploring biological phenomena to make predictions about similar observations

Figure 2. Course objectives presented before survey

Faculty communication significantly influenced student perceptions of "What is Biology?"



Students respond positively to statements of "How do I Learn Biology" independent of faculty communication

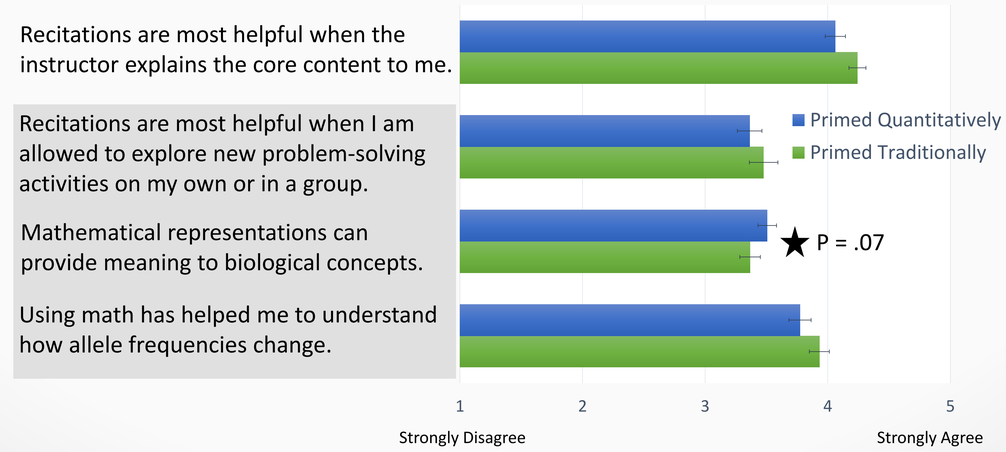


Figure 3. Top: Student responses to "What is Biology" questions. Bottom: Student responses to "How do I Learn Biology". Statements with a reformed perspective are shaded in gray.

MATH, BIOLOGY, & STUDENTS

On average students disagreed with statements that contained math-specific words such as "mathematical" and "equations" (Fig. 3). They did not strongly agree with the idea that biology and math were highly integrated, but in the "How do I Learn Biology" section one of the highest rated statements acknowledged that math had helped them understand how allele frequencies change (Fig. 3).

The free response results indicate students believe math is important to doing biology (Fig. 4).

In a recitation setting, students prefer the instructor to have a more traditional than reformed role. Students also preferred some traditional methods to learning biology over reformed methods (Fig. 3).

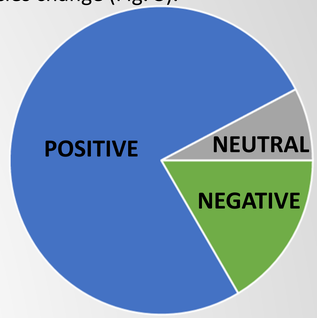


Figure 4. Responses to, "Has quantitative reasoning been helpful in understanding any of the topics covered in this course?"

CONCLUSIONS

There were four statements with significantly different responses, three matching our predictions.

There are several possible explanations for why faculty communication did not influence student perceptions to a large degree in this study:

- The survey was given once in the middle of the course. As a result, student perceptions of the course had likely already been influenced by instructor communication.
- Objectives acting as instructor communication are likely not equivalent to direct communication from an instructor.
- Course objectives are relatively broad statements that may not have a strong influence on students' views about biology and biological skills.

We suggest that future research in this area would benefit from being conducted in a small-scale setting, such as a recitation, in which students receive direct communication regarding an activity.

REFERENCES & ACKNOWLEDGEMENTS

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2. Watkins, J. and A. Elby. (2013) Context Dependence of Students' Views about the Role of Equations in Understanding Biology. *CBE Life Sciences Education* 12: 274-286.

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