

Findings of the Impact of a Non-majors First Year Biology Course on Students' Attitudes Towards Biological Sciences

Gülnur Birol^{1,2}, Kathy Nomme¹, Sandra Keerthisinghe¹, Jennifer Klenz¹

¹Biology Program and ²Science Centre for Teaching and Learning, The University of British Columbia, Vancouver, BC, Canada

RESEARCH QUESTIONS

- What attitudes do non-majors first year biology students have about learning biology?
- Do students' attitudes towards biology as a science and how to learn biological concepts change during a one-term course?

COURSE DESCRIPTION

FIRST YEAR BIOLOGY FOR NON-MAJORS

Structure

- Two sections offered in fall term with ~190 students in each
- Three one hour lecture sessions per week held in a large theatre

Learning Goals

- Develop an appreciation of science as a cumulative, investigative process
- Increase scientific literacy. Acquire means of accessing scientifically reliable information.
- Develop a framework of biological knowledge into which students can integrate personal life experiences
- Work cooperatively in a team to discuss, debate and problem-solve
- Develop self-confidence in evaluating biological issues facing society, forming biologically sound opinions and become aware of constructive alternatives

Content

Biology as a Science, Diversity of Life, Community Ecology, Population Ecology Human Impacts, Infectious Diseases, Cell Division (Cancer), Variation and Inheritance, Natural Selection

Assessment of Student Learning

- Group activities and assignments
- Individual term project on topic of interest
- Midterm exam
- Final exam

METHODS

We adhered to the behavioural research ethics protocol for our university in this study and the participation in the study was voluntary. Quantitative and qualitative data on student attitudes were collected based on the research design shown in Figure 1.

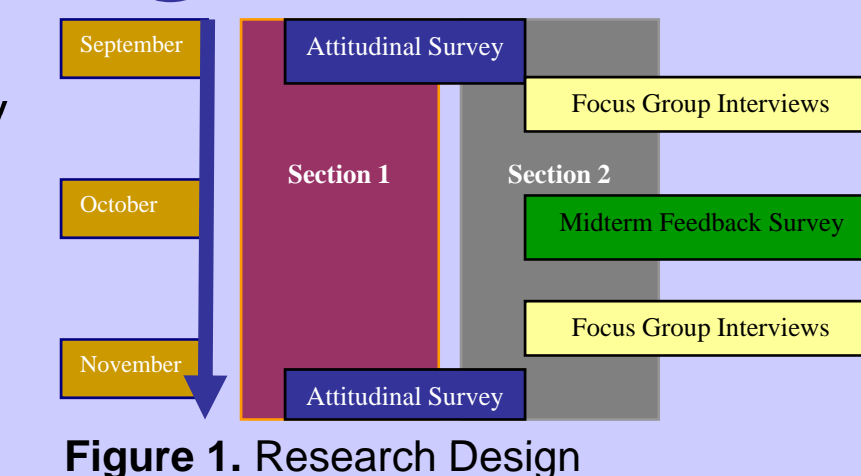


Figure 1. Research Design

Biology Attitudinal Survey (BAS)

- designed to capture students' attitudes towards biology.
- categorized into beliefs, motivation, and learning strategies.
- contained 63 statements in the pre and 70 statements in the post survey that were adapted from Adams et al. 2005 and Quinzel et al. 2005 and personal communication.
- administered online in the beginning and in the end of the term. Survey was open for 10 days each time.
- Student's paired t-test was employed. A p-value < 0.05 was considered to be statistically significant.
- Data were also subdivided into three groups based on marks in the course as top 20%, middle 60%, bottom 20% for further analysis.

Midterm Feedback Survey (MFS)

- Administered in the middle of term to obtain feedback on the effectiveness of teaching strategies and resources in the course and to identify elements that need modification and that succeeded in supporting student learning.
- 67% of students responded.

Focus Group Interviews (FGI)

- Three semi-structured, one-hour sessions were conducted by a graduate student: Two in the beginning (N=9) and one towards the end of the term (N=3).
- Sessions were guided by a set of questions on student opinions on biology as a science, relevance of biology to their lives, attitudes towards learning biology, the topics and mechanics of the course.
- Sessions were audio-taped and transcribed. The transcripts were read by three of the authors independently. A coding rubric was created from emerging themes. Any discrepancies were discussed and resolved for inter-rater reliability.
- The frequency of comments was classified as: frequently emphasized, several mentions, or mentioned once.

RESULTS

1. BELIEFS

Biology as a science

Evidence

Answer to open-ended question about the biological concepts or principles that were new to them: (BAS)

"Patterns in the environment or behaviour of an organism are fundamentally important to the study of biology. These same patterns allow predictions to be made, therefore making biology a science."

"Biology is not a clean cut science, there is never a simple answer."

"I think it is important to study biology but just because it's important to have a better understanding of the world in general." - frequently emphasized - (FGI)

Interpretation

Students acknowledge that biology is complex, requiring careful observation and the testing of hypotheses.

Students appreciate that there are multiple approaches to answering biological questions.

- There is an increase from 35 to 62% in agreement. Many students have come to realize that there is not just one right approach or answer to a biological question. More experience with problem solving in biology would reinforce this belief.

Confidence in ability to learn

Evidence

"Nearly everyone is capable of understanding Biology" (BAS) Significant shift towards agreement from 63% to 74% among all students and towards disagreement in bottom 20% of students (Figure 2).

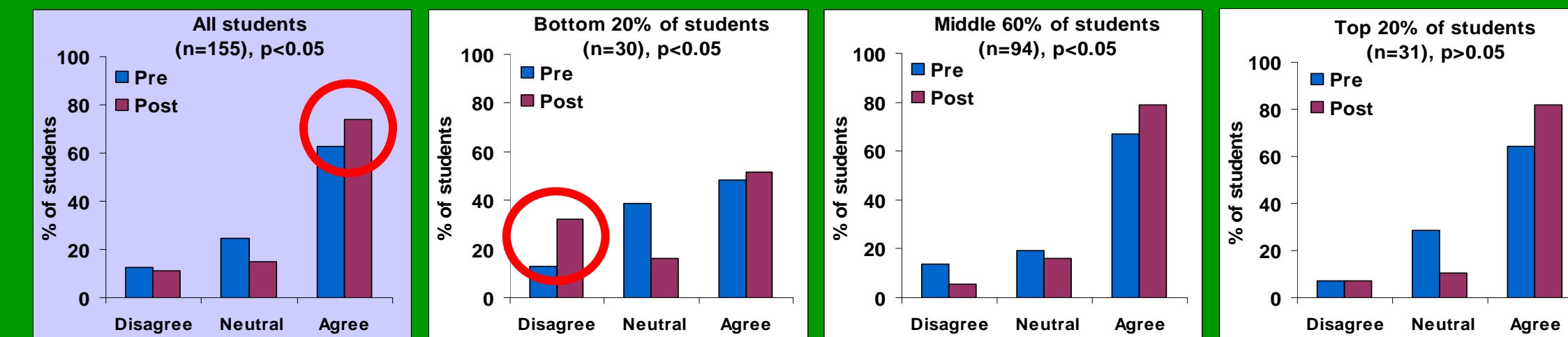


Figure 2. Percent agreement with statement

"It is possible to explain biological ideas with everyday language." (BAS)

Significant shift towards disagreement from 67% to 57% among all students (p<0.05). Bottom 20% shifted to agreement (p>0.05). Middle 60% (p<0.05) and top 20% shifted to neutral and disagreement.

"I can reason through most biological questions without looking up facts." (BAS)

Significant shift towards agreement from 25% to 37% among all students (p<0.05). Similar trends were observed in all sub-groups.

"I seem to know what's going on, so it's much easier than I thought it was. I thought it was going to be hard. I was really skeptical about taking it (Biology 111) cause I thought it was going to be ridiculously hard having not, having not taken biology in a long time." - several mentions - (FGI)

Interpretation

A proportion of students in the bottom group are uncertain about their abilities to learn biology and decline further in their confidence to learn biology.

A decline in beliefs that biology can be explained using everyday language indicates an increasing awareness that common language used in biological context may have special connotations. A portion of the bottom group is less sophisticated in their use of biological terms.

Less than half of the class is confident in their ability to reason biologically. Although 42% of the top group initially indicated they could not reason through questions, this decreased to 29% in the post test with students shifting to neutral and agreement. Many of the top group had a preconceived notion that biology is dependent on knowing facts.

2. MOTIVATION

Intrinsically curious, need to know

Evidence

"I choose to study Biology because I am curious about the living world." (BAS)

Significant shift towards disagreement with statement from 63% to 43% among all students (Figure 4). Similar trend noted in both aggregate and sub-groups.

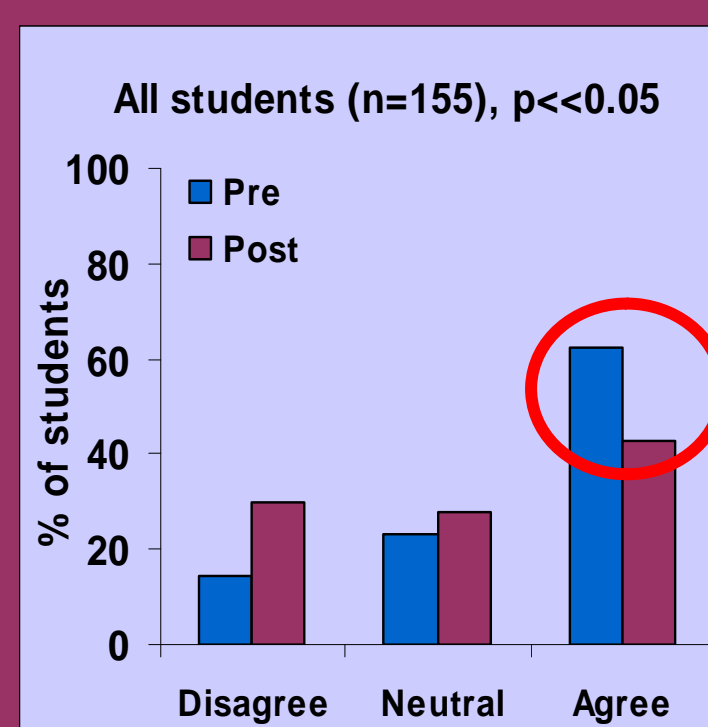


Figure 4. Percent agreement with statement

"I learned more about it (global warming) so that I can make more informed decisions or evaluate what I've learned." - mentioned once - (FGI)

Required for career/program

Evidence

"I never wanted to learn biology ever again after high school. And then I don't even know why I took biology here. I needed another course and it was a prerequisite to a course I considered taking. So I figured I might as well take it. And yeah I think biology is really interesting..." - Frequently emphasized - (FGI)

Interpretation

There is a decline in curiosity about biological issues, especially in the bottom and top groups.

This may be related to time constraints at the end of term when indulging in curiosity may seem frivolous.

Relevance to real world

Evidence

"It is important to study Biology to help find answers to societal problems" (BAS)

Significant shift towards agreement with statement from 54% to 71% among all students. Significant shift in top 20% of students towards agreement (Figure 3).

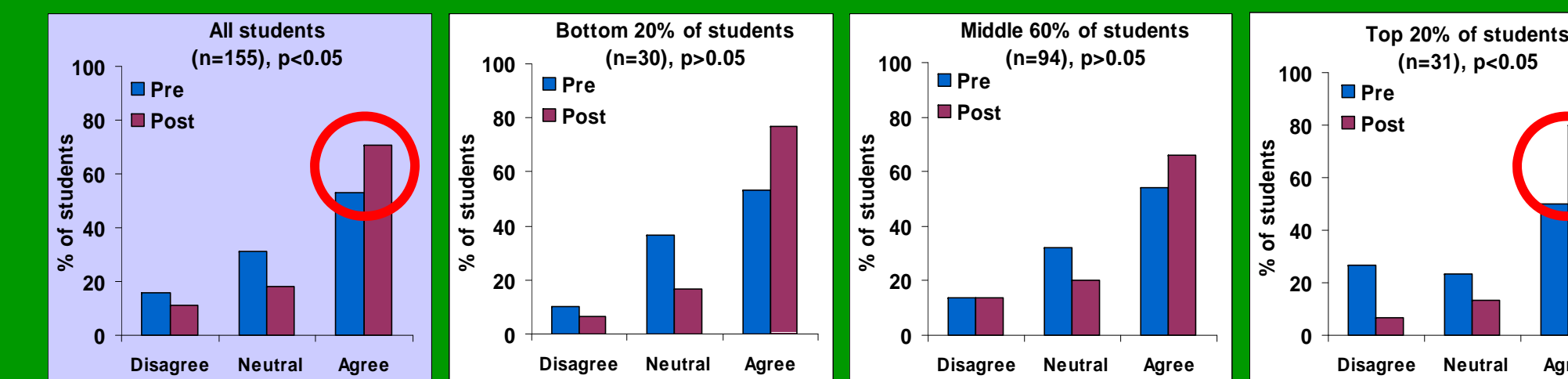


Figure 3. Percent agreement with statement

"Learning Biology changes my ideas about how the natural world works" (BAS) Significant shift towards agreement from 70% to 80% among all students.

A slight decrease in bottom 20% and middle 60% in agreement and a slight increase in top 20% in agreement (both not significant).

"You learn about it and then you understand why. I mean it's relevant because you understand why. . . . You are actually helping to make a difference even though it is just a small difference." - several mentions - (FGI)

60% find the topics relevant either always or most of the time (MFS)

Interpretation

There is a realization that biological concepts are related to societal issues.

A significant change in top group of students indicates they may have had preconceived beliefs about the study of biology that does not include solving societal problems.

The majority of students acknowledge that learning biology helps to understand the natural world.

3. LEARNING STRATEGIES

Relate or apply to real-life situations, problem-solving

Evidence

"I can usually think of several approaches to answering a question in Biology." (BAS)

Significant shift towards agreement from 35% to 64% among all students (Figure 5). Similar trend noted in both aggregate and sub-groups.

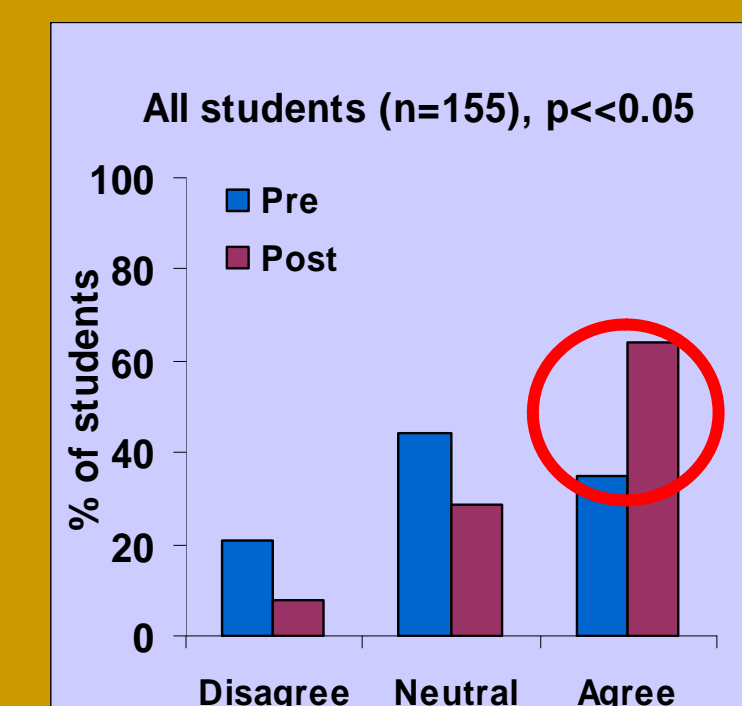


Figure 5. Percent agreement with statement

"Given my time constraints, I only study materials that I think will be examined." (BAS)

Significant shift towards agreement from 43% to 60% among all students. Similar trend noted in both aggregate and sub-groups.

"I love the emphasis on understanding and finding relevance in daily life instead of memorization" (MFS)

Memorization

Evidence

"If they really want to learn you know you'll kind of find a way to learn. And if you're not interested nobody can make you learn you memorize you just kind of pass the course." - several mentions - (FGI)

Conceptual framework development

Evidence

"There's a focus on concepts not on memorizing long scientific words."

"It's not about the little things like vocabulary and stuff you get. It's more about grasping like ideas and then once you grasp that you can build." - several mentions - (FGI)

Interpretation

Students become more focused and limit their studies in preparation for exams at the end of term. Time management becomes critical as final assessments approach.

Students are beginning to think critically about sources of information.

Students appreciate the emphasis on understanding concepts rather than memorization.

Intrinsic motivation is necessary to insight learning. Those not interested in the course material or motivated to learn will choose strategies to simply pass.

IMPLICATIONS FOR TEACHING PRACTICE

- There is a need to relate curriculum to the natural world to provide students with a context for biological concepts. The links need to be explicit and be incorporated into a broad picture of societal and global issues.
- Curricular hooks need to be incorporated into instruction to capture student attention. The relevance of the curriculum needs to be explicit to enhance interest and motivation for learning.
- The purpose of using instructional strategies needs to be made explicit to students. The intentionality of instruction enhances student awareness of expectations and their responsibilities in adopting appropriate learning strategies.
- Instructional support is needed for students that are not confident in their own abilities or are less sophisticated in their approaches to learning biology.
- There is a need to build students' confidence in biological problem solving by introducing more practice activities.
- Course assignments and assessments can be designed and scheduled to motivate students to review and study the material on a regular basis.
- Students need to be reassured that assessment in the course will evaluate concepts, critical thinking skills, and problem solving rather than memorization of facts.
- Evidence can be further analyzed to identify instructional strategies that effectively engage students and those that require modification to further enhance engagement.

CONCLUSION

- A scholarly approach to teaching and learning was taken in the first year non-majors biology course to inform us about our teaching practices and students learning strategies.
- There were statistically significant differences in student attitudes about biology as a science and how to learn biological concepts in the course between the beginning and at the end of the term.
- Further iteration of the attitudinal survey is in progress for its full implementation.

ACKNOWLEDGEMENTS

- This work was supported by the University of British Columbia Skylight Development Grant, Carl Wieman Science Education Initiative Life Sciences Funds, Faculty of Science Dean's Office Travel Grant, and Faculty Certificate Program of UBC.
- Special thanks to BIOL 111 2007 Fall term students for their support and participation in this study.