Beyond the content: Improving student problem-solving in genetics
Lisa McDonnell & Martha Mullally

Overview

Problem solving is a valued skill but it is often not explicitly taught or assessed in our undergraduate genetics courses. Experts problem solve automatically, novices need to learn how to do it through teaching, practice, and feedback.

Research Questions & Methods

What processes/procedures do students use to solve genetics problems, and how does this compare to experts?

Can we improve student problem solving by making it an explicit part of our course curriculum?

Think-aloud sessions: how do students solve problems? How do experts solve them?

Integrated problem solving into the curriculum

Used written work and interviews to assess problem solving behaviour before and after “intervention”. Rewarded problem solving behaviour with marks

Control | Treatment
--- | ---
Pre-test mean (s.d.)
Class | 47 ± 20% | 46 ± 23%
N=180 | N=74
CI Pre-test mean
Interviewed group | 48 ± 19% | 54 ± 16%
N=21 | N=11

No significant difference between means

Interviews with Novices & Experts: Problem Solving Process

Organize: What does the question tell you?
Hypothesis: What is an explanation that might be consistent with the data?
Check: Does your result (based on your hypothesis) support or explain the data given in the question?

Evaluate

How will you check your work?

Evaluate

You’re done!

Check: Checking revealed errors or inconsistencies → Modify hypothesis & try again
Check: Checking validated hypothesis. Consider alternatives.

Teaching & Assessing Problem Solving

More checking! Need more support to evaluate

Control group, unprompted checking correlates with higher grade.

Both groups had the same pre-test scores

Mean score (%)

Treatment group, unprompted checking correlates with higher grade.

Final Exam:

An example of student checking

Set-up | Execution | Reflection
--- | --- | ---
Percent of students demonstrating step
Organize | 0 | 20
Hypothesis | 20 | 80
Apply/Solve | 80 | 40
Check/Alternative | 40 | 0

From Think Aloud Interviews (control group):
Students rarely check their work or consider alternative solutions. Interviews revealed that many students don’t know how to check their work.

Acknowledgements: Trish Schulte, Carl Wieman, Sarah Gilbert. CWSEI-STLFs provided valuable feedback at all stages of the study Jennifer Klenz, Craig Berezowsky, Pam Kalas, and Shannon May-McNally for doing interviews. Biology students who volunteered to participate in the interviewing.

lmcdonne@zoology.ubc.ca @LMcD4 mullally@zoology.ubc.ca