

# Measuring students' engagement and learning during problem-solving: the effects of problem-solving and reflective prompts

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# Problem Solving

## Positive Problem-Solving Behaviours:

- Orienting themselves with the problem
- Many strategies to select from – forming a plan
- Checking work/evaluating
- Knowledge-generation approach, not means-end approaches

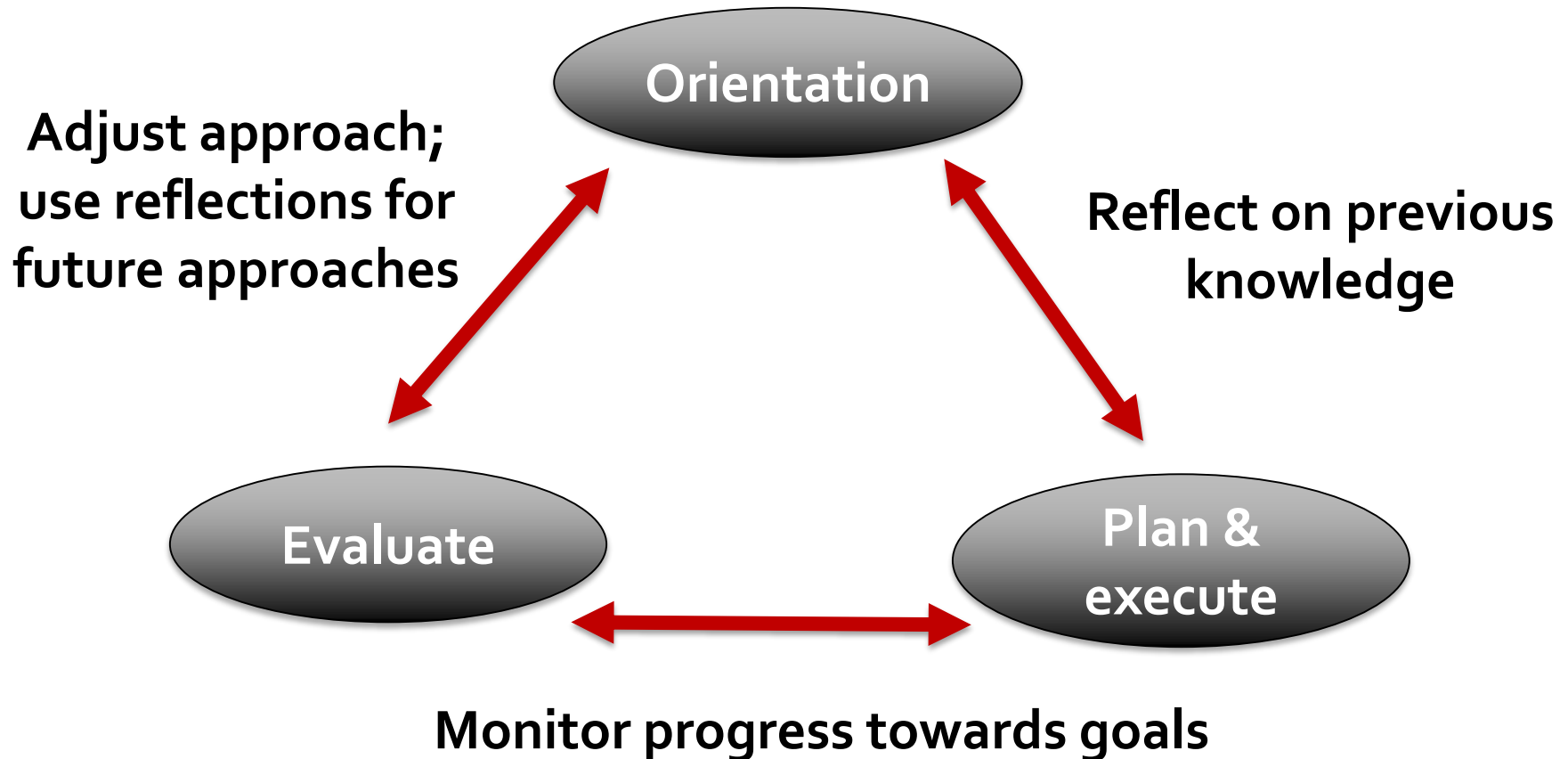
# Self-Regulated Learning

**Self-regulated learning (SRL)** is learning that is guided by:

- motivation to learn.
- planning, monitoring, and evaluating progress against a standard (strategic action)
- metacognition (thinking about one's thinking)

# Problem solving and Self-Regulated Learning

Reflecting, monitoring, controlling



# Goals:

Facilitate students to develop positive problem solving and reflective behaviours

....but, in order to support them effectively, we need to understand **how** students engage with problems, and then we can look at how our supports impact their engagement and learning

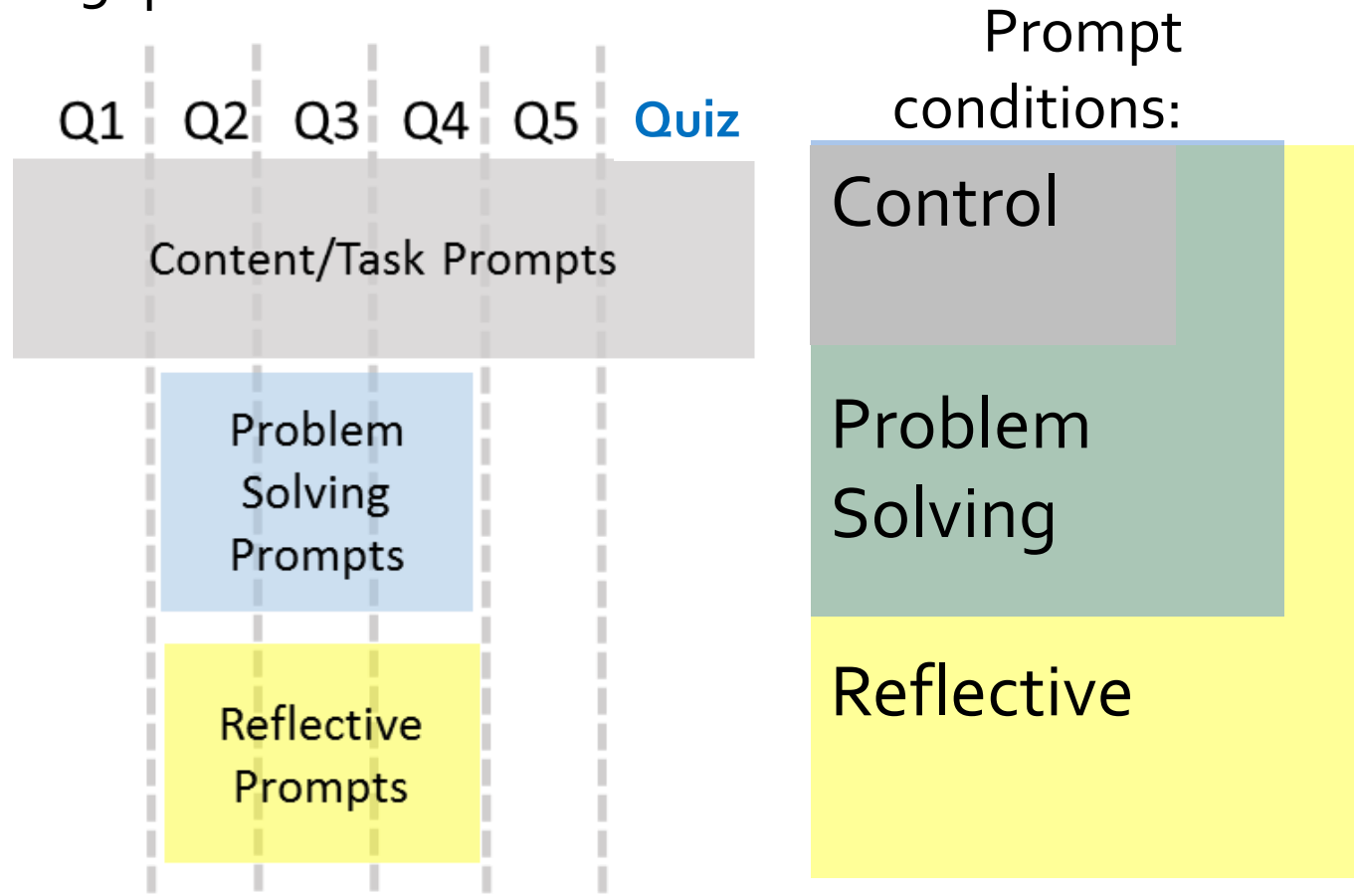
# Research Questions:

1. How can students' engagement while working on problems be characterized?
2. What are the effects of problem-solving and reflective prompts (scaffolds) on students' engagement with problems?

- 300 students randomly split into three conditions: control, problem solving, reflective.
- There were no significant differences in prior knowledge of the students in the three conditions based on pre-intervention test scores (ANOVA,  $F(2, 298) = .016, p > .98$ ).



Genetics Problem set:  
5 questions



# Prompts as scaffolds: examples

Devise a genetic explanation of these crosses. Show complete genotypes for the parents, the F<sub>1</sub>, and the F<sub>2</sub>.

Control:  
content/task

- What are the ratios observed in the scenario?
- Draw a representation of the information given in the scenario.

Experimental:  
Problem  
Solving

- What do the ratios tell you about the problem?
- How did creating a representation of the problem help you solve the problem? Why did it help you solve the problem?
- What strategies did you use to help you successfully solve this problem that will be helpful to use for another, new problem?

Experimental:  
Reflective



# 1) How did students engage with the problem set?



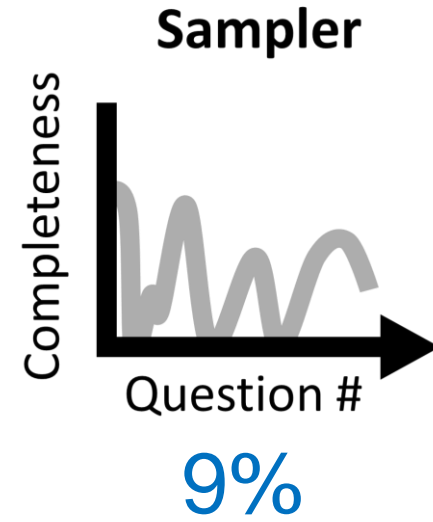
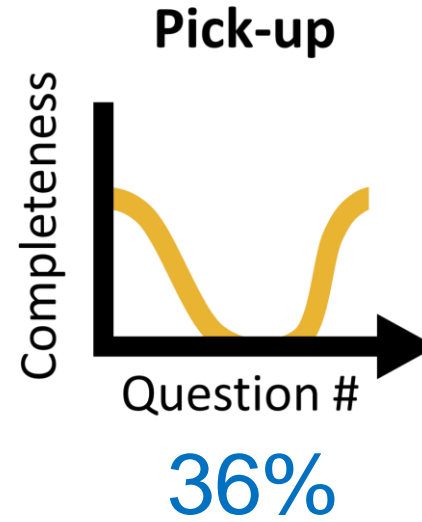
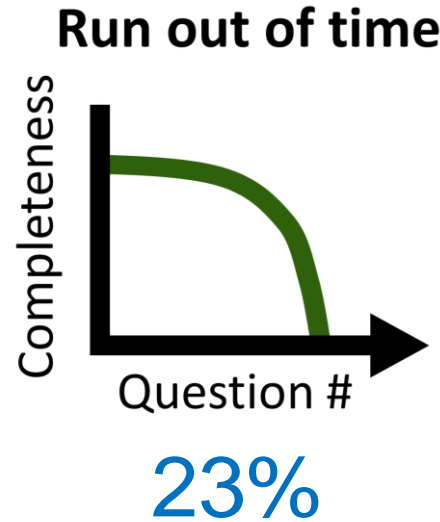
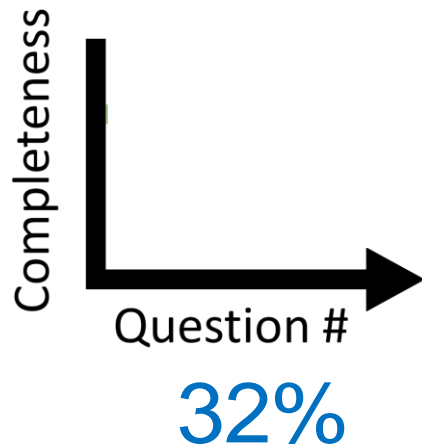
Responses to the problem-set questions and the quiz were scored for:

- Correctness
- Quality of explanation
- **Completeness → used to generate engagement profiles**

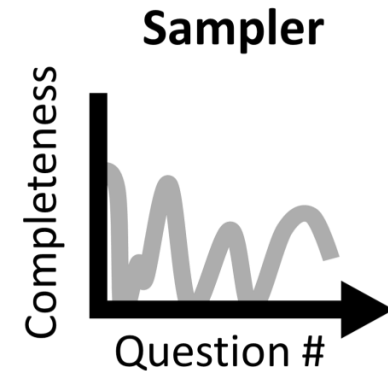
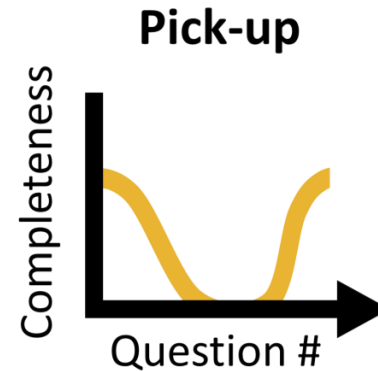
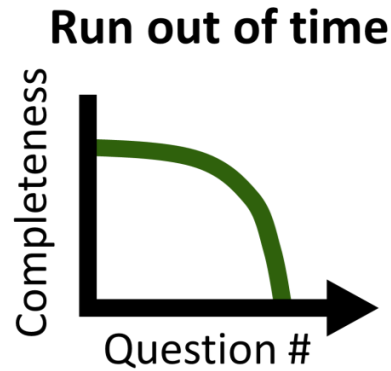
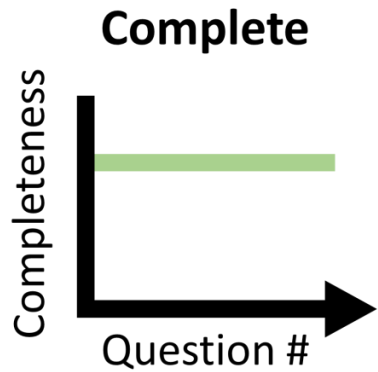
Scoring	Description
0	Not attempted at all
1	Attempted at a basic level; not possible for raters to score correctness
2	Attempted and possible to score correctness
3	Completed question

# 1) How do students engage with problems?

## Engagement Profiles



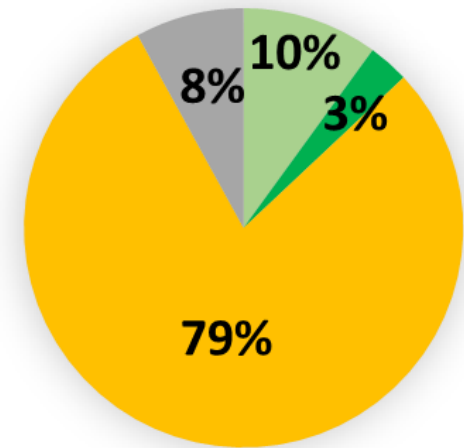
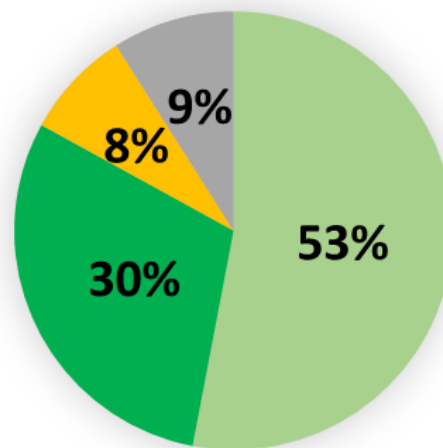
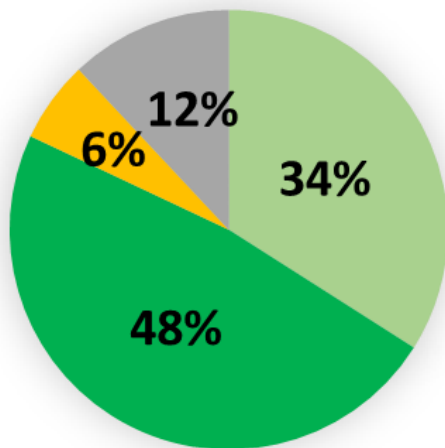
## 2) Does the type of prompt affect engagement?



**Control:** content & tasks, n=67

**Problem Solving:** strategies, n=113

**Reflective:** reflecting on strategies, n=120



$(\chi^2(6, N = 300) = 185.59, p < 0.01)$ .

# Conclusions

- Engagement with the learning activity varied significantly depending on scaffolds
  - Reflective prompts seem to be avoided.
- Measuring engagement with the learning activity is helpful to understand how we can support students' development of positive problem solving and reflective behaviours.
- Prompt type had no significant effect on correctness or explanation quality on the quiz (MANCOVA,  $p = .281$ ,  $\eta^2 = .013$ ), but prior knowledge did have an effect ( $p < 0.01$ ).

# Directions for future work and analysis

Within a single condition:

- does engagement profile correlate with quality of work?
- does engagement profile vary based on prior knowledge?
- Compare only those students who had a “complete” engagement profile – does condition effect correctness or quality of work.
- Longer time on the intervention: does increased engagement with reflective prompts affect learning and problem solving success?
- Foster a culture of engaging in reflective practices:
  - Often, in context, make it valuable, provide feedback

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**Heather's Thesis: Fisher, H. A. 2014.**

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**Questions/ideas – please get in touch!**

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