



## Getting Students to Reflect: The Narrative Reflection

- **Introductory physics labs** at WWU require students to complete a prelab (designed to expose students' initial ideas), work through the lab, correct and annotate their prelab, complete a homework assignment, write a report about a challenging "synthesis" problem, and write a Narrative Reflection.
- **The Narrative Reflection** requires students to respond to a prompt which asks them to discuss what they learned in lab and why their thinking has changed, and to analyze why, when, and where, these changes occurred. The prompt for this activity might change from one quarter to the next, in an attempt to better help students improve their understanding.
- **The kinematics labs prompt** is very structured, to help students develop reflection technique, whereas in the E&M lab the prompt is much less structured, allowing students to adapt their technique into something more personal. Student prelabs and Narrative Reflections are scanned each week so they can be analyzed.
- **Metacognitive Elements Rubric (MER)** is used to analyze qualitative student work by cataloguing student responses as a quantitative list of metacognitive actions.

## The Metacognitive Elements Rubric

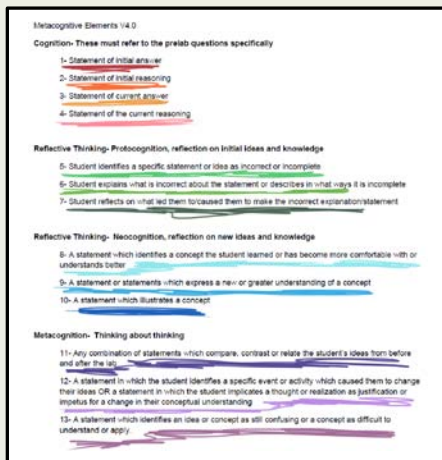


FIG 1. The Metacognitive Elements Rubric. The rubric is used to "code" student responses to allow quantitative analysis of students metacognitive abilities. Each code is color coded to match the coded example Narrative Reflection.

# Analyzing Student Reflection

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## Background:

Metacognition, or "thinking about thinking", is a skill which has been shown to directly relate to expert learning. Reflective activities have been incorporated into the introductory physics labs at Western Washington University in an attempt to encourage the development of metacognitive skills in students. Analysis of both the existence and growth of these skills has provided insights into (1) the difficulties of the task itself, (2) possible approaches to alleviate these difficulties, and (3) the impact of the ongoing research efforts.



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## Proof of Concept

MER is applied to Kinematics Narrative Reflections for 5 out of 7 labs in a single lab section (N=22)

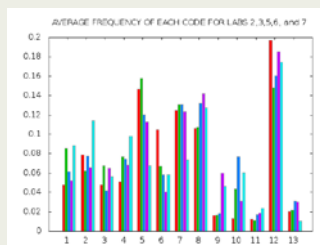


FIG 2. The frequency of each code for each of the 5 labs, the different colored bars correspond to a different lab(2,3,5,6,7) in that order.

- **Frequency** is calculated for each lab as the ratio of statements in a specific code to the total number of coded statements
- **Methodology: Application of MER alone**
  - is useful for establishing consistency of frequency of student statements across all labs, as shown in Fig. 2;
  - is less useful at measuring the impact of student reflection on conceptual gains. As evident from Fig. 3, correlation between the total number of reflection occurrences and FCI gains is very weak.

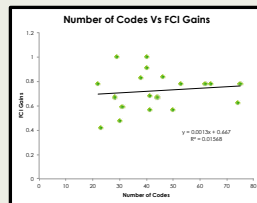


FIG 3. Total number of Codes (Metacognitive Statements) vs Normalized FCI gains.

## New Methodology

Application of MER & analysis of student performance on related post-test questions

- **Research question:** If a prelab question and final exam question are very similar, then how does a students' performance on the prelab and lab annotation relate to their score on the final?
- 71 students from 5 different lab sections were organized according to their performance on prelab, annotated prelab, homework, and final exam question

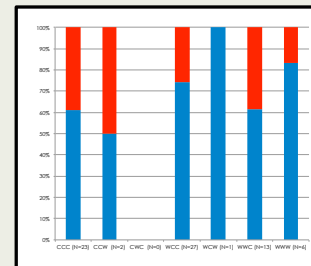


FIG 4. Percentage of students who provided correct (Blue) or wrong (Red) answers on the final. "XXX" corresponds to Prelab, Annotated Prelab, Lab HW, while "C" and "W" stand for correct and wrong answers on each of these tasks.

**Data interpretation:**

- Students who corrected their initial ideas (i.e., WCC) were more likely to answer the test question correctly than students who "knew" the material before the prelab (i.e., CCC)
- Students who were completely wrong on the prelab (WWW) were even more likely to answer the final correctly.
- Limitations: A large number of variable (e.g., lecture instruction) and small N for some categories (e.g., WWW).

## Conclusion & Future Work

The current work involved analysis of a variety of interesting data sets. Data interpretation allowed us to assess strengths and weaknesses of the rubric and Narrative Reflection activity. Fig. 2-5 represent a small fraction of the many different interpretations and uses that data of this form allows.

FIG 5. Average frequency of each code among students grouped according to their lab work and performance on the final.

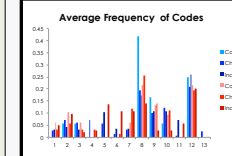
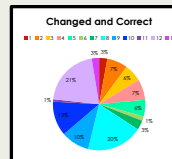
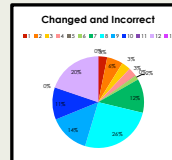


FIG 6 & 7. Average frequency of each code among students who changed understanding. By representing them like this it is easier to understand how these groups reflected differently.



- While the MER does measure the quantity of reflection, it is unable to account for the quality. By modifying the MER we will gain a better understanding of both the depth and the "style" (epistemological preferences) of students' reflective abilities.
- It is necessary to incorporate the lecture into the Narrative Reflection, as some students might learn more from instruction than lab work. The ability to catalogue and analyze student work in this way is incredibly valuable and will help education research develop a much better understanding of students abilities.