# A Look Within: STEM Faculty Emphasizing Deep Approaches to Learning


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## Overview

Disciplinary culture plays a significant role in the extent faculty emphasize and students' engage in deep approaches to learning. This study narrowly focuses on STEM faculty and the variation in their emphasis on two components of deep learning--reflective and integrative learning and higher-order learning. Specifically, patterns in faculty promoting deep approaches to learning in mathematics, biology, mechanical engineering, computer science, physics, and psychology are examined. The effect of gender in these fields is also considered.

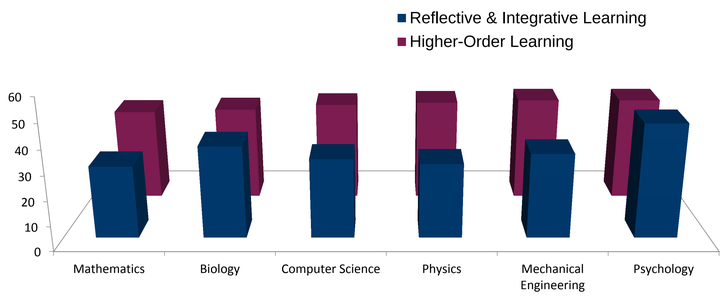
## Background

This study is an extension of research by Nelson Laird, Schwarz, Shoup, and Kuh (2008) that found faculty in education, arts and humanities, and social science emphasized deep approaches to learning more so than faculty in hard disciplines such as biology, engineering, and physical sciences. Relying on Biglan's (1973) classification of fields, Nelson Laird et al. (2008) showed that the hard disciplines (largely science, technology, engineering, and mathematics, STEM, fields) averaged much less emphasis on reflective and integrative learning and less, but more comparable, emphasis on higher-order learning. However, the hard-pure-non-life designation combined faculty from several different STEM fields (e.g., physics, chemistry, mathematics).

As a follow-up, the purpose of this study is to dig deeper into the emphasis on deep approaches to learning within specific STEM fields. Exploring these more specific differences is important because research shows that the effects of deep approaches to learning on important outcomes are largely independent of field (Nelson Laird et al., 2008). In other words, students in all fields benefit, in terms of their learning, when deep approaches are taken and many scholars, leaders, and policy makers are currently pushing for greater STEM learning (Fairweather, 2009; National Research Council, 2003; President's Council of Advisors on Science and Technology, 2012).

In addition, we know from previous studies that women tend to use effective teaching practices more than men (Grasha, 1994; Kuh, Nelson Laird, & Umbach, 2004; Lacey, Saleh, & Gorman, 1998; Singer 1996). Research also shows that disciplinary cultures moderate the effect of gender on teaching styles (Nelson Laird, Garver, & Niskodé-Dossett, 2011). But, it is not known whether gender differences vary significantly among STEM fields. It is quite possible the "consensus of knowledge" in hard disciplines (Biglan, 1973) drives teaching practices more so than social demographics of faculty or even course and institutional context.

## Average Faculty Emphasis on DAL by Select STEM Disciplines




## Purpose & Method

This study explores the gender make up of each STEM field and how accounting for gender changes the observed differences in emphasis on deep approaches to learning in STEM fields while controlling for how other factors contribute to differences among STEM fields.

## Deep Approaches to Learning (DAL)

**FSSE Component Items**

### Faculty Importance of Reflective and Integrative Learning (RIL)

**In your selected course section, how important is it to you that the typical student do the following?** (Not important, Somewhat important, Important, Very important)

- Combine ideas from different courses when completing assignments
- Connect his or her learning to societal problems or issues
- Include diverse perspectives (political, religious, racial/ethnic, gender, etc.) in course discussions or assignments
- Examine the strengths and weaknesses of his or her own views on a topic or issue
- Try to better understand someone else's views by imagining how an issue looks from his or her perspective
- Learn something that changes the way he or she understands an issue or concept
- Connect ideas from your course to his or her prior experiences and knowledge

### Faculty Emphasis on Higher-Order Learning (HOL)

**In your selected course section, how much does the course work emphasize the following?** (Very much, Quite a bit, Some, Very little)

- Applying facts, theories, or models to practical problems or new situations
- Analyzing an idea, experience, or line of reasoning in depth by examining its basic parts
- Evaluating a point of view, decision, or information source
- Forming a new idea or understanding from various pieces of information

## Average Faculty Emphasis on RIL by Gender and Discipline

Results suggest that, while female faculty tend to incorporate reflective and integrative into their courses at higher rates than their male counterparts (statistically significant at the p<.001 level), these gender differences are not as prominent in STEM fields (no statistical difference).


Females Males

**Non-STEM**

Females Males

**STEM**

## Data

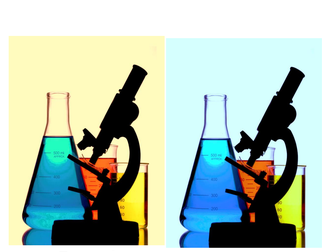
The data from this study come from the 2014 administration of the Faculty Survey of Student Engagement (FSSE). FSSE was designed to complement the National Survey of Student Engagement by measuring faculty perceptions and expectations of undergraduate engagement in educationally purposeful activities, the extent to which faculty promote learning and development in their courses, the extent of faculty interaction with students, and how faculty allocate their time. FSSE 2014 was administered to approximately 18,900 faculty at 143 institutions (41% response rate).

## Average Faculty Emphasis on HOL by Gender and Discipline

Female faculty also tend to emphasize higher-order learning in their courses at higher rates than their male counterparts (statistically significant at the p<.001 level), but these differences disappear in STEM fields altogether (no statistical or practical difference).


Females Males

**Non-STEM**



Females Males

**STEM**

## Additional Results

The gender make-up of a discipline also did not seem to be the deciding factor on the use of deep approaches to learning. The more highly feminized STEM fields vary greatly on the use of both deep learning strategies. For example, biology faculty (44.9% female) report using reflective and integrative learning at one of highest levels among the STEM fields, while mathematics (37% female) has one of the lowest. Most individual STEM disciplines showed high levels of "consensus" among their faculty (regardless of gender). In fact, after controlling for other factors (including gender), field was the strongest predictor of both faculty emphasis on reflective and integrative learning and on higher-order learning.

## Discussion

Our results show that STEM fields have meaningful differences in their emphasis on aspects of deep approaches to learning. This suggests that approaches to developing deep learning in STEM should be done sensitive to such differences. Mathematicians, for example, show more need for help in understanding how to encourage integrative and reflective learning, while other fields may need more assistance with higher-order learning. We encourage institutions to replicate of our findings to help determine appropriate approaches to faculty development on their campuses.