Contextualizing Professional Development in the Engineering Classroom

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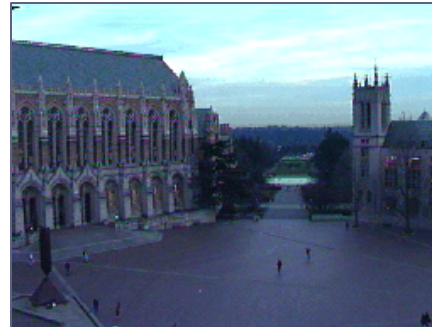# This presentation focuses on contextualized professional development modules for engineering

Introduction

The University of Washington is a large, R1 state institution

Professional Development Modules

This research is part of a NSF funded, multi-university collaborative effort

Phase I Intervention Outcomes

Phase II Implementation

Minnesota State University – Mankato (MSU-M) is a mid-size, regional state institution

Intervention Evaluation & Results

Seattle Pacific University (SPU) is a small private, liberal arts university

Conclusions

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This paper reports on the content and results of an NSF CCLI Phase 1 and 2 project

Professional development course modules were developed and placed into the context of engineering courses

These modules were developed in response to **a lack of professional development opportunities** as a significant reason for choosing **to drop out of the major** [1]-[2].

Phase 1 Efforts

Efforts focused on **designing and piloting** an engineering course that addressed this need

Content and instructional format was developed and implemented in several pilot offerings of **EE 400 Contemporary Worlds of Electrical Engineering** at the University of Washington.

The University of Washington

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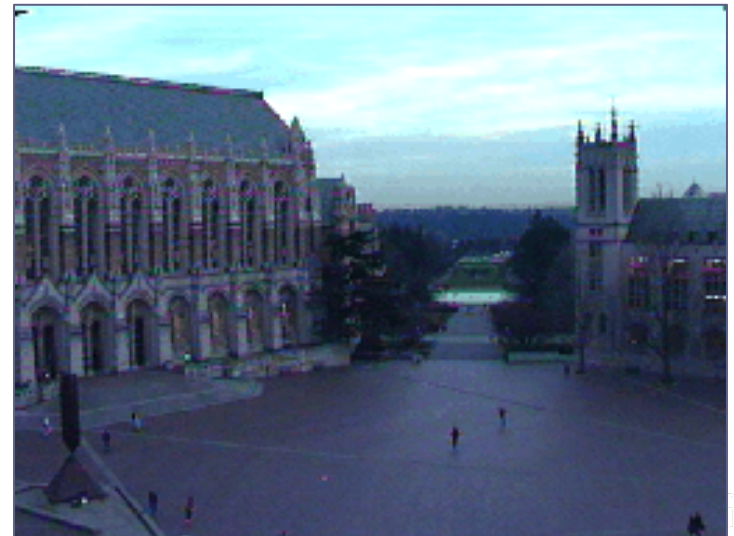
Phase 2 is a multi-university collaboration

Phase 2 Efforts

Related Phase 2 efforts are focused on **integrating** the professional development **intervention modules** into **other engineering gateway courses**

Three universities are involved in the study

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Seattle Pacific University (SPU) is a small private, liberal arts university
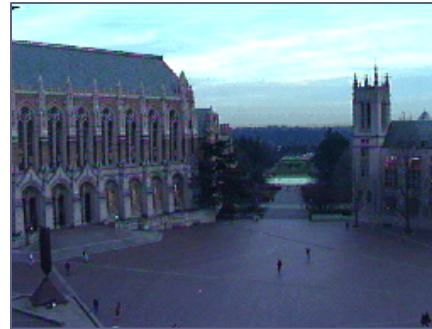
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Nine conceptual development models were developed in Phase I

These modules were developed to

- Contextualize professional development into a Contemporary Worlds (electrical engineering) course

- Provide an instructional vehicle to integrate the intervention into other gateway courses.

The modules can be classified into several categories:

- Engineering education in context of overall educational goals,

- Professional communication,

- Career building strategies, and

- Learning and personality styles

There are four modules related to engineering education in context of overall educational goals

A Brief History of Engineering Education in the U.S.

As it relates to the everyday life of the undergraduate

The Influence of the University/ College/ Department Mission

How these missions influence your engineering degree requirements

The Role of ABET in the Engineering Curriculum

An introduction to the presence and purpose of accreditation

Philosophy of Higher Education: *How Does Engineering Fit In?*

An introduction to the overarching philosophy of education

There are three modules related to professional communication and career building strategies

Written Communication in Technical Fields

Learning to write in the engineering environment

Interviewing, Networking and Building Relationships

Preparing you to enter the engineering profession

Defining Purpose, Goals, & Objectives

How to best define your purpose & goals to achieve maximum satisfaction

There are two modules related to learning and personality styles as they relate to engineering

Your Personality Style

Your Personality Style

Explaining personality styles in terms of strengths and weaknesses

Your Learning Style

Your Learning Style

Explaining your learning style in terms of strengths and weaknesses

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In our Phase 1 effort, we evaluated cognitive, and meta-cognitive outcomes

These outcomes were evaluated for two offerings of the 4-credit EE 400 Contemporary Worlds course (at the Univ. of Washington)

Methods

The **course objectives** were evaluated at the beginning and end of the intervention through a two part survey.

Statistical significance was based on a one-tail t-test of the aggregate meta-cognition outcomes
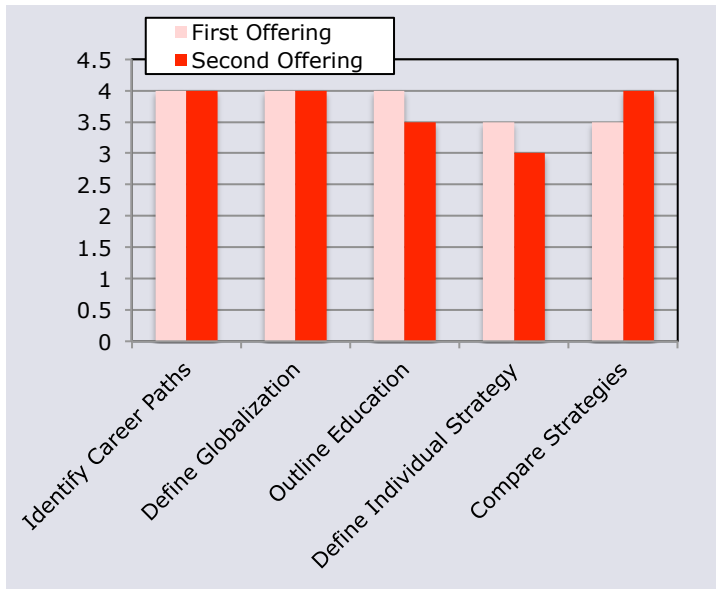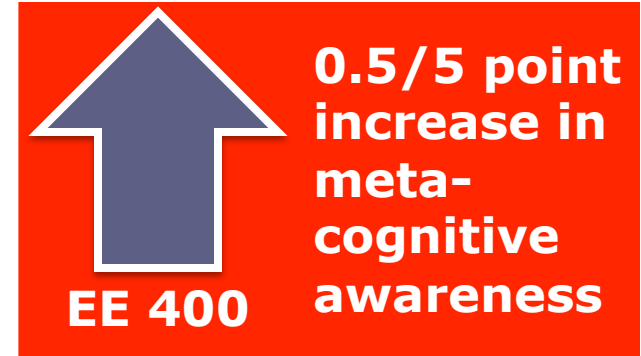
COURSE OBJECTIVES FOR EE 400 (CONTEMPORARY WORLDS)
a. Identify most major application areas and potential career paths within electrical engineering.
b. Define an education and career strategy best matched to individual interests and strengths.
c. Articulate that strategy verbally, in a convincing fashion using storytelling presentation techniques.
d. Reflect, in discussion and in writing, on significant contemporary concepts in electrical engineering.
e. Apply networking, communication, and listening skills in an engineering environment.
f. Define economic globalization and 21st century technology in industry in context of … engineering.
g. Outline the major milestones in the history of engineering education.
h. Compare and contrast strategies for demonstrating fluency in relevant professional skills …

Phase I results showed substantial, statistically significant increases in meta-cognitive awareness

Results: Meta-cognition

Meta-cognition was measured via student awareness of their place in engineering education and in the 21st century globalized workforce.

Students demonstrated a statistically significant **0.5 point increase** (on a 5 point Likert scale) from beginning to end of the **EE 400 Contemporary Worlds** course (aggregate measure)

0.5/5 point increase in meta-cognitive awareness

EE 400

Legend:
- First Offering
- Second Offering

Chart axis values: 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5

Categories: Identify Career Paths, Define Globalization, Outline Education, Define Individual Strategy, Compare Strategies

Comparison of EE400A and EE400B: End of Course Objectives Survey

No significant difference in outcomes was found for two offerings of the same course: This lends evidence that the results may be repeatable.

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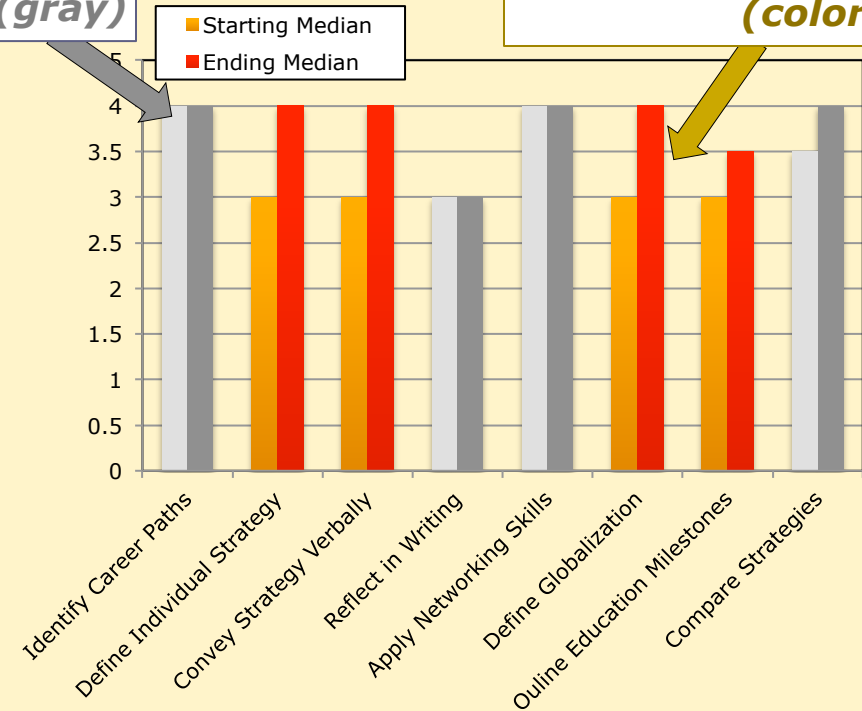# Students tended to adopt and progress most in three areas related to meta-cognition

Results

Students tended to adopt and progress most in

a) *Defining an individual career strategy;*

b) *Articulating that strategy verbally;*

c) *Defining economic globalization; and*

d) *Outlining major milestones in engineering education*

Did not reject the null hypothesis (gray)

Statistically significant gains (color)

Legend: Starting Median, Ending Median

Chart categories: Identify Career Paths, Define Individual Strategy, Convey Strategy Verbally, Reflect in Writing, Apply Networking Skills, Define Globalization, Ouline Education Milestones, Compare Strategies

Assessment of progress in individual objectives for Contemporary Worlds from beginning to end of course

Students' ability to recognize and reflect upon the broader impacts of technology improved

Results: Cognitive Outcomes

Measured the student ability to recognize and reflect upon the broader impacts of technology on society and effectively organize their writing into an audience oriented (rhetorical) format

Results from the first **EE 400 Contemporary Worlds** intervention show an average **increase of 8 points** on a 100 point scale in these cognitive abilities, assessed using a sophisticated multi-dimensional grading rubric
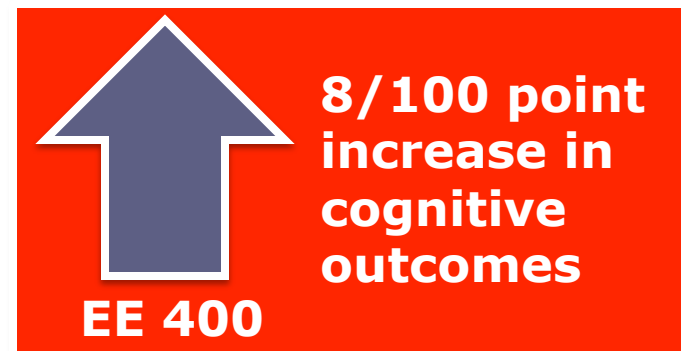
EE 400

8/100 point increase in cognitive outcomes

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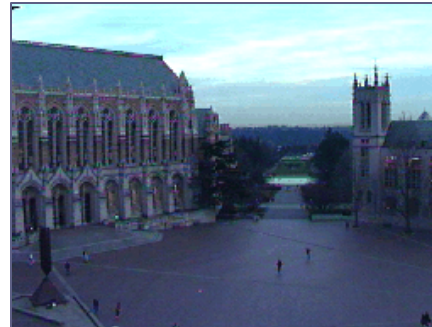Phase I Intervention Outcomes

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In Phase 2, the professional development modules were exported into several other gateway courses

Modules were implemented at the University of Washington, Minnesota State University-Mankato, and Seattle Pacific University

At the University of Washington:
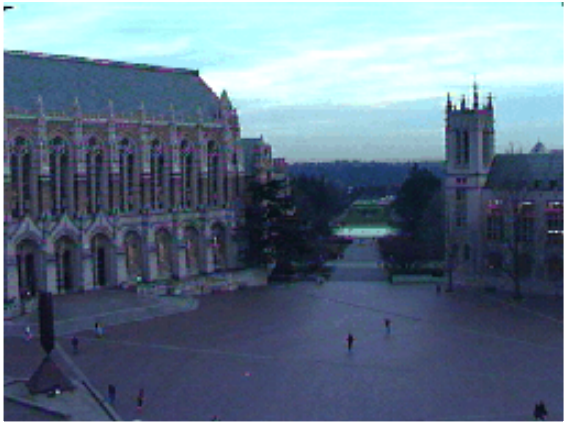
All of the professional development modules were implemented in an offering of the 1-credit upper division gateway course, EE 398, **Introduction to Professional Issues**

At Minnesota State University – Mankato:

All of the professional development modules were implemented in an offering of a 4-credit computer science gateway course, **CS 300, Large-Scale Software Development**

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In Phase 2, the professional development modules were exported into several other gateway courses

At Seattle Pacific University:

The modules were first modified to fit the local institutional culture.

Six modules (*History of Engineering Education, Local Mission, The Role of ABET, Philosophy of Higher Education, Personality Styles, and Learning Styles*) were integrated into two offerings of a 1-credit freshman gateway course, **EGR 1402, Introduction to Engineering**

Three modules (*Written Communication In Technical Fields, Interviewing, Networking and Building Relationships, and Purpose, Goals, and Objectives*) were implemented in one offering of a 1-credit junior gateway course, **EGR 3000, Engineering Seminar and Internship Preparation.**

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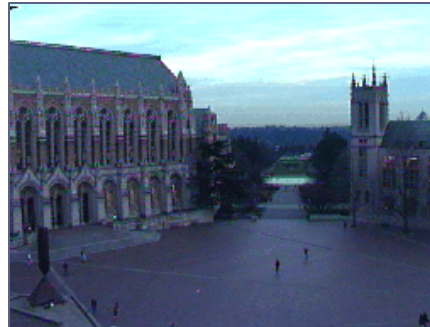
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Phase 2 interventions were evaluated through two-part class surveys

Evaluation Methods

Recruitment: Students were recruited from each targeted intervention class and consent was obtained from each participant

Survey: A two-part survey (beginning and end of term with same questions) was administered to each participant. The questions were based on the course/ professional development objectives.

Analysis: Statistical significance was based on a one-tail t-test ($p < 0.05$) of the aggregate meta-cognition related to the professional development modules (Pre- and post-survey data were compared)

| Course Objectives & Related Professional Development Objectives for EGR 3000 (Engr. Seminar & Internship Prep) |
|---|
| 1. Apply networking, communication & listening skills in an engr. environ. (#6 Networking). |
| 2. Prepare an effective resume for an engineering position (#6 Networking). |
| 3. Identify needed areas for improvement … in an interview (#6 Networking). |
| 4. Define an education & career strategy matched to interests & strengths (#7 Purpose). |
| 5. Reflect, in writing …, on significant (mission related) topics (#5 Written Communication). |

Phase II results showed substantial increases in meta-cognitive awareness in two more courses
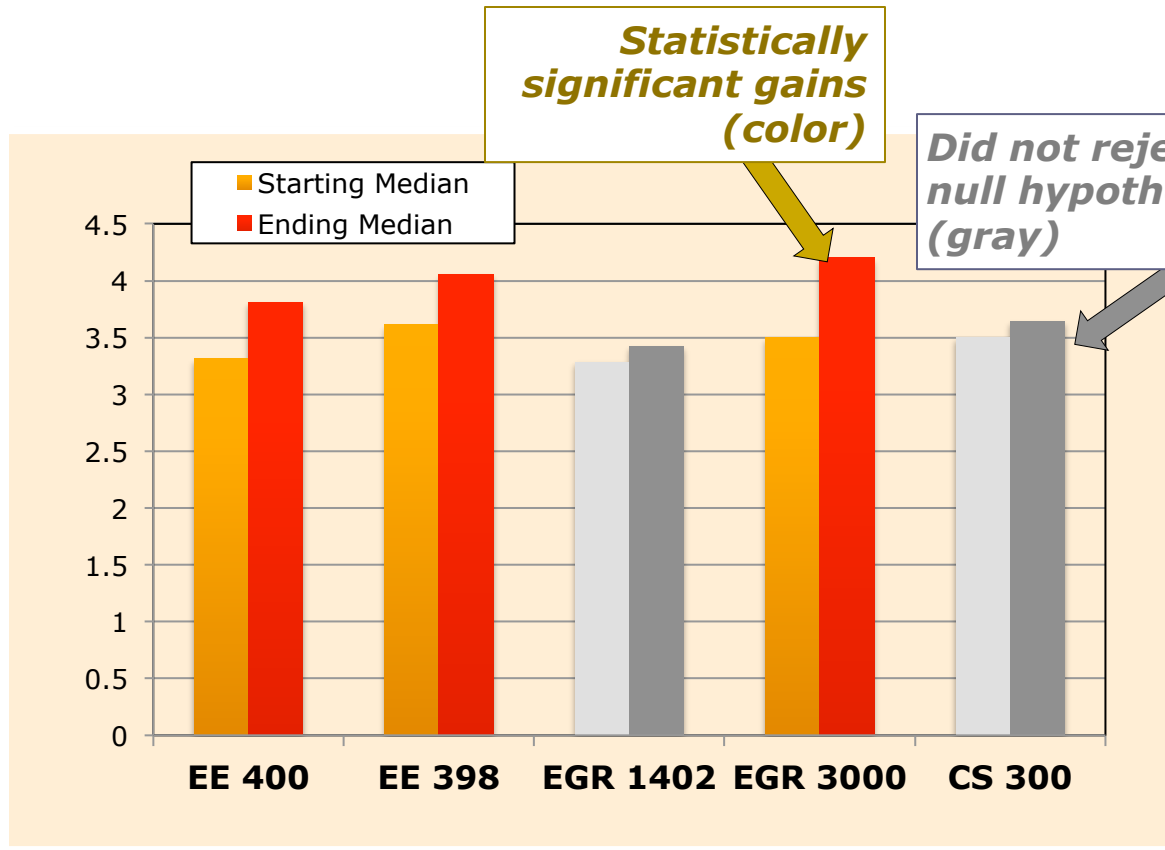
Results: Meta-cognition

Use of the professional development modules showed overall a substantial, statistically significant increase in aggregate meta-cognitive awareness

Students in the **UW EE 398 Intro. to Professional Issues** course demonstrated a statistically significant **0.4/5 point increase** from beginning to end of the course (aggregate measure)

0.4/5 point increase in meta-cognitive awareness

0.7/5 point increase in meta-cognitive awareness
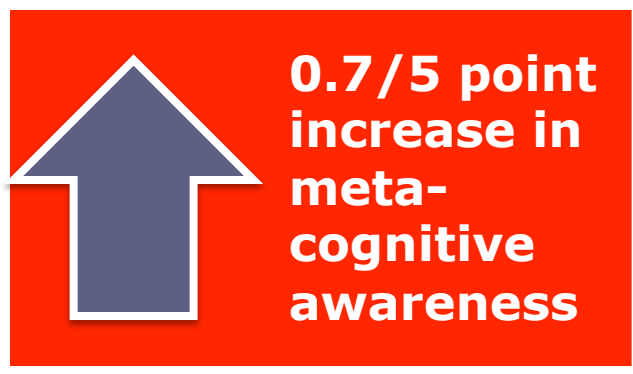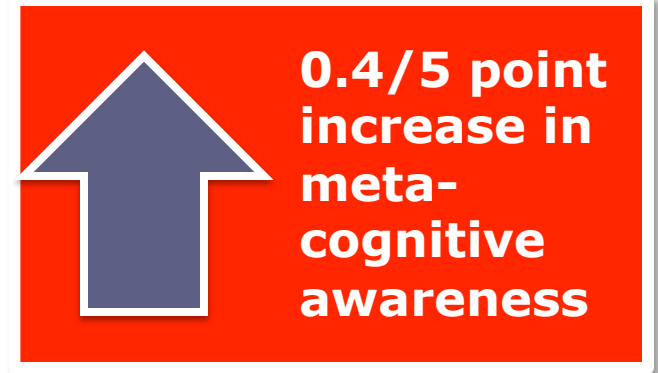
Students in the **SPU EGR 3000 Engr. Seminar & Internship Prep** course demonstrated a statistically significant **0.7/5 point increase** from beginning to end of the course (aggregate measure)

Seattle Pacific

Significant improvements were not found in two other gateway courses

Aggregate Increases in Meta-cognition for Four Phase I & II Gateway Courses

Significant gains were not found in aggregate results for **EGR 1402, Intro to Engr.**, and **CS 300, Large-scale Software Development**

Significant improvements were not found in all professional development categories

Individual Increases in Meta-cognition for EE 398 Intro. Professional Issues
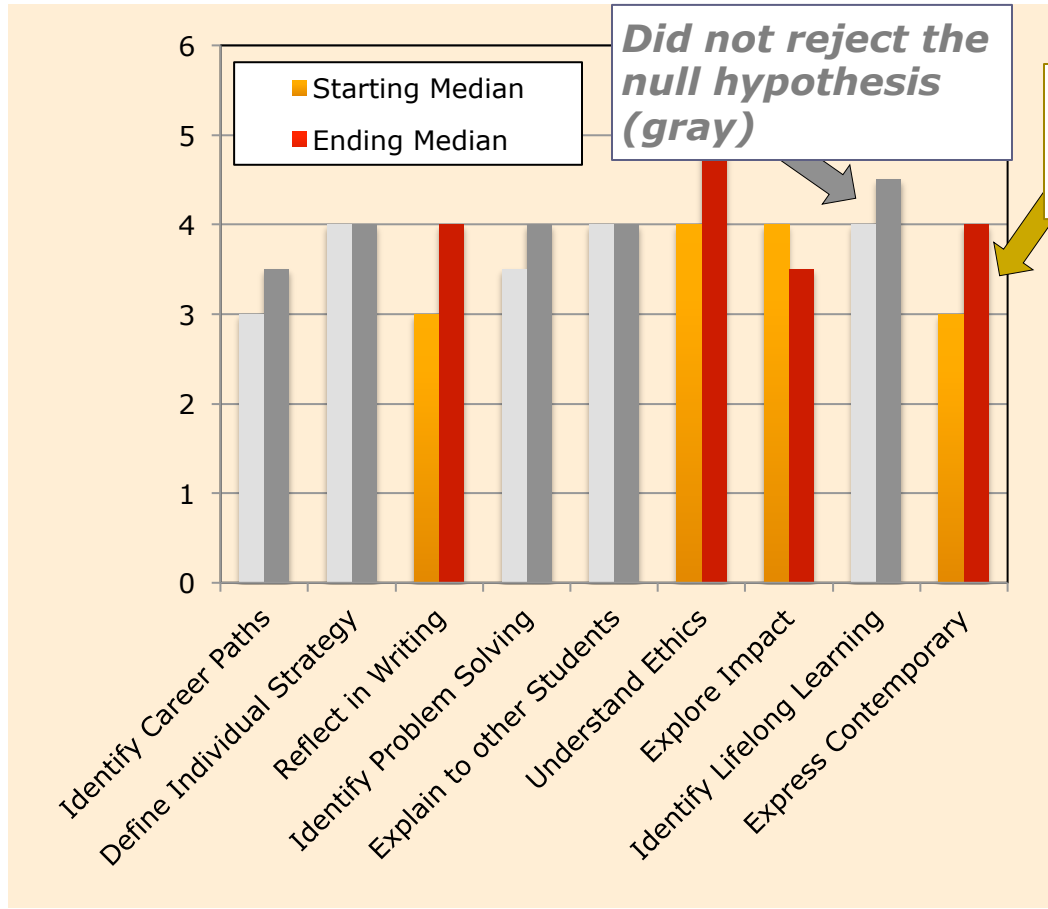
Significant gains in individual categories of *writing, ethics, impact, and contemporary topics* for **EE 398, Intro. Professional Issues**

Significant gains in individual categories were not found for **EGR 3000, Engr. Seminar & Internship Prep**

There were several possible reasons for the lack of significant improvement in various classes

Some insignificant **individual** results for **EE 398 Intro. to Professional Issues**	→	**Not enough time** was spent on the material in the 1-credit course format
Some insignificant **individual** results for **EGR 3000, Engr. Seminar & Internship Prep**	→	Use of an **electronic survey format** contributed to a low survey response rate
Insignificant **aggregate** and **individual** results for **CS 300, Large-scale Software Development**	→	Material was **not well integrated** into the class; **not much time** was spent on the module activities
Insignificant **aggregate** and **individual** results for **EGR 1402, Intro to Engr.**	→	**Not enough time** was spent on the material in the 1-credit course format; use of an **electronic survey format** contributed to a low survey response rate

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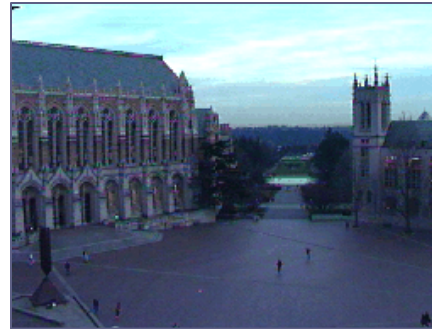
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Contextualizing professional development outcomes into gateway courses can be effective

The Contemporary Worlds course (Phase 1) offerings showed **substantial, statistically significant increases** in the students' **meta-cognitive awareness.**

In **two of four cases** studied in first time offerings of gateway courses at **three universities**, our **aggregate results** showed that **contextualizing professional development outcomes provides significant improvements in student awareness** (meta-cognition) of the professional world.

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Seattle Pacific University

Minnesota State University – Mankato

Observations suggest that to be effective, the course format must be sufficient to adequately develop the instructional intervention strategies.

Thank you... Questions?

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Referenced Literature

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