Contextualizing Professional Development in the Engineering Classroom

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Frontiers in Education 2010
This presentation focuses on contextualized professional development modules for engineering.

Introduction

Professional Development Modules

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

Phase I Intervention Outcomes

Phase II Implementation

Intervention Evaluation & Results

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

The University of Washington is a large, R1 state institution

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

Conclusions
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.
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:

- 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:

1. **Written Communication in Technical Fields**
   - Learning to write in the engineering environment

2. **Interviewing, Networking and Building Relationships**
   - Preparing you to enter the engineering profession

3. **Defining Purpose, Goals, & Objectives**
   - How to best define your personal purpose and goals to achieve maximum satisfaction
There are two modules related to learning and personality styles as they relate to engineering.

**Your Personality Style**
Explaining personality styles in terms of strengths and weaknesses
Matching your personality strengths with your objectives

**Your Learning Style**
Explaining your learning style in terms of strengths and weaknesses
Knowing your strengths and weaknesses

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

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.
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

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

- Did not reject the null hypothesis (gray)
- Statistically significant gains (color)
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.
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Phase II Implementation

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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*
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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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).

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

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).
Significant improvements were not found in two other gateway courses.

Statistically significant gains (color)

Did not reject the null hypothesis (gray)

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

Did not reject the null hypothesis (gray)
Statistically significant gains (color)

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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Phase II Implementation

The University of Washington is a large, R1 state institution.

Conclusions

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

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

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Thank you... Questions?
Referenced Literature


