Work in Progress – Identifying Learning Outcomes of a Multi-Semester International Program in Mechanical Engineering

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Abstract – Global competencies are critical for new engineering graduates, but gaining actual international experience is difficult for engineering students. International programs are not easy to embed in tightly packed engineering curriculums. Additionally, programs are expensive for both students and for schools. Consequently, assessing international program impact is imperative. Understanding a broad range of learning outcomes contributes to sustaining and to scaling programs. Toward those ends, preliminary outcomes for participants in an innovative international program, the Global Engineering Alliance for Research and Education (GEARE) are presented. Work in progress encompasses written survey data and also data gathered in face-to-face “focus group” interaction. Students in the Purdue-Karlsruhe GEARE cohort report substantial change over time in accommodating to new cultural contexts but program impact differs across cultural groups. Purdue GEARE programs have been developed with Shanghai Jiao Tong University and with IIT-Mumbai. The Purdue-Karlsruhe group is the first GEARE group to undergo assessment.

Index Terms – Global competencies, learning outcomes, international programs, global team design.

INTRODUCTION
The National Academy of Engineering identifies “globalization” as one of the potentially defining scenarios for the current century [1]. Global literacy is considered a critical ABET competency [2]. Yet, only about 3% of students who participate in international “study abroad” programs are engineering students [3]. Clearly, innovative programs that are accessible to engineering students, sustainable for engineering schools, and effective in fostering global competencies must be developed. Assessment is crucial to that end. Our work-in-progress addresses learning outcomes of participants in the Global Engineering Alliance for Research and Education (GEARE). GEARE is a multi-semester, experiential international program for engineering students in the Purdue University School of Mechanical Engineering and Universität Karlsruhe (TH), Karlsruhe, Germany. GEARE components are listed in Table 1.

<table>
<thead>
<tr>
<th>Program Component</th>
<th>Location</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic internship</td>
<td>U.S.</td>
<td>3 months</td>
</tr>
<tr>
<td>International internship</td>
<td>Karlsruhe</td>
<td>3 months</td>
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<tr>
<td>Academic coursework with global team design project</td>
<td>Purdue</td>
<td>Semester</td>
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<tr>
<td>Academic coursework with global team design project</td>
<td>Karlsruhe</td>
<td>Semester</td>
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GEARE includes academic coursework at both institutions, a domestic engineering internship and an international engineering internship (three-months during each of two summers) with a partner company, as well as a global team design project completed as part of the academic coursework in engineering design. The GEARE program requires a minimum of three semesters to complete with language competency established prior to departure (two years college level coursework minimum equivalence).

INITIAL ASSESSMENT WORK
Our purpose is to understand more fully how engineering students change in response to experiential programs in intercultural settings.

Initial work is based on written responses and supplemented with interviews conducted in a “focus-group” format. The face-to-face interviews were videotaped and consisted of both “whole group” and “segmented” sessions with two same-language groups (U.S. and German). Each of the language groups was facilitated by one author, matching native languages: German students interacted with German author; U.S. students interacted with American author.

The Purdue students included in this study are now in their last semester of the BSME on the Purdue main campus (January to May 2005), having completed a semester of coursework at Universität Karlsruhe (TH) and before that, a three-month engineering internship in Germany with a GEARE international partner company.

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The German students included in this assessment are closer to the midpoint of their undergraduate engineering program and are currently completing a semester of academic study at the Purdue School of Mechanical Engineering (January to May 2005). The mechanical engineering program for these and all GEARE students includes a design course centered on the “global team design” project first initiated during the Karlsruhe phase of the academic engineering program.

In addition to the written surveys and the face-to-face interviewing already completed, we anticipate adding a standard inventory to assess “cultural sensitivity” levels (the “IDI” proprietary instrument, widely cited in the intercultural program literature) in order to further understand learning outcomes beyond that assessed through academic coursework.

**EXPERIENCE WITH CULTURAL DIFFERENCE**

All students reported that cultural differences impacted their interactions in industrial internships, in team settings and in academic work.

**I. Most Frequently Reported Experiences**

Among the most frequently reported experiences with cultural difference for both the American and the German students are the following:

- Personal/professional or private/public boundaries for interaction on the job.
- Forms of address, familiar versus formal forms.
- Spatial boundary conventions (e.g., closed doors).
- Conventions regarding time (punctuality, formality of "breaks," demarcation of workday end).
- Expectations for multi-tasking, both on the job and in personal relationships.

Both groups, American and German, were aware of accommodating to similar issues regarding appropriate workplace behavior. Both groups reported changes over the course of their programs; both groups reported moving toward more easily accommodating to expectations. Over time, students reported significant gains in how comfortable they were in their new cultural settings. As students became more confident about the expectations of those around them, students reported that they became more productive.

There were exceptions: one student reported on-going isolation is the workplace that may have been gender and/or generation (age) related. Women are much less frequently educated as engineers in Germany than in the U.S and that difference may have contributed to this particular experience.

**II. Differences between U.S. and German Students**

Reports from U.S. and German students taken as groups differed in two respects:

- English language dominance: German students reported English language use as a common resort for all, both Americans and Germans. American students reported considerable progress with their German language skills but did not emphasize any reliance on continued English language usage.
- More overall impact reported by U.S. students: U.S. students reported far more change than German students as a result of the intercultural team experience and the different cultural setting of industrial internships.

Self reports from German students emphasized that the cultural differences they encountered were identifiable but not especially surprising. German students suggested that they were likely to anticipate expectations easily and accurately because of their long experience with American mass media. By contrast, U.S. students, reporting much more “change,” depended much more on academic introductions to German culture (including the cultural orientations provided within the GEARE program). Orientation sessions helped U.S students anticipate and manage issues.

**PRELIMINARY INTERPRETATIONS**

A more comprehensive understanding of outcomes will require additional measures. For example, the Intercultural Development Inventory (IDI) will be introduced in order to provide standardized assessment of cultural sensitivities. Narratives from internship supervisors are also of potential interest.

What is clear from “early returns” based on self-reports is that students are aware of multifaceted changes as a result of their international assignments within GEARE, changes that go well beyond the successful mastery of the engineering content of coursework or the technical content of their engineering internships.

Whether learning outcomes are described as cultural accommodations or as sensitivity to cultural differences, student reports affirm substantial change as a result of program participation. We anticipate further documentation of these changes as we add assessment measures to this and other GEARE cohorts.

**ACKNOWLEDGMENT**

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**REFERENCES**

