Development of PCMI and iDesign Assessment Tools

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I. Introduction

Michigan Tech University has administered the Peace Corps Master’s International (PCMI) program for many years in a variety of departments. It has become the leading university in this kind of program for engineering majors. Despite the years of experience in sending students abroad for 27 months (not including extensions) there is little to describe the impacts on these individuals. Minimal information has been collected to determine some of the differences in these students before and after their tours (Bielefeldt et al. 2010). Additionally, Michigan Tech houses the international senior design program, iDesign. This program takes a group of seniors down to Panama for two weeks of field work and design application. Upon returning to Michigan Tech, the teams work to design and suitable solution to the problem they were posed by a Peace Corps volunteer in Panama. The completion of a design and report comprises their capstone project to fulfill their graduation requirement similar to what involvement in a regular senior design or an enterprise would do. Questions have surfaced on what these students gain as a result of choosing the Peace Corps and iDesign path instead of another (Bielefeldt, 2009; Paterson and Fuchs, 2008). In an effort to respond to these questions, Michigan Tech (Kurt Paterson) has begun collecting data prior to deployment of the students in the Civil and Environmental Engineering Department.

Michigan Tech claims leadership in sustainable engineering education, research, and service; the data analyzed in this study provides preliminary insight on two of these programs. Initial understanding of whether students are learning sustainable engineering is also revealed.

Within the PCMI program their mission suggests that the students involved will assist communities in need via community project development, unfortunately, there is minimal explanation suggesting how they will do this. As part of the data analysis a conclusion can be reached to answer the question regarding how ready these students are to help the communities. Similarly the iDesign program aims to understand how prepared their students are to work within the communities. It is crucial to the overall sustainability of the PCMI and iDesign programs to understand the readiness of the participants. The data analysis can provide invaluable information that could drastically change these programs and help lead to a comprehension of how to promote these programs to others and enhance some of the features they offer.

II. Objectives

The analysis of the collected data is used to aid in a prediction of the future successes or challenges of the individuals involved in international sustainable development. The overall goals of the analysis are to gain a better understanding of:

1.) the individuals attracted to the program,
2.) the effectiveness of sustainable engineering education on preparing them for Peace Corps and iDesign service, and
3.) the programmatic needs for creating truly sustainable engineering practice in developing communities, and
4.) the appropriateness of the assessment program used; as well as resources and issues for scaling it across all the international development programs at Michigan Tech

III. Methods

In order to accomplish the described objectives, the following tasks were initially carried out:

1. Compiling, encoding, and integrating results from six assessment tools administered pre and (near) post on-campus training (and eventually post-Peace Corps/iDesign service). The following is a list of assessment instrument data that will be prepared for analysis:
   a. Skills Assessment Survey
   b. Readiness Assessment
   c. Sustainable Engineering through Service Learning Assessment (SESL)
   d. Intercultural Development Inventory (IDI)
   e. Peace Corps Motivations Essay
   f. Interviews done in the field with students in Peace Corps

Note: instruments b, c, and d have been developed via past research funded by the National Science Foundation (b, c) and the Intercultural Communication Institute (d). All have been validated. Methods a, e, and f follow best practices in qualitative inquiry; together the quantitative and qualitative approaches are needed for a complete understanding of perceptions and motivations.

2. Conducting the following exploratory analyses:
   a. Pattern analysis (e.g. cluster analysis, etc.)
   b. Emergent content analysis

All three methods are standard in the field of exploratory data analysis of these types of datasets. This mixed-methods approach allows for pattern recognition but also pattern understanding.

3. Identification of sustainable engineering education strengths and weaknesses and prediction of the future successes or challenges the involved individuals in international sustainable development may face. Based on the data analyses above, it is hoped that a predictive “risk” or “success” assessment can be generated for each student, allowing preventative mentoring to assist the student during their iDesign or Peace Corps service and research.
Based on current enrollment, the initial dataset (a-e, above) is comprised of results from fourteen participants (taken twice, a total of twenty-eight trials), plus reflective interviews from four students currently serving in Peace Corps. From a mixed-methods perspective, this will provide a substantial challenge for data analysis, but be large enough to begin to explore emergent patterns.

IV. Results

The first step in analyzing the data for each cohort was to determine the variables to be used and code them in such a way that the statistical analysis package being used (SPSS) could understand. It was determined that gender and class rank would qualify as the independent variables, suggesting that they impact the remaining variables. Chi-square and T-tests with a 95% confidence level were conducted utilizing gender and class rank as the predominant independent variables the dependent variables included: readiness, language skills and travel experience (skills assessment survey), challenge question (from the SESL assessment), three components of sustainable engineering through service learning: confidence, attitude, and beliefs, as well as two components from the IDI survey: perceived and developmental score. It was determined through these tests that with a 95% confidence it could be said that class rank impacts the amount an individual had traveled prior to starting in one of the two programs, as well as, impacts the perceived IDI a student had prior to starting in either Peace Corps Master’s International or the iDesign program. From deeper analysis SPSS can conclude that the average graduate student has traveled approximately 3.92 weeks in comparison to undergraduate seniors at 1.76 weeks prior to starting the PCMI/iDesign program. Additionally, graduate students score about 121.58 in comparison to undergraduate seniors at 118.46 on their perceived IDI survey. Lastly, it could be said with a 95% confidence through a chi-square test that gender impacts one of the three components of the sustainable engineering through service learning assessment, attitudes. The remainder of the Chi-square and T-tests were inconclusive on statistical significance. This could be attributed to the size of the study. Further analysis should consider expanding the data set size to reduce error and any inconsistencies.

A secondary approach in analyzing the collected data was to utilize external tools such as the SESL grading rubric in order to better understand some of the difficult to quantify data. The rubric was utilized in the quantification of the challenge question data. For this component of the study students were asked to write a response to a question (out of a choice of two questions) pertaining to designing, developing, and implementing a technology, the location varying between questions. There were a wide range of responses to these questions and the rubric was a tool utilized to acquire aspects of sustainability in engineering design. This tool focused on the three pillars primarily, economics, social, and the environment, and if the student addressed them within their narrative response to the posed question. From this
step, the data was entered into SPSS and included in the aforementioned chi-square and t-tests. Unfortunately potentially due to the lack of enough data, the result of the tests for the challenge question was inconclusive to consider gender or class status to be a contributing factor to their result.

Another component of the collected information was the responses to the motivation narrative. For this students were asked to explain why they were motivated to participate in the program they were entering (PCMI/iDesign). For this there wasn’t a predesigned rubric like with the SESL narrative. In order to tabulate any sort of information on the responses given the lack of resources an online resource was utilized (wordle.net). This resource takes a large amount of text and creates a cloud from the popular terms within the text. This was further analyzed to understand what aspects students consider when explaining their motivations. Below in Figure 1 is a depiction of how this resource works.

From this it is quite simple to see that students entering the PCMI program were considering international aspects, research and career experience, people and communities, and various other topics as they discussed their motivations for entering into the program. Different forms of analysis on this data could be performed given another method such as a specific grading rubric like the SESL challenge question uses.

V. Discussion-Future Considerations
With additional data along with future post (near) post on-campus training (and eventually post-Peace Corps/iDesign service) the set can be expanded and a further understanding of how well these programs are doing overall can be achieved. Part of the difficulty associated with many international programs like PCMI and iDesign is the lack of resources and information to allow for this type of analysis. In order to complete all of the outlined tasks to result in an explanation of how the parties involved will face future tasks in international sustainable development more information needs to be collected. This report solely provides a very basic understanding of how gender and class rank impacts the tabulated results from instruments a-d (Section 3 bullet 1).

Additionally, a better understanding of how the anticipation of future tasks is comprehended by those waiting to be placed by the Peace Corps or iDesign program could be determined on less of a preliminary basis given the appropriate resources. As a result of this understanding, future programs for assistance to better prepare students may be created to aid the individuals prior to service, and ultimately their host communities with truly sustainable development projects. This study aims to begin to address the anticipation faced by students in the PCMI and iDesign programs. This anticipation was addressed in the form of the readiness assessment. Unfortunately, there is no correlation between readiness and gender or readiness and class rank. Further studies could include a wider range in independent variables allowing for more conclusive results.

Variables analyzed in this study included the data (indices for a-d, coupled with qualitative for e-f listed under bullet 1 in section III) collected out of the various tools. With more data the following concerns (hypotheses) could be addressed through the analysis of the surveys:

1. Are the students involved in the PCMI program learning sustainable engineering?
2. How ready are the students to assist communities in need based on the training they are given prior to departure?
3. Can an analysis of an assessment data be used to help design sustainable engineering programs and prepare students to be engaged professionally?

Finally, through this investigation, preliminary evidence has been gathered to inform several program-level challenges for these type of university offerings (Silliman et al. 2010):

• What kind of experience and training are important to successful international sustainable development engineering students? For example, is the standard mix of evidence for acceptance into graduate school adequate?

• Does the ethical imperative of sustainable development require university training to adequately prepare all students regardless of their entering backgrounds? If so,
can the results of this and similar studies determine tailoring of educational plans for individual students? What might that look like?

• What are the costs and benefits of the “one size fits all” business-as-usual higher education strategy? This study may shed some initial light on the sustainability of international development engineering programs both in terms of their operations and their outcomes. This will help suggest what these programs are doing for others, not solely for the individuals enrolled in them.

VI. Discussion-Applications

The tabulation of this data is vital for the sustainable and responsible administration of the Peace Corps Master’s International programs. These programs can utilize this data in altering the process pre- and post-deployment of the individuals involved in the program. Additionally, other universities involved with the similarly spirited programs will have access to the information and further develop their programs they have or are starting. A better knowledge base for how these individuals are preparing for their placement, executing development projects, as well as how they adapt post-service will be gained as a result of this analysis.

VII. Conclusions

This preliminary study creates a basis for which to continue future studies. It is apparent that there is a need to better understand how prepared students involved in international programs like iDesign and PCMI prior to working within the communities with which they will be assigned. From this preliminary analysis it can be concluded that there are correlations with student involved with these program and how they respond to the instruments they are surveyed with. Future analysis is crucial in understanding what can be done to better prepare these students for the work they will do out in the field.

VIII. References


