

**AC 2009-922: INTERNATIONAL CAPSTONE DESIGN PROJECTS:  
EVALUATING STUDENT LEARNING AND MOTIVATION ASSOCIATED WITH  
INTERNATIONAL HUMANITARIAN PROJECTS**

**John Layer, University of Evansville**

John K. Layer, Ph.D., P.E is an Assistant Professor of Mechanical Engineering at the University of Evansville, Evansville, Indiana.

**Chris Gwaltney, University of Evansville**

Chris Gwaltney, P.E. is an Associate Professor of Civil Engineering at the University of Evansville, Evansville, Indiana.

# **International Capstone Design Projects: Evaluating Student Learning and Motivation Associated with International Humanitarian Projects**

**Keywords: Structural Equation Modeling, Questionnaire, Invariance Testing**

## **Abstract**

The University of Evansville, Mechanical and Civil Engineering Department facilitates the active learning of its students by requiring senior mechanical and civil engineering students to be involved with a real-world capstone design project during their senior year. These engineering projects provide the application of classroom instruction, encourage team work and communication skills, and provide an engineered solution that addresses an industrial or societal need. The typical process is to couple the industrial or societal need to the interest of the senior engineering student(s) in order that students have a vested interest in the project and obtain a sense of difference-making in completing the project. This paper evaluates student learning and motivation and provides a status report on the ongoing research at the University of Evansville concerning the enhancement of student learning and motivation by virtue of international and humanitarian attributes associated with international capstone design projects.

Eleven University of Evansville students traveled to the Dominican Republic for a six-day data collection activity that resulted in three capstone design projects for these students plus four additional students. A structural equation modeling analysis is presented that develops independent latent variables for international and humanitarian attributes that affect the proposed dependent latent variables of student motivational and learning outcomes.

This research is on-going and more data is required to develop a statistically significant structural model, although the development of the structural model provides a quantitative process to support other cited development models concerning student learning environments while providing direction with the on-going research. Invariance testing provides a process to evaluate the time-dependent effect of the design process as well as time elapsed from the on-site data collection activities. Invariance testing provides a means to answer the question “does the structural model change as time progresses?” Learning outcomes are shown to be enhanced with the travel related activities. This learning outcome enhancement was evaluated by analyzing the differences between students that traveled to the Dominican Republic versus those students who are associated with the projects but did not travel.

These Dominican Republic projects are distinctive in their coupling of the active learning component of the engineering senior capstone design project concept and the application of an international societal need. This series of Dominican Republic projects furthers the intention of the ABET engineering program outcome of providing “broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context”<sup>1</sup>. The overall benefit of this international capstone design project is to provide the students an opportunity to investigate, assess, coordinate, design, communicate, and possibly witness the

implementation of an engineered solution in an international setting, thus affording a global difference-making awareness in the students.

## **Introduction**

The growth of the world population poses a very interesting situation for the disciplines of engineering. It is estimated that approximately four billion people live on less than 2 USD per day, and that by the year 2030 two billion additional people will populate the world with 95% of them residing in developing or underdeveloped countries<sup>2</sup>. This statement elicits a response in what we believe to be a technologically advanced world. How can we have such a large percentage of the world population separated from what we could consider basic services and infrastructure?

The issue of globalization has become such a focal point among some engineering educators that a recent paper stated, “As educators we must not only prepare students to understand the fundamentals of math, science and engineering, but must also prepare students to work within a global environment... to include ... intercultural interaction”<sup>3</sup>. This emphasis on globalization is continued in the ABET engineering program outcome of providing “broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context”<sup>1</sup>. The Dominican Republic capstone design projects introduce the students to a population that has a high societal need and provide an experiential learning dimension that the students may have not been introduced to in any other way. It has been estimated that only 6500 American engineering students travel abroad to study each year<sup>4</sup>, therefore while educators see an importance in students gaining a global perspective, very few engineering students are actually pursuing such an experience. It is anticipated that the University of Evansville students will gain valuable communication and collaboration skills while working on the Dominican Republic projects and will gain an appreciation of the individual difference-making potential that the engineer can experience by being part of such a humanitarian design project.

Previous research has been conducted on international design projects and suggests the benefit to students are substantial and contain such attributes as learning of differing cultures, societal impact, problem-solving, cross-cultural communication and collaboration. In addition to these benefits, international design projects are reported to afford the broadening of the student experience and exposure<sup>5,6</sup>. It is the intention of this current study to evaluate the causal relationship<sup>7</sup> that the international and humanitarian attributes of this Dominican Republic capstone design project exhibit with the enhancement of the students’ motivation to learn.

## **Dominican Republic capstone design projects**

The perceived societal need is what has driven this University of Evansville Dominican Republic capstone design project effort. Eleven University of Evansville engineering seniors traveled to Santiago, Dominican Republic in August 2008 to take part in a six-day data collection site visit. This engineering data, with the aid of four additional University of Evansville students, will be analyzed during the 2008-09 academic year and precipitate specific capstone design specification recommendations. This general capstone design experience is a requirement of the Mechanical and Civil Engineering departments. The distinctive nature of the Dominican Republic project is

that it couples the departmental requirement of the capstone design experience with the international societal need of the specific Dominican Republic project scopes of work.

The on-site visit provided an opportunity for the students to perform surveying activities, soil in-situ testing and collection of soil samples, evaluate local concrete construction techniques and material strength, and obtain initial data to facilitate the completion of three site assessments. The civil engineering students formed surveying/ site assessment teams and evaluated three sites over a 6 day period. In addition to the site assessment activities, a structural team gathered data needed to design a church, and a mechanical engineering student collected data for a solar water heating project. The engineering information obtained from the initial Dominican Republic visit provided the student teams with critical engineering data for a total of three design projects that would be completed during the 2008-2009 academic year. The three design projects include: 1. a 40 acre Sports Complex, 2. a church structural design, and 3. a solar water heating system for a 60-person dormitory. In addition, the site visit put the students in direct contact with their Dominican Republic client, as well as the general population who will benefit from these projects.

## **Methodology**

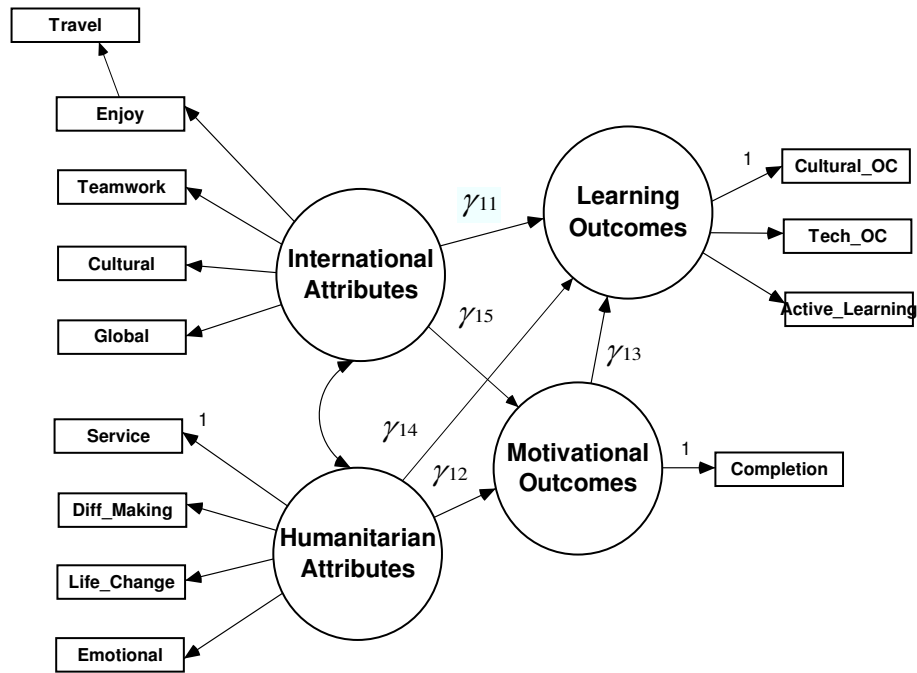
### **Dominican Republic learning outcomes causal model**

The planned outcome of this capstone project is to provide the students an opportunity to investigate, assess, design, communicate, and possibly witness the implementation of an engineered solution in an international setting, thus affording a global difference-making awareness in the students. The evaluation of learning and motivation associated with the projects will be assessed through a series of anonymous student questionnaires that shall be evaluated by a structural equation modeling process utilizing both AMOS and SPSS software packages. This structural equation modeling process assesses the hypothesized cause-effect relationship between model variables. This process analyzes the causal structural relationships that exist between hypothesized independent and dependent latent variables as measured by the standardized structural regression path coefficients ( $\gamma_{11}$ ,  $\gamma_{12}$ ,  $\gamma_{13}$ ,  $\gamma_{14}$ , and  $\gamma_{15}$ ), as well as the measurement model (indexed questionnaire items) that describe the latent variables (figure 1).

The measurement model for the latent variable International Attributes includes four indexed manifest variables: 1. Enjoyment of data collection visit, 2. Teamwork, 3. Cultural Awareness, and 4. Global Awareness. The manifest variables were measured as an index of various indexed questionnaire items. Each of the above referenced indexed variables describes an average of 1 to 4 scaled questionnaire items completed by the student and was tracked according to student and wave number. The item responses generally followed a 5-point Likert-type scale (with some items reverse coded) fitted to one of two possible ranges: 1. extremely satisfied – extremely dissatisfied, or 2. strongly agree – strongly disagree with the final response coding ranging from 1 – very favorable to 5 – very unfavorable. An example of the indexed manifest variable Cultural Awareness included the average questionnaire item response of the following three representative questions:

“My preconceptions of the Dominican Republic culture have been changed by this project ”.  
 “I have gained an appreciation for cultures other than my own since working on this project.”  
 “This project has increased my awareness of societal differences.”

Amos dr data collection\_rev02a\_wave 1 and 2\_hypothesis  
 group = VWave 1 and 2



**Figure 1. Hypothesized Dominican Republic Learning Outcomes Causal Model**

The Humanitarian Attributes latent variable was measured by the following indexed manifest variables: 1. Service Activity, 2. Difference-Making, 3. Life-Changing Experience, and 4. Emotional Involvement. The Learning Outcomes dependent latent variable utilized the following indexed manifest variable as a measurement model: 1. Cultural Outcomes, 2. Technical Outcomes, and Active Learning. The Technical Outcomes indexed manifest variable was developed using the below three representative questions:

*“I gained an appreciation for engineering field work as result of this project.”*  
*“I have been introduced to different engineering considerations as a result of this project.”*  
*“I gained an appreciation for the differing construction methods associated with this project.”*

The independent latent variables of International Attributes and Humanitarian Attributes are modeled in such a way as to evaluate the covariance of the two independent latent variables while directly affecting both of the dependent latent variables. The dependent latent variable Motivational Outcomes is structurally modeled to affect the dependent latent variable Learning

Outcomes, since student motivation (i.e. feeling active, engaged, and excited) is critical in the attainment of learning<sup>8</sup>. Each latent variable was measured by a specific number of indexed manifest variables derived from questionnaire items. A complete questionnaire is included in appendix A for reference.

This study's causal model is consistent with the development model designed by Vanasupa, Harding, and Hughes<sup>9</sup> which depicts the understanding of the broader context (i.e. International Attributes) and the incorporation of engagement and ethical development (i.e. Humanitarian Attributes) causes an increase in the student's internal drive to learn (i.e. Learning Outcomes and Motivational Outcomes). Other studies have described relationships between student confidence, perceived view of importance of subject matter, and student engagement effect learning outcomes<sup>10</sup>. The Dominican Republic Learning Outcomes Causal Model uses structural equation modeling techniques to quantify the causal nature of specific relationships that the Vanasupa et. al. development model suggests, within the context of an international capstone design experience.

Service learning appears as a manifest variable measuring Humanitarian Attributes. Despite the fact that there has been evidence provided that our society is turning from a value system based on self-sacrifice and duty, to more of a value system based on self-attention<sup>11</sup> and self-serving behaviors, service learning remains an important factor in facilitating student engagement and developing student motivation<sup>12</sup>. This experiential service learning component enhances student learning while facilitating the development of self-efficacy. Service learning opportunities provide immediate feedback concerning the student's contribution in addressing a particular societal need, thereby greatly bolstering the student's self-view of capability. Student self-efficacy reinforces perseverance and motivation, and as a result facilitates the learning process<sup>13</sup>.

### **Sampling frame, study procedures and data collection**

The study population will consist of 15 University of Evansville civil and mechanical engineering students, consisting of 13 seniors, 1 junior and 1 sophomore. All 15 students will be associated with the Dominican Republic capstone design projects and be enrolled in the integrated design course sequence. Eleven senior students traveled to the Dominican Republic, while the remaining four students were not actually involved with the international trip but are actively involved with the project during the 2008-09 academic year.

Two of the three planned waves of anonymous, but coded questionnaires have been administered to the 15 students as of this status report. The questionnaires were administered with a request that the student use a code name of their choice on all three questionnaires, so that possible analysis could be conducted while controlling for students. One questionnaire was given during the pre-proposal period, the second questionnaire was given during the design period, and the third questionnaire is planned during the final report period. The pre-proposal questionnaire was designed to evaluate the students during the period between the data collection Dominican Republic trip and the presentation of the student's proposal so that the remembrance of the travel specific experiences were fresh. The design questionnaire was administered during the actual design period approximately three months after the pre-proposal questionnaire was administered,

while the final report questionnaire shall be given during the final report period of the design approximately six months after the pre-proposal questionnaire was administered.

Multi-group invariance analysis evaluates the causal relationships affected by the time following the travel to the Dominican Republic. The structural equation, multi-group evaluation of the validated model was utilized in this model invariance (or equivalence) analysis. Specifically, the invariance testing of the latent variable structural path coefficients was the objective of this analysis. The consideration of time-phased, multi-wave (pre-proposal, design, and final report) invariance is considered plausible. Byrne<sup>14</sup> describes the process of evaluating the summative Chi-squared ( $\chi^2$ ) statistics for each baseline group, as compared to the structural equation model simultaneous (integrated) multi-group  $\chi^2$  statistic for a measure of model factorial significance. “Given that  $\chi^2$  statistics are summative, the overall  $\chi^2$  value for the multi-group model should equal the sum of the  $\chi^2$  values obtained when the baseline model is tested separately for each group (with no cross-group constraints imposed). Therefore, the statistical significance between the summative and simultaneous multi-group models resides in the evaluation of the difference in  $\chi^2$  values ( $\Delta \chi^2$ ) between the two models. This difference is itself  $\chi^2$ -distributed, with degrees of freedom (df) equal to the difference in the model degrees of freedom ( $\Delta df$ ) and can be thus be tested statistically”<sup>15</sup>. Therefore, an insignificant  $\Delta \chi^2$  indicates invariance, or equivalence, of specific multi-group structural model parameters that were constrained to be equal across groups during the simultaneous structural equation solution evaluation.

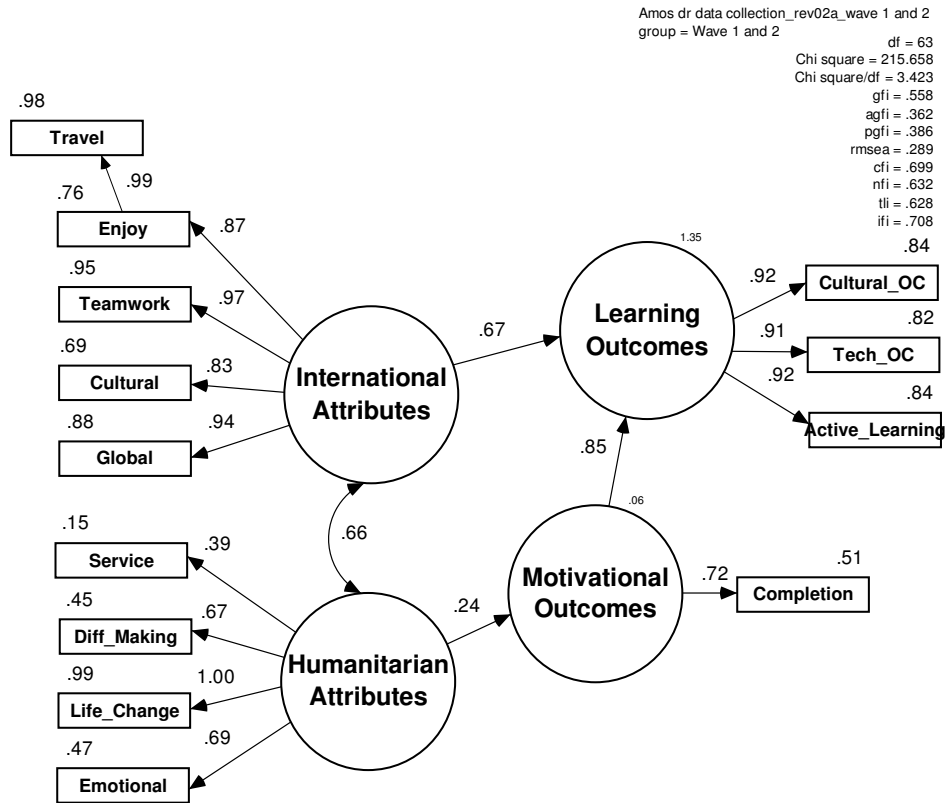
In addition, multi-group invariance analysis evaluating the learning and motivational differences between the students that did travel to the Dominican Republic to assist with the on-site engineering data collection activities (11 students) and those that did not travel (4 students) is a planned research activity of this study.

The descriptive statistics concerning the data from these three questionnaires was evaluated with the SPSS software package. The causal relationship between the latent and manifest structural equation model variables were evaluated with the AMOS structural equation modeling software, utilizing the SPSS database.

## **Results and discussion**

### **Causal model structural validity analysis**

The causal model (figure 2) is the graphical representation of the model’s estimated standardized path regression weights and variable squared multiple correlations following the removal of insignificant regression path coefficients ( $\gamma_{14}$ , and  $\gamma_{15}$ ) present in the original hypothesized causal model (figure 1). All path coefficients contained in figure 2 were statistically significant ( $p < .05$ ), except for the HUMANITARIAN ATTRIBUTES  $\rightarrow$  MOTIVATIONAL OUTCOMES,  $\gamma_{12}$  ( $p = .17$ ), although this relationship is believed to be substantive for future model development.



**Figure 2. Wave 1 and 2 Dominican Republic Learning Outcomes Causal Model**

It should be noted that the combined Wave 1 and 2 structural equation modeling analysis sampling size validation falls below the minimum sample size required for acceptable reliable structural equation modeling practices, therefore the presented structural equation modeling analysis can only be considered substantive or directional, but not statistically significant. In order to have been considered a reliable statistical evaluation the minimum sample size would have been approximately 115, as compared to the actual combined Wave 1 and 2 sample size of 30 at this current phase of the research. The model did not indicate a good fit to the data, with the goodness of fit indices presented in Table 1, including reasonable fit criteria applicable for use with the maximum-likelihood approximation<sup>16,17,18</sup>. The root mean square error of approximation (RMSEA = 0.29) was larger than what was suggested as a reasonable error of approximation (RMSEA <0.08) by Arbuckle<sup>19</sup>. Therefore, in light of the evaluation of all Table 1 goodness of fit indices and the limited sample (n = 30) for this phase of the research, the combined Wave 1 and 2 data does not provide a statistically significant model. Continued data collection is necessary to provide a sample size of approximately 115, although the model does provide directionality to the on-going and future research. The data collection is yielding reliable data with the overall model Cronbach's alpha ( $\alpha$ ) = 0.90.



**Table 1. Combined Wave 1 and 2 Structural Equation Modeling Goodness of Fit Indices**

Goodness of Fit Indices	Reasonable Fit Criteria	Combined Wave 1 and 2 Results
Degree of Freedom	----	63
Chi-square statistic	----	215.6
Chi-square statistic/d.f. ( $\chi^2/df$ )	2:1 to 5:1	3.4
Goodness of Fit Index (GFI)	> 0.90	0.56
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.36
Parsimony Goodness of Fit Index (PGFI)	> 0.50	0.39
Root Mean Square Error of Approx. (RMSEA)	< 0.08	0.29
Comparative Fit Index (CFI)	> 0.90	0.70
Normed Fit Index (NFI)	> 0.90	0.63
Tucker-Lewis Index (TLI)	> 0.90	0.63
Incremental Fit Index (IFI)	> 0.90	0.71

The standardized structural path coefficient INTERNATIONAL ATTRIBUTES → LEARNING OUTCOMES ( $\gamma_{11} = 0.67$ ,  $p < .001$ ) is interpreted such that an increase in the international attributes of the student results in a direct effect (0.67 multiplier) on the improvement in the learning outcomes variable. Similarly, the standardized structural path coefficient MOTIVATIONAL OUTCOMES → LEARNING OUTCOMES ( $\gamma_{13} = 0.85$ ,  $p < .001$ ) is interpreted as any increase in the motivational outcomes experienced by the student results in a direct effect (0.85 multiplier) on the improvement in the learning outcomes variable. The HUMANITARIAN ATTRIBUTES → MOTIVATIONAL OUTCOMES path coefficient ( $p < .17$ ) does not have the strength of association as the other structural path coefficients, but remains substantive in the explanation of the total structural model for continued data collection and research. All measurement path coefficients were statistically significant at ( $p < .03$ ). The review of the squared multiple correlations indicate that 84% of the CULTURAL OUTCOMES variance is attributed to the specific latent variable measurement model, as is 82% of the TECHNICAL OUTCOMES variance, and 84% of the ACTIVE LEARNING OUTCOMES variance.

### Testing for invariance across data collection waves

The evaluation of the time-phased question where the relationship between the latent variables is temporal in nature is first evaluated at the data collection wave level. There has been two waves of data collection at this point in the research, and the testing for the structural path coefficients ( $\gamma_{11}$ ,  $\gamma_{12}$ , and  $\gamma_{13}$ ) invariance was considered a hierarchical first choice in testing the research question of temporal invariance in the structural model. The question, “Does motivation diminish with time following international/ humanitarian experience within the context of a capstone design project?” is a logical question that this invariance analysis wishes to address.

Wave 1 and Wave 2 data collection periods were evaluated individually utilizing the structural equation model and allowing wave specific optimized structural path coefficients ( $\gamma_{11}$ ,  $\gamma_{12}$ , and

$\gamma_{13}$ ) to take on any particular values. The standardized structural path coefficients ( $\gamma_{11}$ ,  $\gamma_{12}$ , and  $\gamma_{13}$ ) are presented in table 2.

**Table 2. Wave 1 and Wave 2 Standardized Structural Regression Path Coefficients**

Path Coefficient	Wave 1	Wave 2
INTERNATIONAL ATTRIBUTES → LEARNING OUTCOMES ( $\gamma_{11}$ )	0.91 (p<.001)	0.70 (p<.008)
HUMANITARIAN ATTRIBUTES → MOTIVATIONAL OUTCOMES ( $\gamma_{12}$ )	0.28 (p<.07)	0.52 (p<.01)
MOTIVATIONAL OUTCOMES → LEARNING OUTCOMES ( $\gamma_{13}$ )	0.58 (p<.001)	0.81 (p<.001)

To evaluate the invariance of these structural path coefficients across the two waves the summative overall  $\chi^2$  value (figure 3) of the two waves ( $\chi^2 = 381$ ,  $df = 126$ ) was compared with the simultaneous analysis which yielded  $\chi^2 = 409$ ,  $df = 138$  (table 3). The  $\chi^2$  difference of these two multi-group models yielded  $\Delta \chi^2 = 0.28$ ,  $\Delta df = 12$ , which was significant. Therefore, the structural path coefficients ( $\gamma_{11}$ ,  $\gamma_{12}$ , and  $\gamma_{13}$ ) are non-invariant (not equivalent) across the two waves of data collection, implying that the relationships between the latent variables do vary across waves of data collection relating to three months of elapsed time between data collection periods and the initiation of the project design activities.

**Table 3. Multi-group Invariance Testing Across Data Collection Waves**

Model Description	Sample Size	$\chi^2$	df
Wave 1	15	197	63
Wave 2	15	<u>184</u>	<u>63</u>
Total:		381	126
Simultaneous Analysis:	30	409	138

The sample size of both waves of data collection was small ( $n = 15$ ) and did not yield a statistically significant multi-group structural equation model, although the results do provide directional consideration for further research. A difference of two means t-test was conducted on

the indexed manifest variables in order to verify the non-invariant nature of the Wave 1 and Wave 2 data. All indexed manifest variable Wave 1 and Wave 2 means did statistically equate to each other, except for the CULTURAL AWARENESS variable ( $p < .05$ ) which indicated an increase in the cultural awareness experienced by the students in the time between Wave 1 and Wave 2 data collection.

### Testing for invariance across students that did/and did not travel to the Dominican Republic

A natural consideration for this study was whether the actual travel to the Dominican Republic affected the students' motivational or learning outcomes, so testing for invariance across students that did/ and did not travel was evaluated. The sample size of the students that did not travel ( $n = 8$ ) was too small to utilize the AMOS multi-group structural equation modeling analysis, so the difference of two means t-test was utilized for the indexed manifest variables. Table 4 presents the results of the t-test revolving around the null hypothesis  $H_0: \mu_1 - \mu_2 = 0$ , where the mean of the particular indexed manifest variables of the two groups were tested for equivalence.

**Table 4. Evaluating Students who Did Travel/ and Did Not Travel to the Dominican Republic: Difference of Two Means t-test ( $\alpha = 0.05$ )**

Indexed Manifest Variable	Did Travel ( $\mu_1, s_1$ )	Did Not Travel ( $\mu_2, s_2$ )	Test Statistic	$H_0: \mu_1 - \mu_2 = 0$ $H_a: \mu_1 - \mu_2 \neq 0$
<b>International Attributes:</b>				
Enjoyment of Data Collection	4.82,.40	0.00,.00	34.14	Reject $H_0$
Teamwork	4.61,.34	1.38,1.51	9.70	Reject $H_0$
Cultural Awareness	3.97,.57	2.48,1.44	4.14	Reject $H_0$
Global Awareness	4.68,.48	2.00,2.20	5.52	Reject $H_0$
<b>Humanitarian Attributes:</b>				
Service Activity	4.55,.60	4.50,.53	0.19	Accept $H_0$
Difference-Making	4.74,.33	4.65,.41	0.60	Accept $H_0$
Life-Changing Experience	4.33,.41	3.75,.66	2.91	Reject $H_0$
Emotional Experience	4.57,.50	4.31,.53	1.23	Accept $H_0$
<b>Motivational Outcomes:</b>				
Completion, Drive to Success	4.58,.42	4.41,.50	0.94	Accept $H_0$
<b>Learning Outcomes:</b>				
Cultural Outcomes	4.54,.32	3.83,.42	4.93	Reject $H_0$
Technical Outcomes	4.21,.42	2.79,1.11	5.18	Reject $H_0$
Active Learning	4.54,.33	2.49,.60	12.11	Reject $H_0$

The difference appeared in the INTERNATIONAL ATTRIBUTES and the LEARNING OUTCOMES. The students that did not travel to the Dominican Republic for the six-day data collection activity did not possess as strong a sense of teamwork, nor did they develop a depth of global and cultural awareness as the students that did travel to the Dominican Republic. An extrapolation of the structural equation model directionality would suggest that this lessened INTERNATIONAL ATTRIBUTES variable in the students that did not travel substantially attributed to the lower achievement of the LEARNING OUTCOMES variable as indicated in table 4.

## Summary

This paper is presented as a status report of the ongoing research that is being conducted at the University of Evansville concerning the enhancement of student learning and motivation by virtue of international and humanitarian attributes associated with international capstone design projects. International and humanitarian attributes appears to be substantial in affecting the motivational and learning outcomes of students within the context of international capstone design projects, although the causal modeling presented does not have a sufficient sample size to provide statistical significance at the current phase of the on-going research. The directionality of the causal modeling does provide the potential to quantify cited developmental models that describe contextual, ethical, and motivational components of student learning environment. The structural equation modeling process of this study suggests that an increase in the international attributes (as measured by questionnaires) of the student results in a direct effect (0.67 multiplier) on the improvement in the learning outcomes variable. Similarly, the motivational outcomes enabled by the humanitarian attributes and experienced by the student result in a direct effect (0.85 multiplier) on the improvement in the learning outcomes variable.

The invariance testing provided insights into the time-phased effect of the design process and time elapsed from the on-site data collection activities in the Dominican Republic. A structural causal model difference appears to exist between the latent variables. The humanitarian attributes gain validity as the time progresses, where the international attributes influenced by the actual travel specific activities may lessen in strength during the three month period between questionnaires.

A very interesting finding has been the invariance attributed to students that did travel to the Dominican Republic and those students that did not travel. The findings suggest that while both groups see the design activities as humanitarian in nature which facilitates the motivation to complete a successful project, it is the foundational activity of travel that provides the substantial ingredient that enables the enhancement of learning outcomes. The students that did not travel to the Dominican Republic and participate in the six-day data collection activities did not exhibit the strong sense of teamwork, nor did they develop the depth of cultural and global awareness as the students who did travel to the Dominican Republic.

The professors associated with this Dominican Republic design effort wanted the students to experience the difference-making potential a single person can have by taking their engineering

skills to a people that are less fortunate than themselves. A few student comments are included below which give the authors hope that this objective was met:

“It is one of my life experiences that has changed the way I view life ... words cannot adequately describe the feeling, you have to experience it.”

“Going to the Dominican Republic gave me the opportunity to help someone that is in need.”

“Our senior projects in the Dominican Republic are really needed by people now; these projects are not just an exercise.”

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**Appendix A**  
**Questionnaire (DR-2)**

## 2008 Dominican Republic Pre-Proposal Survey: DR-2

Anonymous Code Name (print): \_\_\_\_\_

Today's Date: \_\_\_\_\_

Are you male or female? M  F

Did you travel to the Dominican Republic Y  N

The following survey ask you questions about your Dominican Republic project. Please darken the circle that best represents your responses. If the question is not applicable to you (i.e. you did not travel to the Dominican Republic), check the "Question Not Applicable" box.

Rate your level of *satisfaction* or *dissatisfaction* with the following Dominican Republic project attributes.

	Extremely Satisfied	Somewhat Satisfied	Undecided	Somewhat Dissatisfied	Extremely Dissatisfied	Question Not Applicable
241 To what degree are you satisfied with the way your peers get along at this point in the project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
236a To what degree are you satisfied that the quantity of data received during the site visit was sufficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
236b To what degree are you satisfied that the quality of data received during the site visit was sufficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
61 To what degree are you satisfied with the technical content of your project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4 To what degree are you satisfied with the relatedness of the project scope to what you have learned in class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
205 To what degree are you satisfied with the level of decision-making you experienced during the site visit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
232 To what degree are you satisfied with the data collection planning and logistics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
48 To what degree are you satisfied that your oral communication will be enhanced by this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
200a To what degree are you satisfied with the client/project team communication	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
42 To what degree are you satisfied that your written communication will be enhanced by this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
234 To what degree are you satisfied with the amount of interaction between the faculty/students at this point in the project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17 To what degree are you satisfied that you are meeting the needs of a group of people with your engineering solution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
220 To what degree are you satisfied with the client relationship that has been fostered at this point in the project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3 To what degree are you satisfied with your ethical development concerning this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22 To what degree are you satisfied that your engineering work on this project will aid the quality of life of someone else	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your level of *agreement* or *disagreement* with the following Dominican Republic project attributes.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Question Not Applicable
1 The level of effort required for this international project is greater than a domestic project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
249a I believe that the data collection international visit was important to my overall education	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16 This project involved me on an emotional, as well as intellectual level	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
249b In retrospect, I believe that the six day data collection activity was an appropriate length of time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
60 I felt safe during the site visit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
226 My design experience has been enhanced by virtue of this international project scope	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
225 My overall educational experience would not be as rich if I had a domestic project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27 The site visit provided a sense of belonging or comradeship among the students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6 The international project scope greatly increased my interest in completing a successful project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7 The site visit "hands on" engagement helped to solidify various in class learning points	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
243 My preconceptions of the Dominican Republic culture has been changed by this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



## 2008 Dominican Republic Pre-Proposal Survey: DR-2

The following survey ask you questions about your Dominican Republic project. Please darken the circle that best represents your response.

Rate your level of *agreement* or *disagreement* with the following Dominican Republic project attributes.

		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Question Not Applicable
9	This project is important in that it will enhance the quality of life of a specific group of people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	I feel that I can make a difference with the successful completion of this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21	My involvement on this project has been a life changing experience for me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	This project has affected my view of life-long learning, there is much to be learned about different cultures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
244	The design process has strengthen my belief that the data collection activity was successful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
229	My global awareness of engineering or societal needs has been enhanced by working on this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
240	I have gained an appreciation for cultures other than my own since working on this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23	I gained a meaningful personal insight on the impact of engineering in humanitarian situation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
211	The humanitarian nature of this project has increased my appreciation of the impact of engineering in a societal context	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31	I developed, or enhanced, an interest in learning about different cultures as a result of this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
47	International projects require a larger degree of adaptation or improvisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
200c	The design process has strengthened my resolve for completing a successful project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24	I am motivated to drive this project to a successful completion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	I feel a healthy degree of pride when I think of the engineering work I am providing on this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
39	I gained an appreciation for the differing construction methods associated with this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
230	This project has increased my awareness of societal differences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18	This project has the potential to shape my values in the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
235	I enjoyed the international data collection visit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	The humanitarian nature of this project has increased my motivation to complete this project successfully	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
212	I consider this project as an act of service, in addition to an engineering project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
62	I would recommend an international senior project to another student in the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
200b	The design process has facilitated my overall learning experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
35	The beach day was important for relaxing and unwinding prior to traveling home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
228	I gained an appreciation for engineering field work as a result of this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
250	I have been introduced to different engineering considerations as result of this project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
37	The cross-culture working relationship increased my learning experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
38	This international project increased my learning in ways that a domestic project could not	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	This project has increased the awareness of my role as a global citizen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please provide comments concerning your Dominican Republic project

Has the design process strengthened, weakened, or had no effect on your drive to successfully complete this engineering project? Please explain.