International Experience of Engineering Technology Students Learning About Renewable Energy

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Dr. Lucietto has focused her research in engineering technology education and the understanding of engineering technology students. She teaches in an active learning style which engages and develops practical skills in the students. Currently she is exploring the performance and attributes of engineering technology students and using that knowledge to engage them in their studies which includes renewable energy..

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Cultural exposure is said to be an enhancement to collegial learning. With this in mind, students in an engineering technology program were given the opportunity to go to Germany to a regional university, experience education in that setting, and visit sites dedicated to renewable energy. The students were given a two-week experience that taught them through both formal and informal means. Ultimately, students experienced curiosity, openness to different cultural norms, and were able to identify components of other cultural perspectives responding with their own worldviews.

The researchers utilized the Miville-Guzman Universality Diversity Scale (M-GUDS-S) to assess pre and post activity thoughts regarding culture, thoughts, and beliefs. The data gathered from the student population was evaluated using descriptive statistics as well as content analysis. The instrument provides an indication of how the student perception changes for both individuals and the aggregate population experiencing the material provided during the trip.

Overall the engineering technology students learned more about other ways of life and were encouraged by their peers to become more open minded. Their observations proved that the approach to renewable energy in Germany and Europe as a whole is very different from the United States or other countries, such as India. The program leaders observed that students gained a great deal, in particular learning to accept the differences from their own beliefs and values found in people of different cultures, races, and habits.

Introduction

At universities throughout the United States and in developed countries throughout the world, global experiences are recognized as having a positive benefit on students [1]. These students will be working and interacting more globally than any other generation before them. Therefore, more and more programs throughout higher education are incorporating a global requirement or aspect into their programs. Studies have been published on the effects of global experience on students [2-4], although none was found to focus on engineering technology students. The author, who co-led the study abroad experience described in this work, is sharing these experiences with the intent of encouraging other like-minded engineering technology faculty/staff to do the same.

Literature Review

Study abroad exists in many forms. Some programs are held mid-semester during a fall or spring break, others during the summer break between semesters. Those held during the semester are one week in duration, including the travel time. Others held during the break between fall and spring semesters have a little more flexibility related to travel time. The study abroad experience described here was of two weeks in duration and sponsored by a university in Germany. The study abroad

program has taken place for nearly ten years, with great enhancements in the last few years as related to Germany's drive to attain national leadership in the use of renewable energy technologies to power their country, otherwise known as Energiewende [5].

What is Energiewende? Two significant issues occurred to encourage Germany to transition from nuclear power to renewable technologies. The first was the disaster at Fukushima Daiichi as a result of a tsunami and a couple of years later the signing of the Paris Climate agreement[6]. The result was a phase-out of nuclear power, due to powerful internal political pressures, and then the resulting energy transformation to use of renewable energy technologies. In short, the program enlisted the assistance of villages, towns, and in a couple of cases parts of larger cities to choose, utilize, and improve technology. These areas worked to convince the residents it was important to use the power produced by these means. The cost of the power included incentive payments to spend the next 20 years improving the technologies to make them more viable.

The Experience – Case Study. For an individual group going to Germany, the program consisted of technical lectures, followed by visits to the associated technology. For instance, during one lecture, students were taught how wind towers worked, basic calculations, and some of the recent improvements to the technology. Following the lecture, students were taken by bus to a village. When they arrived at the village, they met the Bŭrgermeister or mayor. A short welcome and then visit to the wind farm provided students with the ability to ask questions, and interact with the personnel that operates the equipment. Similar experiences were afforded to the students with biomass facility, and thermal power solar manufacturing facility. Lectures were delivered by professors from the German university, one in Finland, and also an American professor. Topics ranged from fuel cells, geothermal, hydropower, as well as German history, local history, and tours to an old silver mine, Berlin, Bremen/Bremerhaven, and Hamburg.

The program entitled "International Summer University" was designed to share information about emerging renewable technologies, as well as teaching students about German history and culture. All of which intertwines in the development of the Energiewende experience. This program provided students with a cultural experience that intertwines with Germany's increasing reliance on sustainable energy technology.

Miville-Guzman Universality Diversity Scale [7]. Program leaders were asked by the group responsible for encouraging global experiences within the colleges to administer the Miville-Guzman Universality Diversity Scale to the students. The author chose to share the results to provide a better understanding of how the students reacted to the experience and the changes in the way they experience other cultures based on their summer experience in Germany.

The developers of this scale intended to build a tool to evaluate how people appreciate similarities between themselves and others, as well as placing value on the differences between people.

Therefore as a pre and post trip tool, the differences, as well as individual pre-trip evaluation, are important in assessing the impact of the experience/intervention on the students.

The scale is divided into three different areas [8]. The first is Diversity of Contact (DoC), which is designed to indicate how interested students are in participating in cultural and social activities. Relativistic Appreciation (RA) is a measure of the value placed on diversity and self-understanding as it relates to personal growth, essentially how much they value experiences with others regardless of their differences. The last is Comfort with Differences (CwD), which is the level of comfort a person has as it relates to people that are different from them.

Intercultural Learning Goals. In preparation for the study abroad experience, the leaders of this cultural experience identified the following intercultural goal for the program.
Students acquire knowledge in ways they did not anticipate through the learning, social, and cultural experiences at the German university. Ultimately, students experience curiosity, openness to different cultural norms, and can identify components of other cultural perspectives responding with their worldview.

The leaders also added a reflection to the end of the Miville-Guzman Universality – Diversity Scale when administered post-event to further their understanding of what the students experienced and learned the through this program. It is recognized that formative experiences such as these are important to the development of student identity [9].

Global Inclusion in Engineering Technology Education. Engineering technology students tend to be very hands-on, and experiential [10, 11]. Their perceptions differ from other majors, giving them a unique perspective of the world around them. Learning the technical, while incorporating the cultural, is a unique way of teaching topics and understanding the rationale for how they evolve and are utilized. Students throughout the world value these experiences, making their incorporation into programs important to the growth of these students [12]. It is the intent of this author to share and provide a basis for more global programs like this for engineering technology students.

Methods

The methodology used to administer and then study the results of the survey follow.

Administration of the Diversity Scale. Opportunities to include the use of the scale pre and post study abroad did not present itself. The leaders chose to administer at the first dinner after everyone arrived and then after the last dinner at the hotel. All students stayed in the same hotel, making this an opportunity to have them answer the survey where all students were together in the same place.

Student Population. This student population includes “traditionally aged students,” of which seven are international students. Overall, this population includes ten white students, two black students, six Asian students, and one student that is Asian and white.

Analysis. Due to the limited size of the student population, with one group of students, with a two-week study abroad experience, there are limitations in the analysis. The performance of more advanced statistical measurements risk being misleading, therefore the author chose to evaluate available data using descriptive statistics.

Findings

Available data is shown in two ways. The first is shown in Figure 1, using the three categories described earlier. These are done by student race, using the values calculated when summarizing each of the areas: Diversity of Contact (DoC), Relativistic Appreciation (RA), and Comfort with Differences (CwD).

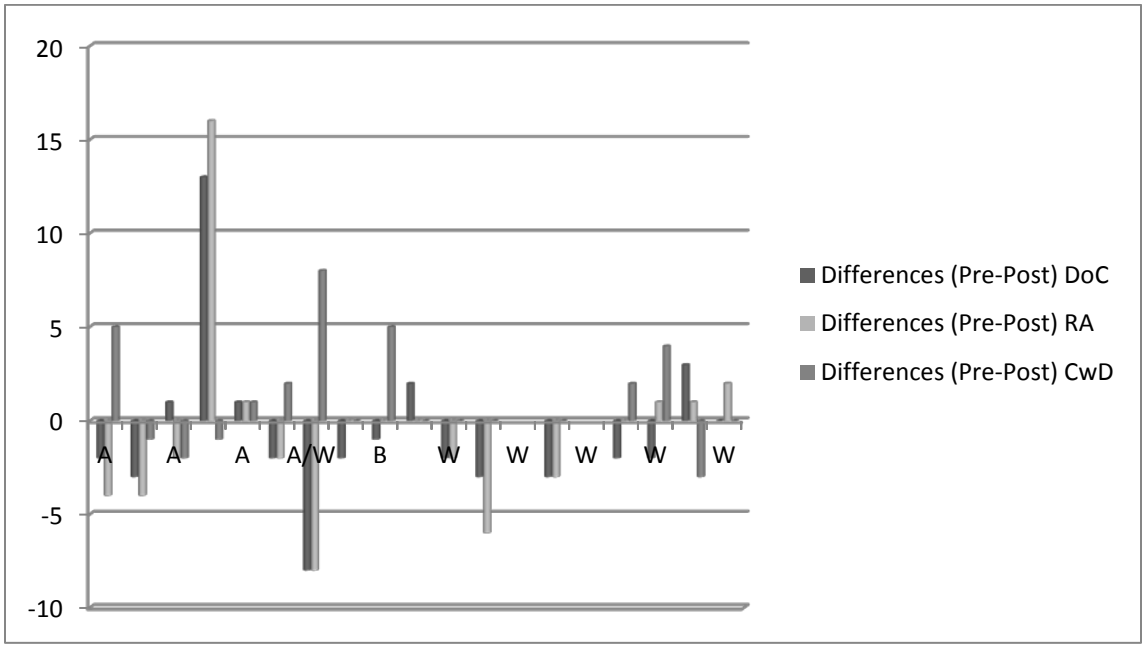

Figure 1. Sorted by Race and Displaying Difference in Responses Pre and Post Intervention

To restate these categories [7, 8], the

- Diversity of Contact (DoC) considers pre and post-intervention interest in participating in cultural and social activities.
- Relativistic Appreciation of Oneself and Others (RA) measures the value placed on diversity and self-understanding as it relates to personal growth, essentially how much the experiences with others are valued regardless of their differences.
- Comfort with Differences (CwD) the degree of a student's comfort with others that are different from themselves.

The values shown in Figure 1 represent the raw scores students had pre and post-intervention in each category, while Figure 2 below represents the actual difference.

There are five questions per category, with CwD being reversed scored. A Likert scale of 1-6 was utilized, and each of the questions in the category totaled to determine the total score. Total possible for each category is 30 points, and the minimum is 6 points. The differences are shown graphically in Figure 1 by category and in Table 1 numerically.

Table 1. Raw Data from Miville-Guzman Universality Diversity Scale (n=19)

Demographics	Differences (Pre-Post)		
Race	DoC	RA	CwD
A	-2	-4	5
A	-3	-4	-1
A	1	-2	-2
A	13	16	-1
A	1	1	1
A	-2	-2	2
A/W	-8	-8	8
B	-2	0	0
B	-1	0	5
W	2	0	0
W	-2	-2	0
W	-3	-6	0
W	*	*	*
W	-3	-3	0
W	*	*	*
W	-2	0	2
W	-2	1	4
W	3	1	-3
W	0	2	0

- - student either didn't respond to pre or post scale

Data Analysis – From Diversity Scale – Descriptive Statistics [13]. Using the information provided and additional scholarly references interpretation of the data follows:

- Overall data shows that students increased slightly in all categories.
- However, one student who is a domestic, black student of traditional age made significant changes to their views of diversity in contact, and relativistic appreciation. This same student scored similarly to their colleagues in the comfort with differences category.
- Another student who is both Asian and white also had significant changes to their viewpoint, but not as much as the black student already described. The data shows changes to their viewpoint in all categories to a similar degree as other students.

Based on the first observation and review of the individual data, an increase in students' interest in participation in the program increased.

Data Analysis – From Additional Question – Content Analysis [14]. The leaders chose to ask the students, during the post assessment, to note things they found during the experience that they had not anticipated or was surprising. Some of these items are quoted here:

How Germans Live

- The outlets are round.
- Most of the public restrooms are pay to use.
- The stores do not provide plastic bags. You need to bring your own or buy it.
- Credit card cannot be used everywhere. Cash is more commonly used.
- German people's life is relaxed.
- Even with modern architecture and technology, Germans have worked hard in preserving their history. Something we all should learn from.
- People are friendly, but not as friendly as people you pass on bikes and walking paths at home.

Transportation

- Public transport is more developed compared to the US.
- The cars are smaller.
- The road laws for cars and pedestrians are taken more seriously here.
- The railway transportation is much more convenient in Germany.
- Their driving is different
- There seems to be a lot less "pedestrian right of way."

Technical and Renewable Issues

- Engineering and efficiency is put before cost in comparatively ignored situations in the US.
- They care more for renewable energy here.
- Recycling - big difference.
- Renewable legislation in Germany.

Discussion

Through the results of the Miville-Guzman Universality – Diversity Scale, and the use of the additional questions, the program leaders are confident that they were able to meet the desired learning outcome for this program. Students learned from the professors presenting material in the program, through organized trips to sites that included a wind farm, solar panel manufacturer, biomass power production facility, and similar locations. Further opportunities included a day trip to Berlin, Bremen/Bremerhaven, and Hamburg to experience culture, food, and interact with one another as well as students from Germany and another group that joined them from China.

The engineering technology students that went on this trip learned about renewable energy and the way of life in Germany. Through the observations and reactions students had to the environment, they found that renewable energy is much more accepted than what they experienced in their own lives. Further, they found that the citizens working on the various renewable energy projects more

open-minded to change and work toward better ways of incorporating these technologies into their lives. Overall, the differences that the students experienced from what they know changed the way they looked at renewable energy and others in Germany. The leaders of the program observed that the students gained a great deal; in particular changing their perspective about things, they formerly felt about different cultures and races. This is also obvious in the data presented using the Miville-Guzman Universality – Diversity Scale and the additional questions posed by the program leaders.

Conclusion

Students majoring in engineering technology are not often studied about their international experiences. By examining the experiences of students participating in this particular program, it was found that these students by studying abroad were able to increase their global experience positively. Through this case study, it identifies that the majority of students benefited from the experience by increasing their appreciation for the experience and the other students at the university and in the program, as well as by learning more about renewable energy.

Future work in this area should strive to obtain a larger more diverse student population. Due to the size of the population changes related to race might be somewhat evident, but it is not plausible to make conclusions based on one or two students observed in this environment.

Additional Thoughts for Practitioners Wanting to Replicate this Experience. Universities in Germany offer higher education at no additional cost to students. This includes foreign students. It is difficult to obtain admittance, and Germans pay higher taxes as a result. A program such as this is possible due to the policies and those that know educators willing to take on this additional work. Housing in the same hotel or facility is important to the student as a social support structure as well as being with students/leaders that are from home. This is exceptionally important to students who have not traveled away from family/country previously. This program was funded by student contributions, paying for their transportation to Germany at the airport or train station specified by the host university. They arranged for transportation to the hotel, between venues, and food for most of the trip. There were times students had to provide funds for food, and any souvenirs they wished to purchase. There were some scholarships available to students going on a study abroad for the first time, as their home university was encouraging such experiences and wanted to help make them possible. In general, the only problems encountered were students that neglected to apply for the scholarships. Experiences for engineering technology majors such as this are highly recommended due to the exposure they will obtain to different cultures, preparing them for the possibility of future work for a foreign employer or clients.

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