

# Filling in Cultural Awareness Gaps for International Senior Capstone Projects

## Background

Most undergraduate students do not have the opportunity to travel abroad and experience and develop communication skills with other cultures. However, in this global world, today's engineer is likely to have to work in global international teams with colleagues from other nationalities. The challenge for many engineering curricula is how to include, in a realistic way, this global dimension and to deal with the unfamiliarity with other cultures.

## Industry sponsored senior capstone project

As a baseline, in the School of Engineering Technology (SoET) at Purdue Polytechnic Institute (PPI) of Purdue University, electrical, computer and mechanical students are expected to complete an integrative capstone project addressing real world, significant problems. The projects typically have the following characteristics:

- Be open ended requiring evaluation of multiple solutions
- Be complex and challenging requiring innovation, out of the box thinking,
- Be on subjects just beyond the student's present courses requiring self-directed learning
- Have sufficient scope that would require a team approach
- Be multi-disciplinary—requiring students from more than one discipline for successful completion.

The needs of the project drives the type of skills and talents needed to be successful. All degree disciplines in the SoET are possible resources for projects while students from other areas of the PPI are invited and include engineering industrial design and business particularly marketing. In 2014-2015 teams of mechanical engineering technology and electrical and computer engineering technology students addressed 32 projects on a broad range of topics. Some representative and typical projects that can be accomplished are listed in Sanger (2011).

Even though these projects are very challenging, these projects do not give the students the opportunity to understand the complexity of working with people from a different culture, i.e. performing in the global community.

## International Senior Capstone Projects

To fill this additional need, the engineering technology program created an international capstone experience. For the international capstone project, the resources and course content is expanded to include history, languages, psychology and many of the social sciences that naturally fit in and are important for the success of the project.

This international capstone project builds on the existing, industry sponsored, multi-disciplinary capstone team project program but differs in several ways. In the international project, half of the team members are students from a non-US university. The full team works on a project proposed by companies with a global footprint in both the U.S. and in proximity to the foreign institution. Most of the global project is carried out using the full range of

electronic communication tools such as email, skype, and blogs. Communicating using these tools can be challenging when dealing with different cultures. The overall plan includes at least two trips in opposite direction by the teams accompanied by their mentors. These trips are approximately ten days long including both weekends. Most of the week involves intense project work. Ideally the first of these trips occurs early in the project and allows for solution conceptualization and for the forming of work assignment and responsibilities. The second trip is usually the integration phase of the final deliverables. Each of the trips has a cultural element—activities that are typical of the host culture. For instance, in the U.S. it has included a football game and visit to local tourist attractions or activities such as skiing, hiking, museums etc. depending on the location. To increase the development of solid relationships, the students of the host teams are responsible for the logistics and housing of the visiting team. Visiting team members live with the host students instead of hotels or with faculty. This latter feature does not work for all cultures. However, where this hosting feature has been used, the feature is highly popular with the students, reduces the cost to the sponsoring company but most importantly gives the visitors an authentic real cultural experience and improves the building of personal relationships across cultures.

### Base Lining Cross Cultural Attitudes

In initiating this program and developing the supplemental course content, a survey of the cross cultural diversity and attitudes was taken from all the students in the senior class. The Miville-Guzman Universality-Diversity Scale (M-GUDS)-S in its trimmed version was selected for this broad survey because this tool focuses on areas that would be relevant to measure a change in attitude as a result of curriculum changes ( Fuertes, 2000). In the compressed tool, groups of questions are used to create three subscales to assess behavioural, cognitive and emotional dimensions of UDO. The subscales and the questions used to form the subscales are shown below.

#### Diversity of Contact

This subscale explores what is the students' level of broad interest in participating in diverse social and cultural activities such as music, dance, celebrations and organization and focuses on behaviour.

- I would like to join an organization that emphasizes getting to know people from different countries.
- I would like to go to dances that feature music from other countries.
- I often listen to music from other cultures.
- I am interested in learning about the many cultures that have existed in this world.
- I attend events where I might get to know people from different cultural backgrounds.

#### Relative Appreciation

This subscale explores the extent that diversity has on a person's self-understanding and personal growth and is a cognitive, reflective element

- Persons with disabilities can teach me things I could not learn elsewhere.
- I can best understand someone after I get to know how he/she is both similar to and different from me.
- Knowing how a person differs from me greatly enhances our friendship.
- In getting to know someone, I like knowing both how he/she differs from me and is similar to me.

- Knowing about the different experiences of other people helps me understand my own problems better.

### Comfort with Differences

This subscale explores the degree of emotional comfort the person has with individuals of a different culture (Note that, in the tool, these items are reverse scored)

- Getting to know someone of another culture is generally an uncomfortable experience for me.
- I am only at ease with people of my culture.
- It's really hard for me to feel close to a person of another culture.
- It is very important that a friend agrees with me on most issues.
- I often feel irritated with persons of a different culture.

The MGDUS-s survey uses a six-point Likert scale ranging from strongly disagree to strongly agree and was found to be a good fit with the study.

### Pre-Survey Results comparing U.S., German, Polish and Russian Students

Sanger (2015) presents the results of this survey shown in Table 1 given to engineering students from the U.S., Germany, Poland and Russia. The demographics of the populations was predominantly traditional student ages and gave a good representation of the differences in attitude toward cultural diversity in these four countries and fully described in Sanger (2015). In Figure 1 the data is reduced into the three subscales which facilitates some of the conclusions. In table 1 the data for each nationality are presented for each question of the survey. In this section, the discussion is also centered on detailed responses that are significantly different than the other responses and could be useful in the creating of curricular enhancements to the international experience. The observations are as follows:

Generally Americans stand out from the other cultures as being more at ease with a diversity of cultures. Perhaps that situation stems not only from the diversity of cultures in America but also from the melting pot effect that exists in America. The Russian students stand out relative to the other cultures as having a heightened interest in learning more about different cultures. Their interest is clearly above all the other cultures surveyed.

As seen in question 5, all the students survey seem to have uniform openness to being aware of differences and similarities across cultures. This result is very encouraging and indicates that pedagogical approaches to increase cultural awareness could be successful.

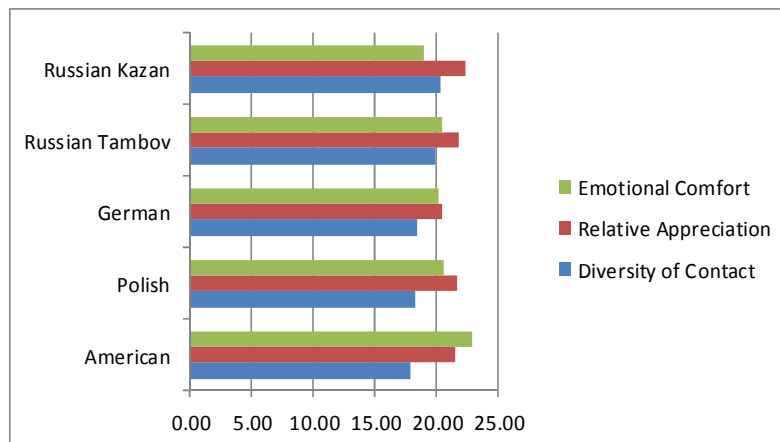


Figure 1: Composite Data on the five populations according to the three major subscales.( Sanger 2015)

Table 1 Detailed responses to the MGUDS-s survey from students from the U.S, Germany, Poland, and Russia.(Sanger 2015)

	American	Polish	German	Russian Tambov	Russian Kazan
1. I would like to join an organization that emphasizes getting to know people from different countries	4.46	4.09	4.12	4.34	4.5
2. Persons with disabilities can teach me things I could not learn elsewhere	4.63	4.47	4.17	4.14	4.6
3. Getting to know someone of another culture is generally an uncomfortable experience to me	1.75	1.97	2.02	2.04	2.2
4. I would like to go to dances that feature music from other countries	3.50	3.74	3.29	4.46	4.3
5. I can best understand someone after I get to know how he/she is both similar to and different from me	4.60	4.32	4.35	4.28	4.4
6. I am only at ease with people of my culture.	1.63	2.34	2.85	3.04	3.
7. I often listen to music of other cultures	3.45	4.15	3.76	4.82	4.7
8. Knowing how a person differs from me greatly enhances our friendship	4.04	4.1	3.8	3.38	3.9
9. It's really hard for me to feel close to a person from another culture.	1.63	2.25	2.43	3.12	3.0
10. I am interested in learning about the many cultures that have existed in this world	4.48	4.41	4.31	5.06	4.7
11. In getting to know someone, I like knowing both how he/she differs from me and is similar to me	4.56	4.37	4.07	4.42	4.1
12. It is very important that a friend agrees with me on most issues	2.73	3.62	3.55	4.02	4.4
13. I attend events where I might get to know people from different cultural backgrounds	3.88	3.72	3.9	3	3.4
14. Knowing about the different experiences of other people helps me understand my own problems better	4.27	4.46	4.1	4.22	4.4
15. I often feel irritated by persons of a different culture.	1.89	2.35	2.57	1.98	2.1

- From questions 6 and 9, American students are much more open to closeness than the other four populations. Americans and Russians are at two extremes very far apart regarding closeness to people of another culture. This result is surprising from the authors personal experience when in their experience the opposite it more the case.
- Music seems to be particularly important to both the Polish and Russian cultures.
- Dance is of great interest to Russians
- Americans according to this survey seems to tolerate disagreement among friends more than the other three nationalities.
- Americans and Russians seem to be less irritated by other cultures than the Polish and the Germans.

### Supplemental Course Content Stemming from the Survey

As can be seen in the responses to question 12, there is a large variation among the cultures surrounding disagreement. Thus additional training has been added to the course in the area of conflict resolution.

Since the survey points out that American students have a low interest in learning about new cultures, the course has added discussions on regional history, language, celebrations and holidays and other aspects of the culture that they will be visiting. Much of this learning is done by self-study reporting back to the class in a discussion format.

Finally the music seems to be an area where American students have much less interest than Polish and Russian students. Improving American awareness in the music area could result in fertile ground for relationship building.

## International Projects in Germany and Poland

Two international senior capstone projects were launched in August 2014 and completed in June 2015.

The Lenze project: four technology students from SoET (3 electrical and one mechanical) joined four students from Leibniz University of Hannover (with similar disciplines) on a project sponsored by Lenze Corporation in Hameln, Germany to fully integrate the power electronics and controls of a 1.2 Hp motor into the cylindrical form factor of the motor.

The Eaton project: three electrical technology students from SoET joined three mechanical students from Gdansk University of Technology on a project sponsored by Eaton Corp in Auburn, IN and Tczew, Polmerania, Poland to develop, build and test a technique to inspect



Figure 2 The goal of the Lenze project was to design, build and test a motor system that fit a cylindrical form factor: the original system on the left and the reconfigured system on the right.

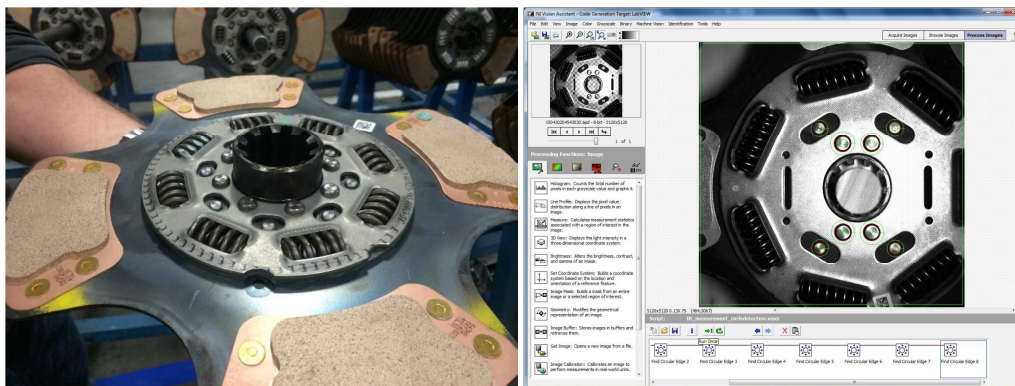


Figure 3 Clutch Rivet inspection performed using Image Analysis for Eaton Corp.

clutch assemblies for properly installed and compressed rivets

Each of these projects resulted in final presentation of results in both countries and delivery of process/product. Besides project completion the final two week trip abroad included visits to local cultural venues including Berlin and Hamburg in Germany and Krakow and Malbork Castle in Poland.

## Comparison of Attitudes Pre/Post

Upon return from abroad the MGUDS-s was readministered to the students and a before and after comparison was made as well as an evaluation of the reflection paper written by each student.

In the subscale “diversity of contact”, the answers to the questions reflected a 70% improvement and over half of those responses (35%) were two points or more increase on the six point Likert scale. Only two of the 20 responses regressed and that was in the area of music appreciation clearly indicating that more work from an instruction point of view might be useful. In the cognitive subscale of “relative appreciation”, 100% of the responses showed no change or improvement (65% same, 35% improved) with no regression. Finally in the subscale of “emotional comfort with differences”, only one regression with 50% remained the same and 45% improved. The only regression was to the issue of agreement with self. The two areas where regression was seen confirms the need for good training in the following two areas: conflict management and the arts.

The student reflections reflected growth in cultural awareness. It must be said that none of these students had worked with a foreign student before while only one of them had been to Europe prior to this experience. An interesting observation follows which is relevant to the students reflection of a specific difference in approach to the engineering task at hand:

“One of the most memorable moments in this project was when the Purdue team introduced the German team to the idea of ball parking a number. In other words using the information already at hand, as well as engineering intuition to predict a result, or an acceptable range for that result. This notion went counter to our German colleagues’ desire for high precision. The principal lesson from this project however is, that by leveraging the differences in both cultures’ engineer styles, the team balanced cost, time, and quality. All in all I regard this project and the opportunities it has given me as the single most defining aspect of my college career.”

As far as the structure of the course, with unanimity, all the students (foreign and American) thought the full immersion during their visits was outstanding. They were able to experience the country the way people their own age lived and worked. During their visit and in their reflections, many observations revealed increased awareness and a deliberate effort to understand the culture. As an example, here is the following:

“One of my favorites was something I discussed with \_\_\_\_ and with \_\_\_\_: many Polish are very honest. She explained this by saying if you say “The weather is lovely today!” to someone of Polish descent, they would likely respond with something along the lines of “It is nice weather now, but it is supposed to rain later.” She explained that they try to be honest in how they reply, and it sometimes makes them appear to foreigners as a bit standoffish or even rude.”

## Conclusions

Overall the model that has been implemented in these international capstone projects has been shown, at least in the initial trials, to be quite effective to increase cultural awareness in a positive way and it is being extended to other countries including Peru, Netherlands, Australia and Dubai. Cultural, historic, and geographical research plus group discussion has been added to the course to expand awareness and increase empathy with their non-US teammates. Finally it is recognized that this

course should not be first encounter of engineering technology students with different cultures or with the subject of cultural diversity. The on-going transformation of the Purdue Polytechnic Institute where global awareness is one of key learning objectives is pulling this aspect of the curriculum earlier in the program but in smaller doses.

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