

What Affects Engineering Students' Global Competency?

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Abstract

The world is more globalized today than it has ever been before, and globalization continues to be at the heart of business around the world. This trend comes with many great challenges for college students throughout the world. Students must now be globally aware in order to remain competitive in today's globalized society. This paper will focus on understanding what factors affect the global competency of engineering students. A survey was created to assess students' global awareness knowledge. The study focuses on students' responses to knowledge-based questions regarding different global content/issues. This paper does not seek to gauge students' interest in global issues, but rather discover which factors play a significant role in their knowledge of the globalized world. The discussions will be presented based on statistical analysis of student responses to the survey.

Keywords: Global Awareness, Engineering Students, Assessment

1. Introduction and Background

Globalization has been one of the most prominent movements of the past decade. The globalization movement has been driven by economic, technological and political progress¹. As a result, this movement has even reached the engineering sphere. Engineers need to be ready to take on problems never seen before in a world that is open and competitive².

According to Andersen³, engineers today require not only advanced technical skills but also the ability to function in international projects with different cultures and beliefs to be successful in the business world. However, in the United States (U.S.), engineering students have a difficult time engaging with and accepting ideas from those whose culture is different than their own⁴. International students favor research involving both quantitative and qualitative approaches, while U.S. engineering students prefer to conduct experiments and test numerous hypotheses⁵. Engineering students need to develop the ability to analyze how national differences are important to the work environment. They need to recognize the wide spectrum of proposed ideas and perspectives with which they are likely to engage on the job site⁴.

The term global competency has a variety of meanings and is expressed numerous ways in the different literature. Some people define global competency as simply as communicating and interacting with other cultures, while others feel it is much more complex than this⁶. To be globally competent in academics is different from being globally competent in a specific industry⁷. For academics, Gardner and Walker⁷ believe that one should view oneself as a citizen of the world, but do not feel it is as important to do so in a work environment. It is important in industry to understand the different ways products are designed, manufactured, and used in different cultures around the world, but this is not necessary for academics. In both academics

and industry, however, the ability to communicate with and appreciate other cultures is critical to one's success⁷.

Global competency has led colleges and universities to focus on internationalizing their curriculum and the college experience in general⁸. Because of this need, universities have begun trying to increase the global competency of their students. Universities play one of the largest roles in a student's development of global competency. Through programs such as students studying abroad, mission trips, establishing branch campuses in foreign countries, faculty exchange programs and the open acceptance of foreign students of all backgrounds, universities attempt to create possibilities for students to become more globally aware⁶. Universities recognize that the world is becoming increasingly globalized and are looking for new ways to implement the necessary skills into their students⁹. Universities in the U.S. have made graduating globally competent students who are able to excel in the global marketplace as part of their mission¹⁰.

Joint academic and research programs with foreign universities are two recent ways that U.S. universities are trying to link their schools to the globalized world. For instance, the Technical University of Dortmund in Germany and the University of Virginia of the U.S. created a joint online class, bringing together German and American engineering students⁸. In this online class, the students used online role-playing simulation software to work together on nuclear energy. This project allowed the students to develop global competency skills while gaining experience working in an international setting. The students faced problems that immediately had to be dealt with. For example, one recurring problem was the difference in measurement units since the customary system is used in the U.S. and the metric system is used in Germany. Numbers constantly had to be converted between the two groups. Besides adapting to physical differences, they also had to adapt to diverse opinions. Nuclear energy was thought of much differently by the German students than the U.S. students, which was surprising to many U.S. students. Overall, the students found the class extremely useful and educational, especially in the global context. Students who work in intercultural engineering environments as shown in the example, demonstrate the development of personal and professional skills that are needed to succeed in the real world³.

College students are required to take a variety of courses outside of the area that they are studying. General education courses attempt to make an individual well rounded and knowledgeable in subjects other than their specified majors, but do engineering students primarily focus on the engineering curricula and ignore the rest? A study of Russian engineering students found that they direct their main attention on engineering, and focus very little on arts and social sciences⁶. In order for a student to be more globally competent, they should have a well-rounded education in addition to social skills. In order to expand the knowledge of engineering students in Russia beyond engineering, it is suggested that students pursue a minor degree⁶.

The purpose of our study is to focus specifically on what factors affect engineering students' global knowledge. To this end, a questionnaire was developed and undergraduate engineering students were surveyed. In Section 2, the details of the instrument and data collection were

explained. Section 3 displays our research questions and data analysis. Discussions about our findings can be found in Section 4, and concluding remarks are in section 5.

2. Instrument and Data Collection

In order to assess students' knowledge of global awareness, a questionnaire was developed. First, the students were asked to answer questions related to their backgrounds. Next, they were asked to answer questions related to knowledge of a variety of subjects associated with global awareness. The background portion of the instrument provided basic information about the students by asking simple things such as gender, race, and GPA. It then continued to ask questions related to global awareness, such as if they have ever traveled abroad or if they know a second language. The knowledge-based portion of the instrument was meant to quiz the students of their global awareness knowledge. Each multiple-choice question had four possible answers from which to choose with only one of the answers being correct. Each question also had a fifth possible answer of "Not sure" for students who did not have any idea about the question. The students were then graded based on their responses to the questions. If a student chose "Not sure" as a response, then that was considered as an incorrect answer. More information about the instrument can be found in Vance et al.¹¹.

The knowledge part of the survey included the following categories: Media, Tourism, Business, Geography, Economy, Religion, Food, Languages, History, Labor Issues, Health, Environment, and Politics. The media, tourism, business and food categories were primarily related to customs and culture. The geography portion concentrated on life expectancy and population along with capital cities. The economy questions focused on jobs, currency, and imports/exports. The politics portion of the survey related to world leaders, alliances, and trade agreements. The questionnaire consisted of a total of 52 questions. The background section consisted of 17 questions and the knowledge portion totaled 35 questions. The questionnaire, which was in an encrypted link, was emailed to students located in the multiple campuses of a large university in the Northeastern U.S. A total of 424 undergraduate engineering students (after eliminating the non-complete responses) completed the survey. The range of students' academic year standing included: 153 freshmen, 122 sophomores, 91 juniors, and 58 seniors as shown in Fig. 1. Of these students 332 were male and 92 were female. The respondents had multiple ethnicities as shown in Fig. 2. All participants took the survey at their leisure within a prescribed period of time.

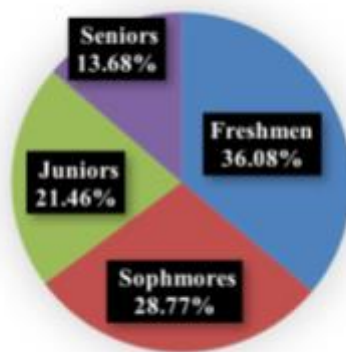


Figure 1: Range of Students' Class Standing

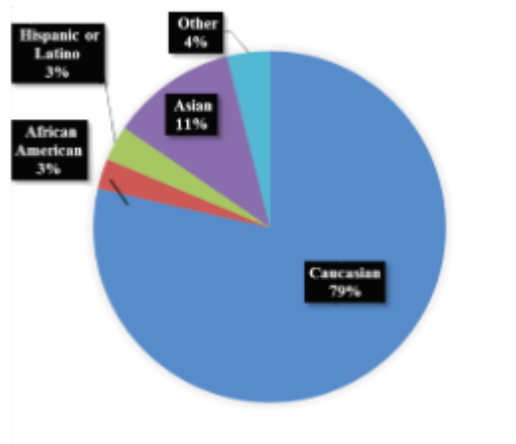


Figure 2: Range of Students' Ethnicity

2. Data Analysis

In order to help answer the question “What factors affect an engineering student’s global knowledge”, questions were created regarding the background information of the students in relation to their knowledge. The questions were categorized as follows: gender, ethnicity, class standing, extra academic engagement, academic performance, global involvement, foreign language proficiency and global awareness channels. A multiple regression analysis was then performed relating the questions to the overall knowledge of the students. The overall knowledge for each student was based on the percentage of the questions that he/she answered correctly.

Gender: Does the gender of the student make a difference in their global awareness knowledge?

Ethnicity: Does the ethnicity of a student make a difference in their global awareness knowledge?

This question was based on the background question asking students to mark their ethnicity. The students could choose from Caucasian, African American, Hispanic or Latino, Asian, or Other. The students were then sectioned into two groups, Caucasian and Minority. All students that were not Caucasian were considered Minority for the purpose of this analysis.

Class Standing: Does the class standing of students (freshmen and sophomores vs juniors and seniors) make a difference in their global awareness knowledge?

In order to see if the college education has any effect on the students, they were separated into two groups: freshmen and sophomores vs juniors and seniors. The second group having more college experience than the first group can tell us what effect if any college/maturity has had on the students.

Extra Academic Engagement: Do students that meet one of the following criteria have greater global awareness knowledge than those who do not?

- Double Major
- Minor
- Undergraduate Research

This question focused on students who are involved in extra academic programs. Extra-curricular activities were not included since they do not relate directly to academics. If a student has participated in at least one of these three areas, they were grouped together for the purpose of the analysis. The question was meant to see if students that embrace more academics have a greater global knowledge.

Academic Performance: Do students that meet one of the following criteria have a greater knowledge than those who do not?

- Dean's List
- Honors Student
- GPA of 3.5 or above

This question focused on students that have a high academic performance. Students that met at least one of these criteria were grouped together for the purpose of the analysis. This question set to see if a higher performance in academics translates to a higher understanding of global knowledge.

Global Involvement: Do students that meet one of the following criteria have a greater knowledge than those who do not?

- Studied Abroad
- Volunteered Overseas
- International Student

Students that met at least one of these criteria were grouped together for the purpose of the analysis. The question focused on seeing if students that have actually interacted in the day to day society of a global environment have a greater global knowledge.

Proficiency in a Foreign Language: Do students that can speak a second language at an oral proficiency of at least 70 percent have greater global knowledge than those who do not?

In the questionnaire, students were asked if they know a foreign language and if so, to rate their estimated oral proficiency in that language. Many people claim to know a second language, but cannot effectively communicate in that language. Therefore, the question focuses on students that estimated 70 percent or more. This means that they can communicate efficiently and effectively in the language.

Global Awareness Sources: Do students that read or listen to three or more sources about global issues have a greater knowledge than those who do not?

The questionnaire asked students to choose what sources they use to read or listen to about global issues. The students could select as many sources as they think that applied to them. The students had the following options to choose from: newspaper, online news outlets, academic journals, broadcast media, magazine, and radio. This was meant to see if students that actively try to learn more about the global environment by reading/listening to a number of sources have a greater global knowledge.

A multiple regression analysis was conducted using SPSS (Table 1), and based on this analysis, Gender (p value= 0.014), Class Standing (p value=0.010), Extra Academic Engagement (p value= 0.040), Global Involvement (p value= 0.004), Proficiency in a Foreign Language (p value= 0.017), Global Awareness Channels (p value= 0.081) are statistically significant factors on engineering students' global awareness knowledge (dependent variable).

Table 1. Multiple Linear Regression Results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.602	.032		18.689	.000
Gender	-.049	.020	-.121	-2.458	.014
Class Standing	.044	.017	.125	2.574	.010
Minority	-.013	.020	-.032	-.656	.512
Foreign Language Proficiency	.053	.022	.119	2.390	.017
Academic Performance	.022	.016	.065	1.365	.173
Extra Academic Engagement	.037	.018	.102	2.063	.040
Global Involvement	.072	.025	.147	2.931	.004
Global Awareness Sources	.030	.017	.083	1.751	.081

Dependent Variable: Global Awareness Knowledge

4. Discussions

The results of the regression analysis resulted in not only expected but also surprising outcomes. It was expected that the more global experience a student was involved in, the greater the global knowledge he/she was likely to have. An international student, and those who have studied or volunteered overseas are more likely to have a greater knowledge than others since they have experience in other cultures. The survey showed that global involvement was a significant factor to the global knowledge of a student. Another expected outcome was the factor of global awareness sources. Students that are actively trying to learn about global issues through media channels obviously will tend to have a greater global knowledge.

Based on our multiple regression analysis, class standing turned out to be a significant factor as well. An ANOVA test (using only class standing as a single factor) also showed that class standing was a significant factor, $F\text{-value}= 12.343$, $p\text{ value}= 0.000$. It would make sense that students that are older and have had more college experience, would have greater global knowledge. Colleges are trying to implement things to help students become more globally competent, and it seems like they may be making an impact. As seen in Fig. 3, the difference between the global knowledge of the two groups is obvious. Juniors and seniors answered on average 69 percent of the global knowledge questions correctly. Freshmen and sophomores did not perform as well, with an average of 63 percent of the questions answered correctly. This shows the students who have been in college longer, performed better on the global knowledge questions. This may be because they have spent more time interacting with other cultures, have taken classes regarding global studies, have taken a greater interest in global topics as they mature, or a combination of them all.

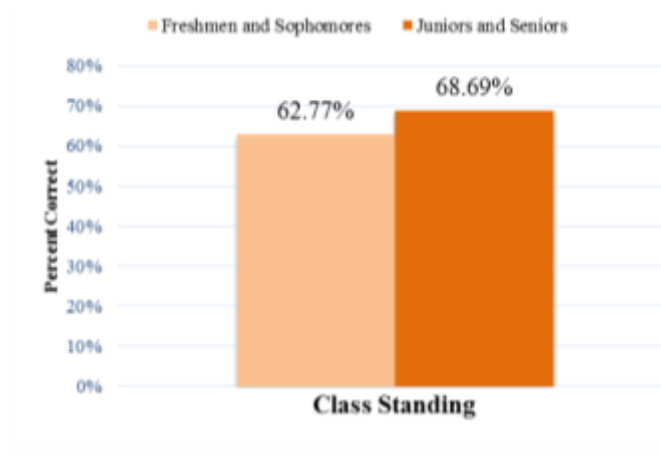


Figure 3: Percentage of Knowledge Questions Answered Correctly by Class Standing

With other factors, such as gender, there was no expectation as to what the results would yield. Gender turned out to be a significant factor in a students' global awareness knowledge based on our multiple regression analysis. Male students had an average of 65.07 percent and female students had an average of 64.06 percent as shown below in Fig. 4. There is a slight difference in average global awareness knowledge of males and females, and an ANOVA test (using only gender as a single factor) also showed that gender was not a significant factor, $F\text{-value}= 0.256$, $p\text{ value}= 0.613$.

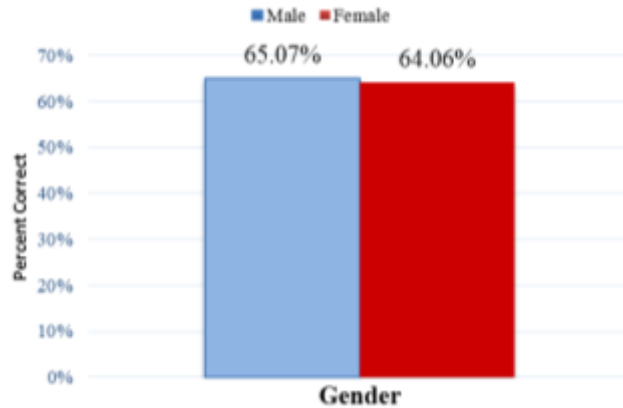


Figure 4: Percentage of Knowledge Questions Answered Correctly by Gender

Ethnicity was another tested factor, which turned out to be not significant. This means that Caucasians did not perform any better or worse than those grouped as minorities in reference to their global knowledge. Students knowing a second language also performed better than those that do not. One explanation for this may be that they are inclined to multiple cultures, being they know two languages. Academic performance and extra academic engagement are two factors that are very similar to each other, but yielded different results. Extra academic engagement turned out to be a significant factor in a student's global knowledge, but their academic performance was not. This means that students that take on extra academics tend to have a higher global knowledge than students that are enrolled in a standard program. However, high academic performance does not necessarily translate to higher global knowledge performance. It could be expected that students that perform higher would also know more about the global environment, but that isn't true. One reason might be that these students are so focused on their academics that they pay little attention to the global environment.

5. Conclusions

The goal of this paper was to determine what factors affect engineering students' global knowledge. Our team first reviewed prior literature as a reference in the development of a questionnaire. Once all of the questions were analyzed, we concluded that most of those factors that we analyzed were significant in determining an engineering students' global knowledge. The significant factors are as follows: gender, class standing, extra academic engagement, global involvement, proficiency in a foreign language, and global awareness channels. Global knowledge is important for the development of successful globally competent engineering students. These specific factors are important for the development of engineering students' global knowledge which will help them succeed in the global market. Based on this study, one possible direction for future research would be to compare and contrast the global knowledge of engineering students versus that of students in the other majors.

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