

# Measuring Global Awareness Interest Development of Engineering and Information Technology Students

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**Abstract**— Engineers and information technology professionals often work in international settings or teams, as well as across diverse cultures in today's global economy. Ever expanding globalized society has required updates in organizational procedures and practices, especially for engineering and information technology organizations, to keep up with increasingly competitive and technology-oriented markets. Professional accreditation organizations (e.g., ABET, Inc.) also recognized that it is necessary to develop programs to prepare globally competent graduates. In this paper, our primary emphasis is on understanding students' interest in global awareness. As the theoretical framework, we use Model of Domain Learning (MDL) – a learning theory that has a three-pronged approach to the conceptualization of learning in a domain, covering interest, knowledge and strategic processing. Students' interest in a domain changes from situational to individual as they develop from novice to proficient in the domain. Therefore, we propose interest as an additional construct to measure students' global awareness. We developed an instrument to effectively measure students' global awareness development and engagement throughout their education. In this paper, we present our preliminary findings for the proposed global awareness interest assessment framework and also analyze factors affecting engineering and technology students' global awareness interest.

**Keywords**—global awareness; interest; assessment; engineering; information technology

## I. INTRODUCTION AND BACKGROUND

Development of new communication technologies has been one of the major reasons to accelerate the globalization phenomenon. Multinational corporations can now have access to knowledge and human capital anywhere in the world in an efficient and direct fashion. This new global order requires educating engineering students with competencies to be competitive in the global market. The calls for change in engineering education to prepare engineers not only with technical knowledge but also with professional skills are coming from a multitude of sectors: government, industry and academia [1]. In 1996, the Accreditation Board for Engineering and Technology (ABET) approved the set of Engineering Criteria 2000 that includes “the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal contexts (criterion 3(h)).” [2]

Allan and Chisholm [3] present a comprehensive list of competencies for engineers to develop professionally in multicultural contexts and in diverse global environments.

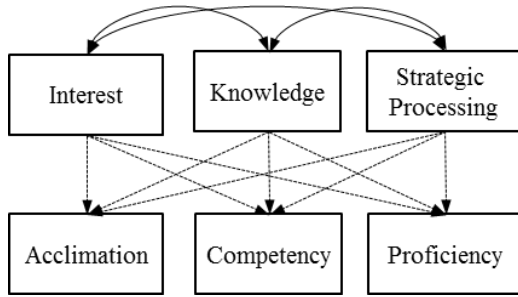
These competencies highlight the ethical and social responsibility of engineers in a global context, the ability to interact and work with people with different languages and from different cultural, religious, and ethnic backgrounds, the capacity to design and create products based on cultural differences and that meet the needs of a global society, and the ability to make decisions understanding the impact in a global context among others competencies. Many educational initiatives are taking place around the world to prepare students to work in global environments [4]. Some of these initiatives include study abroad, international internships, multinational projects, and in-class activities. However, the percentage of engineering students participating in activities that required travel abroad has been traditionally low in the U.S. A recent report shows that only 7.5% of engineering students participate in study abroad programs [5]. When they participate, however, “the skills & competencies developed by having to experience and adapt to living in a different culture and institution” seem to be their most important perceived gain [6]. The work by Zappe et al. [7] on first-year students' perception on global awareness reports that 94% of first year students considered global awareness somewhat important (58%) or very important (36%) at a personal level, and 95% of students considered global awareness somewhat important (43%) or very important (52%) at a professional level. This study concluded that students probably overestimate their assessment on personal perceptions on global awareness.

Students might recognize the importance of global competencies in engineering; but, they are not ready and in some cases, they are not even interested in developing global awareness. Observations and a mostly non-rigorous evaluation of global awareness have shown that first year students understood the need but have not developed the global competencies necessary [1]. The level of interest in learning about global issues, including other languages and cultures, is mostly low among American-born students, who consider that global businesses are managed in English and other cultures have been westernized to adapt to the global business environment. Such student attitudes are detrimental to their development towards effective professionals, and perhaps with dire consequences for the organizations they work for. Moreover, given the above discussed ABET criterion such apathy or misconceptions about global awareness is not acceptable. A comprehensive and meaningful assessment of the level of student development of global awareness interest at different stages of engineering education is needed to properly distinguish students' perceptions and actual level of knowledge on global issues.

In this work-in-progress paper, interest is proposed as a construct to track global awareness development of students. Interest is one of the elements of learning in Alexander et al.'s three-pronged domain learning model [8][9]. The specific contribution of the paper is the illustration of how interest can be used to assess global awareness of engineering and technology students. In the proposed assessment framework, global awareness of a learner is evaluated in three dimensions: (1) interest, (2) knowledge, and (3) strategic processing (Fig. 1). Multiple-choice questions are utilized for assessing knowledge, and a mixture of multiple-choice questions and short case studies have been developed for evaluating strategic processing. To evaluate interest, two types of survey questions have been developed as described in Section II.

In the proposed framework, the assessment items for each dimension are mapped on three developmental stages: acclimation, competency, and proficiency. Both the individual score of a learner in each developmental stage and the correlations among the dimensions are utilized to evaluate the global awareness of the learner. For example, a lack of correlation between knowledge and interest as well as a lack of a significant increase in the interest levels of students throughout their education may indicate stagnation in the development of global awareness [10].

Fig. 1 Overall structure of the proposed assessment framework.



The primary objective of this work-in-progress paper is to establish the reliability of the interest questions that will be a part of the proposed assessment framework that was briefly described above. Since interest has not been previously studied in the literature for its connection to assess global awareness, the global awareness interest instrument presented in this paper also affords a contribution to the state-of-the art.

The secondary objective of the paper is to ascertain whether various student demographics may have an effect on global awareness interest. Among these demographics, class standing is of particular interest; according to our MDL-based assessment framework, students' global awareness is expected to increase throughout their educational journey.

## II. METHODOLOGY

### A. Description of the Global Awareness Instrument.

A global awareness interest survey was developed to measure students' interest in different global issues and

contexts. Before administering the survey, we asked our subject matter experts to provide feedback on the items/questions so that we were able to perform a content-validation of the survey; we then proceeded with incorporating their feedback. The updated version of the survey includes a total of 42 questions; 15 of these relate to understanding the background of the respondent, 24 questions specifically focus on their interest towards global awareness, and 3 questions are domain specific self-efficacy questions.

The interest questions were of two types. The first group (11 questions) asked students about their willingness, interest, or likelihood of performing the activities related to global awareness. For example, "Rate your level of interest in attending a free workshop on global awareness." These questions were operationalized using a continuous scale from Very Unlikely (0) to Very Likely (100); respondents interacted with a slider bar while completing the survey. We refer to this first group of questions as "intention-interest" questions to distinguish them from the second group questions. The second group of 13 interest questions asked students how many times they were involved in educational and social activities related to global issues (e.g., attending a seminar). These questions will be referred to as "involvement-interest." Responses to these questions required selecting one choice from a five-point Likert scale with the following options: 1-Never, 2- one to two times, 3- three to four times, 4-five to six times, and 5-more than six times. The average values of both groups of questions were used to represent the level of student interest in global awareness.

### B. Participants and Validation of the Survey

We administered the survey using Qualtrics, which was emailed to undergraduate students at multiple campuses of a large research university in the northeast region of the United States. After removing incomplete answers, a total of 181 students' (87 Engineering and 94 Information Technology) responses remained for further analysis.

First, we performed two separate exploratory factor analyses (the generalized least squares method with the varimax rotation) to determine the underlying factors for the intention as well as involvement interest questions and to identify the questions with low factor loadings. In the factor analysis for the intention-interest questions, three factors were identified. Six questions were loaded on the first factor strongly (with all factor loadings > 0.5), and three items loaded on the second factor strongly (one factor loading < 0.5 and two factor loadings > 0.5). However, the third factor had all low loadings. In addition, one of the questions that loaded on the third factor had a low communality (0.330), and the questions that loaded on the second factor had low internal reliability (Cronbach's Alpha = 0.656). Therefore, we only utilized and thus presented herein the questions that loaded on the first factor. The six intention-interest questions that loaded on the first factor (Cronbach's Alpha = 0.860) were as follows:

- Rate your level of interest in attending a free workshop on global awareness.

- Rate your level of willingness to take an elective course in order to improve your global awareness skills.
- Rate your level of interest in reading literature about global issues.
- While you are browsing a news website, you have spotted an article entitled “Asian Women Challenging Their Ancient Cultural Female Norms.” Rate your likelihood of reading this article.
- A renowned global awareness specialist will give a workshop on “issues with intercultural communication in multinational organization” at your institution. Rate your level of interest in attending this workshop.

In the factor analysis for the involvement-interest questions, two factors were identified. The following five questions loaded on the first factor (all factor loadings>0.5 and Cronbach's Alpha=0.821):

- Read an online article about global issues.
- Read a newspaper/magazine article about global issues.
- Had conversations with your friends about global issues.
- Watched a video clip or foreign film outside of class work about global awareness/issues.
- Performed a web search to learn about global awareness/issues.

Subsequently, the following five questions loaded on the second factor (all factor loadings>0.5, Cronbach's Alpha=0.799):

- Attended a seminar about global awareness/issues.
- Attended a speaker event about global awareness/issues.
- Attended a cultural dinner or event on campus.
- Coordinated or taken part in a fundraiser for a global issue.
- Attended a diversity training class.

The main difference between the two groups of involvement-interest questions is that the questions loaded on the second factor require more individual effort and are usually performed less frequently. The questions that loaded on the first and second factors will be referred to as acclimation level and competency level involvement-interest, respectively.

In addition to the interest questions, the following three questions (Cronbach's Alpha=0.806) were used to measure students' global awareness self-efficacy.

- I feel that I am prepared for an international job opportunity
- I feel that I can understand other cultures
- I feel that I can thrive in a multi-cultural environment

### C. Analysis of Factors Effecting Global Awareness Interest

Multivariate ANOVA was used to determine the effects of several background variables, such as gender, ethnicity, class standing, language proficiency, and GPA, on the interest variables. Some background variables, such as ethnicity and work experience, could not be included in the statistical models due to a limited number of samples in their various

levels. After a preliminary analysis, Class Standing, Gender, and Language Proficiency were shown to have the most significant effects on the interest variables. Table I summarizes the multivariate test results for the MANOVA model, which included only main effects, using Gender and Class Standing as factors and Foreign Language Proficiency as a covariate.

TABLE I. MULTIVARIATE TEST RESULTS (WILKS' LAMBDA)

Variables	<i>F</i>	<i>p</i>	$\eta_p^2$
Gender	13.434	0.000	0.206
Class Standing	2.287	0.123	0.042
FL Proficiency	9.411	0.000	0.154

Table II presents the between-subject *F*-value, significance (*p*), partial eta-squared ( $\eta_p^2$ ) statistics of the MANOVA, while Table III summarizes the means and standard deviations of the interest variables across the factor levels. Overall, the MANOVA results indicated significant differences for the intention-interest and involvement-interest at the competency level. Language Proficiency had the most significant effect on these two variables. Gender and Class Standing had a significant effect on the intentional-interest. This result was previously observed in a data set including mainly students from business programs [11].

TABLE II. BETWEEN-SUBJECT STATISTICS FOR THE MANOVA

Source	Dependent Variables	<i>F</i>	<i>p</i>	$\eta_p^2$
Model	Intentional	14.029	.000	.211
	Involvement Acc.	2.182	.092	.040
	Involvement Com.	3.566	.016	.064
	Self efficacy	11.636	.000	.182
Gender	Intentional	16.449	.000	.095
	Involvement Acc.	3.181	.076	.020
	Involvement Com.	2.465	.118	.015
	Self efficacy	1.783	.184	.011
Class Standing	Intentional	6.274	.013	.038
	Involvement Acc.	2.995	.085	.019
	Involvement Com.	2.876	.092	.018
	Self efficacy	1.960	.163	.012
Language Proficiency	Intentional	18.842	.000	.107
	Involvement Acc.	.001	.981	.000
	Involvement Com.	5.362	.022	.033
	Self efficacy	30.753	0.00	.164

As seen in Table III, female students had a higher-level involvement-interest, and the intentional-interest increased from the lower level (first-two years) to the upper level (last two-years) of their education. Moreover, the more proficient students were in a foreign language, the higher-level interest they indicated. On the contrary, no significant effect with  $p<0.05$  was observed for involvement-interest at the acclimation level. Only Language Proficiency was found to have a significant effect in self-efficacy as seen in Table II.

TABLE III. MEANS AND STANDARD DEVIATIONS OF THE MEASURED VARIABLES ACROSS THE FACTOR LEVELS

Factor/Levels/n			Intention Interest	Involvement Interest Acclimation	Involvement Interest Competency	Self Efficacy
Gender	Male	Mean	45.91	3.47	1.45	58.28
	(141)	Stdv. <sup>a</sup>	20.67	1.04	.61	22.79
	Female	Mean	60.13	3.03	1.64	62.93
	(40)	Stdv.	21.11	1.00	.77	22.42
Class Standing	Lower	Mean	46.81	3.27	1.44	58.09
	(120)	Stdv.	21.48	1.06	.59	23.19
	Upper	Mean	53.37	3.54	1.59	61.69
	(61)	Stdv.	21.29	.98	.77	21.80

<sup>a</sup> Standard Deviation.

### III. DISCUSSIONS

Although the results presented in this paper are based on only preliminary data to test the reliability of the interest questions that will be used in the proposed framework, the findings are supportive and promising for the broader research objectives. Firstly, the findings showed that interest in global awareness tended to increase throughout students' academic journey. In addition, a strong correlation was observed between intentional-interest and involvement-interest (Pearson Correlation of 0.434 with  $p < 0.01$ ). Furthermore, the interest level correlated with Language proficiency as expected. These findings support that interest could be used as an additional construct in order to assess global awareness. Interestingly, Class Standing had no significant effect on global awareness self-efficacy. This observation is similar to the results of our previous study that focused on the teamwork domain [11], which indicated that students' teamwork self-efficacy did not increase across their years of education in a four-year program.

The findings also support the advantages of grouping assessment item into the three stages. For example, while no difference was observed in the involvement-interest at the acclimation stage, a significant difference was observed at the competency stage.

Although interest plays a crucial role in learning, current assessment instruments for professional skills do not include this construct. Extant research (e.g., [13][14]) supports that an increase in student interest results in increased student learning. Eventually, individual interest in a subject indicates how much students are willing to immerse themselves into the subject. As a potential precursor for sustaining long-term learning, interest can be a promising construct to determine global awareness development.

### IV. CONCLUSIONS AND CURRENT RESEARCH

Global awareness is an important 21<sup>st</sup> Century skill for students' professional development; therefore, measures should be taken to assess this professional skill. In this paper, we put forward interest as a construct to evaluate students' development in global awareness, and have established the groundwork to assess global awareness interest. The interest questions presented in this paper are parts of a more comprehensive instrument to assess global awareness. This broader instrument, which is currently being administrated in several universities, also includes assessment items to evaluate

students' knowledge about global issues and strategic processing abilities. The collected data will be utilized to validate the whole instrument as well as to study the relationships between interest, knowledge, and strategic processing abilities as well as how they evolve based on students' background and educational development. If the proposed assessment framework is valid, the collected data should point out positive relationships between students' global awareness interest, knowledge, and strategic processing.

Using the proposed framework, it is possible to evaluate assessment outcomes against a theory that explains the journey of students toward expertise not only in global awareness but also other professional skill areas.

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