Assessing Engineering and Technology Students' Global Awareness: Interest, Knowledge and Strategic Processing

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Abstract

Engineers and Technology specialists often work in international settings or teams, as well as across diverse cultures in today's global economy. 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' 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. Relationship among interest, knowledge and strategic processing in assessing students' global awareness is studied in accordance with the MDL's experience-based stages, which are acclimation, competency and proficiency. An instrument to effectively measure students' global awareness development and engagement throughout their education is developed. One of the advantages of the proposed MDL-based assessment framework is to allow instructors to make intervention in the curriculum. Our findings for the proposed global awareness interest, knowledge and strategic processing assessment framework will be presented.

Keywords

Global Awareness, Assessment, Model of Domain Learning

Introduction

Engineering and Technology educators and practitioners have recognized the necessity of educating globally competent engineering graduates, who will be capable of working globally in collaborative and cross-cultural contexts. Reimers[1] defines a globally aware student as a student who (*a*) uses 21st century skills to understand and address global issues, (*b*) works collaboratively with individuals representing diverse cultures, religions, and lifestyles in the spirit of mutual respect and open dialogue in personal, work and community contexts, and (*c*) understands other nations and cultures, including the use of non-English languages. The goal of this research is to develop a set of assessment tools that allow students' global awareness level to be measured.

The Miami University Diversity Awareness Scale (MUDAS) focused on 983 first year students' global awareness at Miami University[2]. The study determined the definition of 'diversity awareness' "a person's acknowledgment of culture and social context variables." The study further defined awareness to consider respect, knowledge, global collaboration, taking appropriate actions and having an adequate mindset. The 37-item survey had three dimensions reflecting diversity awareness, which were cognitive, affective and behavioral. The study emphasized the differences in results among gender and ethnicity.

Another study was administered to American students to observe how virtual collaborative assignments impact cultural differences. American and German students worked together primarily through e-mail exchange for six weeks. One of the objectives of this study was to assess students' interest in the German culture through selected questions from the pre- and post-surveys. Results from the instrument reported that American students did not further develop their interest in the German culture, after the course ended[3]. Turney-Purta[4] discussed one of the Educational Testing Service's studies focusing on students' knowledge of global issues, such as health, religion, race and ethnicity, food, trade, population, international relations, the arts, energy, international conflicts and the environment. A key finding was that students knew the least about global conflicts.

The Wesleyan Intercultural Competence Scale (WCIS) entailed sixteen possible scenarios a student could experience, while studying abroad[5]. Each scenario was mapped based on the stages, which are denial, defense, minimization, acceptance, adaptation and integration, of the Developmental Model of Intercultural Sensitivity (DMIS)[6]. For each scenario, there were six responses to select from. The instrument involved a Likert Scale measuring accuracy. Lohmann et al.[7] inquired about engineering students' global awareness. In order to assess students' knowledge of global competence, assessments included coursework about international, worldwide, and economic affairs as well as questionnaires and contemplative essays, regarding the foreign experience.

To assess students' global awareness, in this paper, the Model of Domain Learning (MDL) was chosen for the assessment framework as proposed by Alexander et al.[8] and further suggested for professional skill assessment by Kulturel-Konak et al.[9] and Chipperfield et al.[10].

Data Collection

An online survey via Qualtrics survey software is designed based on the MDL. The survey questions (84) involve the following three sections or the MDL's learning-based components: interest (20), knowledge (35) and strategic processing (12) with additional 17 background questions. In the interest section, the questions measure the frequency of and the level of interest in cultural activities. In the knowledge section, the questions are fact-based and multiple-choice in the following areas: Customs and Culture, Geography, Economy, Religion, Food, Language, History, Labor Issues, Health, Environment, Politics. In the strategic processing section, the questions entailed reacting to various cultural scenarios through multiple-choice. Each question of the last two sections has a correct answer. Each question is mapped in accordance with the MDL's experience-based stages, which are acclimation, competency and proficiency.

As students develop an interest in a field of study, there is a transition from situational to individual interest[8]. Situational interest is temporary and spontaneous in response to external factors, while individual interest is long lasting, deeper, and more personal. Situational interest occurs in the acclimation stage. When a student has an individual interest in the domain, he/she is more willing to study the domain more so and tends to lead to long-term learning[8]. Individual interest occurs in the proficiency stage. According to Alexander et al.[8], the knowledge becomes more integrated and deeper as students continue their educational journey. At the acclimation stage, the questions involve limited knowledge, minimal thought required and only requiring one topic. At the competency stage, the questions entail knowing a few facts about the domain and

more complex definitions. At the proficiency stage, the questions involve acute knowledge, making deeper connections, considering three or more topics and incorporating uncommon or in-depth research. As students gain better strategic processing capabilities, the information becomes more linked and connected; in addition, the student is able to apply the information and knowledge to problem solving[8].

Participants

In this investigation, there were 184 participants from the Engineering and Information and Sciences Technology programs at Penn State Berks. Students were in various stages of their undergraduate degree programs: freshman (63), sophomore (50), junior (44), and senior (27). Collected responses were analyzed in two groups: freshman and sophomore (the number of students in Group I, N_I=113) and junior and senior (the number of students in Group II, N_{II}=71). All participants took the survey on their own time.

Data Analysis

Figure 1 illustrates the average overall test scores, the average scores of domain knowledge and strategic processing questions, as well as the average scores of interest and perceived importance questions for the two groups. One of the advantages of the proposed MDL-based assessment framework is to allow instructors to make inferences about student progress based on the MDL theory. From Group I to Group II, there is an increase in knowledge, strategic processing, intention interest and involvement interest of global awareness. When compared, these increases are statistically significant in *t*-test for strategic processing (p=0.034) and intention interest (p=0.012); however, they are not for the knowledge (p=0.37) and involvement interest (p=0.117).
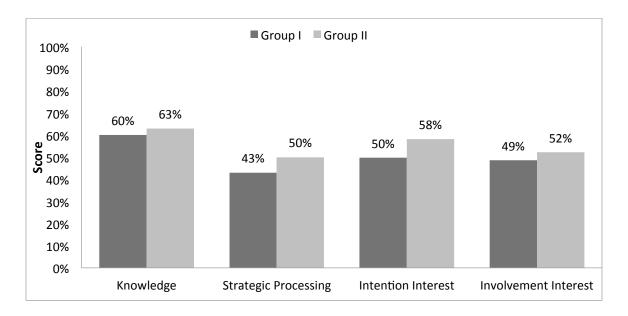

Figure 1: Comparison of Groups I and II across the MDL components.

However, another way we can evaluate student progress is to analyze the aggregated scores of knowledge and strategic processing divided among the MDL's experience-based stages as noted in Figure 2. The MDL's theory is supported in that students are more likely to answer the acclimation stage questions correctly for knowledge and strategic processing, while they were less likely to answer the proficiency stage questions correctly for both learning-based components. Although there is a slight increase or no change between the two groups for both knowledge and strategic processing, the only statistical significances reported are knowledge at the proficiency stage ($p=0.05$) as well as strategic processing at the proficiency stage ($p=0.009$). By analyzing the data in the three dimensions, namely knowledge, strategic processing, and interest, the proposed MDL-based assessment can point out deficiencies in students' progress toward achieving competency as in the presented case. This is the main advantage of the proposed MDL-based assessment framework over traditional score-based assessments.
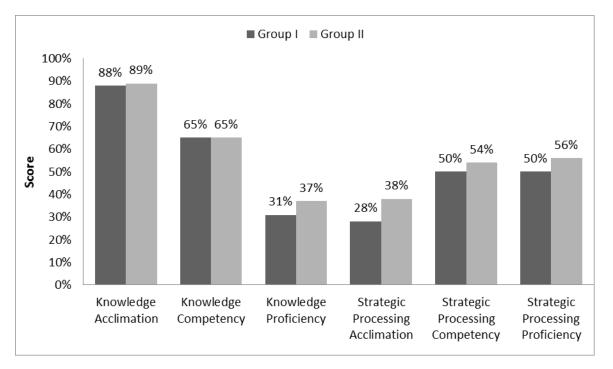

Figure 2: Knowledge and Strategic Processing Scores across MDL Stages.

Conclusions

Using the proposed framework, the evaluation of assessment outcomes based on a theory emphasizing the students' journey to improve in a field of study and being able to make more informed decisions about students' educational progress. Score-based rubrics consider the expectations of students in their skills and capabilities, but sometimes do not evidently analyze the relationships between these competencies and attitudes. As a result, the proposed MDL-based framework provides a deeper insight without solely depending on the average assessment scores. When analyzing the empirical results, one would conclude that students are transitioning

from acclimation to competency in terms of students' knowledge of global awareness but remain in the acclimation stage for strategic processing. Students are not ready to commit a more personal and deeper effort toward the global awareness domain.

Acknowledgment

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