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Assessment of Engineering Students' Global Awareness Knowledge, Strategic Processing and Interest*

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Undergraduate engineering students are expected to develop an understanding that engineering solutions can have global implications. Perceptions on engineering solutions by people from different cultures can be very different, and globally aware engineers need to understand and anticipate these perception differences. As engineering programs strive to instill the requisite learning to produce this outcome, a fundamental question to address is whether global awareness can be assessed as a part of engineering students' progress in the engineering curriculum. This article proposes and validates a new instrument, based on a developmental model—the Model of Domain Learning (MDL)—to gauge engineering students' growth in global awareness. Presented research responds to the following research questions: (i) Does engineering students' global awareness improve throughout their education? (ii) Do the expected relations among components of the MDL (i.e., knowledge, strategic processing, and interest) hold for the domain of global awareness? A total of 425 students, enrolled in 18 different engineering programs in a US land-grant university, participated in this study. The study findings supported that, (i) as they progress in their education, engineering students' knowledge, strategic processing, and interest increase in tandem for the domain of global awareness, (ii) the MDL can serve as a framework for assessing engineering students' development of global awareness.

Keywords: Model of Domain Learning; assessment; global awareness; undergraduate engineering

1. Introduction

The increased interconnection among people, cultures, and countries that characterizes today's world requires students to be interculturally competent and knowledgeable. Therefore, it is essential to support student learning, and understand how capable they are to cope with and engage in situations where values, ideologies, and customs profoundly different from theirs are presented. Mansilla and Jackson [1] provide three rationales for educating globally competent students: (i) changing demands of work due to the flattened global economy, (ii) developing multi-cultural tolerance and understanding due to the increased level of immigration, (iii) addressing climate instability and environmental problems. Fawson and Naffziger [2] describe the traits of a globally competent employee as follows: an awareness of the wider world and a sense of the role as a world citizen; an understanding of how the world works economically, politically, socially, culturally, technologically, and environmentally; an outrage of social injustice; a commitment to participate in and contribute to the community at a range of levels from local to global; a willingness to act to make the world a more sustainable place; and an acceptance of responsibility for individual actions. Global competency is a complex and multi-dimensional construct. Reimers [3] defines global competency as a set of knowledge and skills to understand the world, comprehend current global problems and affairs, and devise solutions considering human dimensions as well as a positive attitude towards interacting peacefully, respectfully, and productively with people from diverse cultures. Deardorff [4] defines a four-stage process model of intercultural competence. The Council of Europe (2016) provides a conceptual model of global competency for informing educational programs and policymakers. This model encompasses four dimensions: (i) Skills (e.g., flexibility, empathy, conflict resolution, interacting respectfully, linguistic, analytical and critical thinking), (ii) Knowledge and Critical Understanding of global issues and other cultures (iii) Attitudes (e.g., openness, respect to other cultures, and civic-mindedness) (iv) Values (human dignity, human rights, and cultural diversity).

Engineers are required to have not only advanced technical skills but also the ability to function on international projects with different cultures and beliefs to be successful in the business world [5]. Downey et al. [6] argue that engaging engineering students with cultures other than their own

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encourages them to formulate problems differently and devise solutions considering important human dimensions. Educating students for global competency can promote civilized interactions among individuals to find common solutions to difficult socio-economic problems of today's diverse societies. Higher education institutions recognize such social and educational benefits of global competency; therefore, they are looking for new ways to instill the necessary global competency into their students [7].

Global awareness is a precursor to global competency. Milman [8] suggests that global awareness refers to understanding global issues while global competency requires skills and abilities to act upon those issues. Hanvey [9] defines global awareness as a multi-dimensional construct that encompasses the recognition of cultural differences, knowledge of cultures, history, global economics, social, and political trends, and awareness of prevailing world problems as well as how different cultures respond to these problems differently. The essence of Hanvey's [9] global awareness definition is the understanding that the others may have views of the world that are profoundly different from one's own and that local and national decisions can have international implications. Merryfield [10] expands Hanvey's [9] global awareness definition by including eight dimensions: human beliefs and values of global systems, global issues and problems, cross-cultural understanding, awareness of human choices, global history, and indigenous knowledge.

The definitions of global awareness given above align with a specific learning outcome of the Accreditation Board for Engineering and Technology (ABET), Inc.: ''understanding the impact of engineering solutions in a global, economic, environmental, and societal context.'' To the best of our knowledge, however, the development of global awareness in engineering students has not been studied. In addition, extant instruments for assessing global awareness do not include items designed to measure student interest toward being globally aware. Shuman et al. [11] note that awareness outcomes are difficult to measure, especially in technical fields where awareness should be incorporated into problem-solving activities in a global and social context. The lack of empirical evidence regarding whether engineering students' global awareness improve throughout their undergraduate education is one of the motivations for studying this question herein, but not the main one. In this article, we propose an instrument to assess engineering students' professional development in global awareness based on the Model of Domain Learning (MDL, [12, 13]). As we briefly summarize in the background section of this article, there are several instruments in the literature to assess global competency. While those instruments aim to evaluate students' performance in different dimensions of global competency, our objective is to assess students' global awareness based on a developmental model.

According to Hanvey's [9] and Merryfield's [10] definitions, the domain of global awareness includes the set of concepts and issues that shape our world, including world history and politics, knowledge about other cultures, environmental issues, socio-economic and political systems, and global events. The MDL explains how learners progress toward expertise in a domain through changes in three dimensions: *knowledge, strategic processing*, and *interest.* According to the MDL, these changes follow a common pattern regardless of the domain; in fact, related evidence exists for social studies, astrophysics, human biology/immunology, educational psychology, and special education [12–15]. Our primary research objective in this investigation was to explore how the changes and interplay among knowledge, strategic processing, and interest can be used to evaluate students' development in global awareness and validate the appropriateness of the proposed approach.

The MDL captures development in academic domains across three stages: *acclimation, competency*, and *proficiency*. According to the MDL, notable changes are observed in learners' knowledge, strategic processing, and interest as they move from acclimation to competence in a domain, and possibly in proficiency for some selected individuals. In the acclimation stage, learners have very limited and fragmented knowledge about the domain. This lack of knowledge coincides with limited individual interest or personal investment in the domain. Interest is more often stimulated by external and temporary factors (i.e., situational interest). Due to limited knowledge and individual interest, acclimation stage students also tend to rely on surface-level strategies when they are faced with a problem or a learning task. Within competence, by contrast, there is more evidence of principled domain knowledge, growing personal interest, and an increased ability and willingness to engage more deeply in problem-solving. Finally, for those who achieve proficiency or expertise, there is not only evidence of highly structured and extensive domain knowledge but also a deep commitment to and investment in the domain and associated activities, as well as an extensive repertoire of strategies that permit deep and effective analysis of problems. Those in the proficiency level are, in fact, self-motivated, think critically when solving problems, and evaluate information from multiple perspectives.

Previously, Kulturel-Konak et al. [16] proposed an assessment framework based on the MDL. The work revealed in this study expands on the previous foundation by developing an instrument and validating the MDL-based assessment framework for global awareness. The proposed framework aims to enable academic programs to assess their students' growth in various professional skills (e.g., teamwork, global awareness, and ethics) on the same dimensions (knowledge, strategic processing, and interest). Thereby, academic programs can better identify professional skill areas in which their students lack progress. In this article, we specifically aim to demonstrate that the developed instrument could be used to detect shifts in engineering students' professional growth in global awareness in three dimensions, knowledge, strategic processing, and interest. This objective is attained by comparing students' development within the first two years (lower level) of an engineering program emphasizing global awareness to those students' in the last two years (upper level) of the target program. We also aim to show that the predictions of the MDL are valid in the domain of global awareness nested within an engineering program. Once the validity of the MDL predictions is established, an instrument based on the MDL can be used to assess students' developmental stage (i.e., acclimation, competency, proficiency) by evaluating their level of knowledge, strategic processing, and interest and the interrelations among these foundational areas. This will facilitate the integration of professional skills assessment into an overall program assessment plan using a uniform framework.

2. Research aims

The specific research questions for this study are as follows:

(i) Do higher level engineering students have a higher level of global awareness then lower level engineering students?

To the best of our knowledge, this question has not been studied in the literature although global awareness has been one of the ABET outcomes. Through Research Question I, therefore, we intend to demonstrate that the instrument can be used to detect shifts in students' professional development in three dimensions, *knowledge, strategic processing*, and *interest*, by comparing the learning of the lower level engineering students to that of the upperclassmen, within an engineering program emphasizing global awareness.

(ii) Are the hypothesized relations among knowledge, strategic processing and interest by the MDL supported in the context of global awareness?

According to the MDL, some notable changes should be observed in MDL components of knowledge, strategic processing, and interest as learners' progress from a beginner stage of their development in a domain to a more advanced stage. More importantly, these changes should follow a common pattern regardless of the field [12–15]. We aim to show that MDL predictions are also valid in the domain of global awareness nested within an engineering program. We used correlation analysis to demonstrate how engineering students' knowledge, strategic processing, and interest interact in a similar way to the earlier studies [14, 15] that evaluated the MDL in different domains.

3. Background

In this section, we review the existing instruments for the assessment of global awareness with an emphasis on how these instruments relate to the knowledge, strategic processing, and interest components of the MDL. We explain how various assessment tools measure each MDL component as related to global awareness.

3.1 General assessments

Based on a review of 46 academic papers, Ball et al. [17] organized 23 global competencies for engineering students into five categories: (1) cross-cultural communication, (2) cross-cultural dispositions, (3) world knowledge, (4) cross-cultural teams, and (5) engineering specific cross-cultural competencies. The relative importance of these competencies was then rated by industrial and academic experts. Despite a few differences between ratings by industrial and academic experts, the authors argued that 23 competencies were comprehensive. However, appropriate methods to measure these competencies were not discussed.

Several instruments measure global competency using Likert-scale items. In these cases, students indicate their level of agreements with given statements. The instruments in this category include the Cross-Cultural Sensitivity Scale (CCSS) [18], the revised Intercultural Development Inventory (IDI) [19], the Miami University Diversity Scale (MUDAS) [20], the Global Perspective Inventory (GPI; [21] and the Cultural Intelligence Scale (CQ; [22]). The CCSS [18] measures knowledge and strategic processing wherein responses to 24 statements reveal how well students understand Canadian relations with other countries and the current issues in Canada. The CCSS has a Cronbach's α of 0.93 [18]. However, the CCSS does not include sections on students' way of addressing complex situations, or strategic processing that may require global awareness. The IDI [23] gauges how curious students are about other cultures, and their poten-

tial to accept them through the stages of adapting to cultural differences on six scales: Denial, Defense, Minimization, Acceptance, Adaptation, Integration. The original version of the IDI was administered to Japanese students, who spoke English at varying levels of proficiency [24]. The IDI has 60 items, uses a seven-point Likert Scale, and considers students' prior international experience and thus interest level to some degree [23, 24], and all six scales of the IDI have Cronbach's α values higher than 0.74 [23].

The stages of the Developmental Model of Intercultural Sensitivity (DMIS; [25]) assess students' development in working with other cultures. The MUDAS gauges first-year students' global awareness through a 29-item survey and across three dimensions: cognitive, affective, and behavioral [20]. The cognitive dimension focuses on knowledge, while the affective dimension emphasizes thankfulness and acknowledgment. The behavioral dimension stresses social justice and international interplay. This assessment tool's measures parallel all three of the MDL's learning-based components in that the statements address how students react to global situations, how knowledgeable they are about global issues, and what the likelihood for their participation in an activity is related to increasing global competency. However, the MUDAS does not address a student's growth in skills throughout his/her education, and reliability measures are not provided by Mosely-Howard et al. [20].

The GPI assesses global perspective through the following dimensions: interpersonal, cognitive, and intrapersonal [21]. Each dimension has two scales grounded in theories of intercultural communication and intercultural development. The interpersonal dimension measures college students' interactions with different cultures and norms. The cognitive dimension gauges students' knowledge of various cultures. The intrapersonal dimension assesses emotional intelligence and the individual development of cultural identity. The six scales of the GPI have Cronbach's α values between 0.657 and 0.773. The most updated version of this assessment instrument includes additional forms for specific circumstances, such as studying abroad and being a first-year student, which consider the campus environment and curricula. The GPI was administered to about 19,528 undergraduate students through approximately 40 items on a five-point Likert Scale. The GPI addresses MDL's knowledge component in its cognitive domain, as well as the strategic processing component through the interpersonal and intrapersonal domains.

The CQ [22] measures students' knowledge, energy and behavior toward global competence through 40 items. The scale considers the following aspects: behavioral CQ, motivational CQ, metacognitive CQ, and cognitive CQ. The behavioral CQ emphasizes how appropriately students interact with people of other cultures. The motivational CQ is defined as the motivation to learn and apply oneself in intercultural situations effectively. The reliability of scales in CQ has been studied to be between 0.70 and 0.86.

3.2 Knowledge assessments

While the MUDAS, CCSS, IDI, DMIS, and CQ rely on self-report questionnaires, the knowledge and strategic processing items in this study are multiple-choice test questions that provide objective performance measures. There are several instruments in the literature that utilize multiple-choice tests to evaluate global competency knowledge. The Ohio State Global Awareness Test, with 76 items, specifically measures students' cultural knowledge through the following categories: geography, US-Soviet relations, humanities, global institutions, economic development and ecological matters [26]. Lohmann et al. [27] present a conceptual model to define global competency, curricular interventions, and an assessment model to determine if graduates have achieved it. This conceptual model is based on five elements: proficiency in a second language, international coursework and immersive international experiences that should be combined in a coherent program tying the elements together and integrating them within a student's major. The assessment model also includes pre/post surveys and essays. The Global Awareness Profile (GAP) gauges intercultural competence through 120 multiple-choice questions and considers the following global topics: politics, religion, culture, environment, and geography [28].

3.3 Strategic processing assessments

The Cross-Cultural Adaptability Inventory (CCAI) gauges students' intercultural communication, adaptation, and interplay through 59 items [29]. The CCAI focuses on emotional resilience, personal autonomy, perceptual acuity and flexibility/openness. The Wesleyan Intercultural Competence Scale (WCIS) discusses 16 possible situations students could face while studying abroad. Most participants involved in the study experienced similar scenarios to some capacity. The response options, on a six-point Likert scale, were based on the intercultural competence levels of denial, defense, minimization, acceptance, adaptation, and integration [30] of the DMIS [25]; these scales have Cronbach's α values between 0.62 and 0.82. Responses were to reflect whether the said situation occurred or not during students' most recent experiences abroad. In each

situation, the characteristics of the students' behavior would reveal their state in the DMIS stages.

The Multicultural Personality Questionnaire (MPQ) assesses intercultural behaviors and tendencies and multicultural effectiveness involving approximately 63 items on four-point scales of applicability and agreeableness [31]. The following five dimensions were measured: sensitivity, emotional stability, open-mindedness, social initiative, and flexibility with Cronbach's α values between 0.75 and 0.90. A notable finding was that less emotionally stable students also had increased academic performance. The study included 305 students from two international business schools in France and the Netherlands. The Global Citizenship Scale assesses global citizenship on a five-point Likert scale of agreeableness; and includes global civic engagement, social responsibility, and global competence as core constructs with Cronbach's α values between 0.72 and 0.92 [32].

3.4 Interest assessments

The extant works on interest assessment have been limited despite notable exceptions [16, 33, 34]. Cushman et al. [35] discussed how a university's curriculum could be improved in terms of incorporating global awareness to a higher degree. Through this workshop, graduate students have gained an individual interest in addressing diversity and global issues personally. At the end of the workshop, students' interest was indirectly assessed based on the results of the student evaluations in the form of open-ended comments. There are also instruments assessing interest level in ratings to reflect students' agreement with given statements. Having students state to what degree they agree while assessing interest is not effective because it reveals opinions and attitudes not necessarily the individual interest. The Interest in Foreign Language Scale gauges students' interest in foreign languages [36]. The scale had six sub-scales measured on a five-point Likert scale with Cronbach's α values between 0.80 and 0.91. The assessment also communicated perceptions on how useful a foreign language can be for students and how language interest can lead to engaging in other cultural events and discussions. Alexander et al. [13] stated that further engagement in cultural activities is an indicator of individual interest.

4. Research methods

4.1 Participants

Participants in this study were undergraduate students (n = 425) enrolled in 18 different engineering programs at a land-grant university in the Northeastern United States. Four engineering programs (Mechanical, Industrial, Chemical, and Engineering Technology) constituted approximately 50% of the participants. In terms of the academic standing, 36% of participants were first-year students; 28.70% were second-year; 21.64% were third-year, and 13.64% were seniors. To study Research Question-I, the dataset was divided into groups based on the class standing of the participants as Lower Level (first- and second-year students, n = 275) and Upper Level (third- and fourth-year students, n = 150).

Some relevant demographics of participants were as follows: 78.35% were male, 21.64% were female; 9.41% were from underrepresented groups (Hispanic/Latino, American Indian/Alaska Native, Black/African American, Native Hawaiian/Other Pacific Islander, and two or more races); and 10.11% were international students. These percentages were representative of the population of the engineering students in the university, which included 20.9% female, 8.8% unrepresented groups, and 15.5% international students at the time when the study was conducted.

Because the interest questionnaire was developed for the first time in this research, we also used a secondary dataset (n = 747) that included non-engineering students (40.1% business, 31.7% sciences, and 24.7% social sciences and liberal arts) to investigate the underlying factor structure of these interest items through an Exploratory Factor Analysis (EFA). Then, we tested the internal consistency of the extracted models and the interest questionnaire on the target data set using confirmatory factor analysis. The relevant demographics of the secondary data set were as follows: 55% female, 22.4% underrepresented students, 21.6% first-year, 23.4% second-year, 28.9% third year, and 26.1% fourth-year, and 5% international students.

An important aspect that makes this study population relevant is that the College of Engineering for the university, where participants were drawn from, has articulated an aspirational goal of becoming a world-class engineering college for its students. All engineering students are required to take six credits of general education courses with an international component. The College also offers several experiential learning opportunities on a global level such as study abroad, summer global programs, global learning scholarships, and humanitarian engineering projects.

4.2 Procedures

An anonymous URL link pointing to the online survey (created using Qualtrics) was emailed to the

target population. The participation in the survey was voluntary with no incentives for participation.

4.3 Variables

4.3.1 Knowledge

The MDL distinguishes two types of knowledge-domain knowledge and topic knowledge. The domain knowledge involves an understanding of the scope of the knowledge base in a field of study. According to the conceptual model of the Council of Europe (2016), the domain knowledge in the context of global awareness is broad and encompasses various areas such as world history, world politics, cultures, low, human rights, religion, environmental issues, sustainability, global socioeconomic and political systems, and global events. Topic knowledge is more specific and indicates how much one knows about a particular topic related to one of the domain areas. In the context of global awareness, for example, topic knowledge may constitute the knowledge and understanding of a student about religions and beliefs systems other than his/her own.

In this study, the global awareness knowledge of students was measured using 35 multiple-choice questions about global events and knowledge in a broad range of topics, including customs and cultures, geography, economy, religion, food, language, history, environment, and political/economic issues. These topics were selected from the literature and included the concepts given in the global awareness definition in [9, 10]. The multiple-choice questions were created by the research team and reviewed by a panel of faculty and outside subject matter experts (SMEs). The knowledge test aimed to include questions with different difficulty levels representing the three developmental stages of the MDL. The knowledge questions at the acclimation stage measured basic awareness of current global events. We anticipated undergraduate students to answer acclimation level questions. At the competency and proficiency stages, the knowledge questions required more in-depth and specific knowledge. To answer the proficiency level questions correctly, students should have not been enticed by the choices that seemed obvious. SMEs provided feedback on the appropriateness and difficulty of the questions for undergraduate students. Their input was used to make sure that we had questions for all three stages of the MDL. We added, removed, or modified questions based on the feedback from the SMEs. Reviews by the SMEs and alignment of the questions chosen with similar instruments from the literature ensured content validity.

The percentage of the correct answers by each participant was used as the score of the student's global awareness knowledge. The knowledge questions also included a "not sure choice," which was also graded as a wrong answer. The "not sure choice" option was included to distinguish the participants who answered the questions and who did not. This option prevented us from wrongfully eliminating participants who skipped questions because they were not sure about the correct answer. To establish the reliability of the knowledge test, we first calculated the specific question's discrimination index, revealing how well a question differentiates among the top 27% scorers and the bottom 27% scorers. In addition, we calculated Kuder-Richardson (KR-20) reliability, which is typically used for dichotomous multiple-choice test items [37]. The questions with lower than a discrimination index of 0.16 in their level were excluded from this study. The remaining knowledge test included 8 acclimation, 10 competency, and 10 proficiency level questions. The overall knowledge test had the KR-20 reliability of 0.81, the average discrimination index of 0.41, and the average difficulty index of 0.64. The acclimation level questions had lower discrimination indexes with the average of 0.29 and the minimum of 0.16 since these questions were answered correctly by the majority of the participants (see Table 8 for the average test scores). Although two acclimation level questions had discrimination index levels of 0.16 and 0.17, which are considered low according to Ebel [38], they were included in the study considering the high average test scores at the acclimation level. Sample knowledge questions are provided in the Appendix.

4.3.2 Strategic processing

Within the MDL, the strategic processing means the application of domain knowledge into relevant problem-solving procedures. While solving a problem, students may apply different strategies based on their knowledge and interest in the problem domain. If students have limited knowledge related to the domain of the problem, they rely on text-based strategies to comprehend the textual content of the problem [14]. These are mainly surface-level strategies such as rereading and fact-finding in the text. Advanced students can apply deep-processing strategies to critically evaluate the problem, given facts, and alternatives based on their background knowledge in the domain. We used 12 mini-case study multiple-choice questions to evaluate strategic processing abilities of students regarding global awareness. In each mini-case study question, students were introduced to a scenario related to global issues and expected to select the best course of action among the presented four choices.

Unlike the knowledge questions that were dichot-

omously scored, the strategic processing questions were scored polytomously. Each question has a most appropriate choice (scored as 5), a distractor choice (scored as 3), which is partially appropriate, and two incorrect options (scored as 1). The strategic processing score for each student was calculated as the percentage of the total score of the student out of the maximum possible score. The scenarios, their choices, scoring of the choices of the strategic processing questions were designed by the research team with the help of undergraduate students. A panel of five undergraduate students provided criterion-related evidence [39] for the content validity of the questions and choices. The student panel evaluated the first draft of the questions with regards to the extent the scenarios represent real-world cases faced by undergraduate students and whether the provided choices are representative of undergraduate students' behaviors, or sphere of knowledge. The student panel also provided feedback on the language and context of the questions. Later, the questions were also reviewed by the panel of outside experts and revised based on their feedback. The panel of experts also made recommendations on the difficulty of questions to ensure that we had questions for all three developmental stages of the MDL. The most appropriate and distractor choices were considered as the correct choices to calculate the difficulty indexes of the questions. Two questions were not used in this study because their discrimination indexes were less than 0.2 [38]. The remaining 10 questions (3 acclimation level, 3 competency level, and 4 proficiency level) had the KR-20 reliability of 0.67, the average discrimination index of 0.40, the minimum discrimination index of 0.24, and the average difficulty index of 0.69. Sample strategic processing questions are given in the Appendix.

4.3.3 Interest

The previous models and instruments of global competency do not include a dimension related to interest. In the MDL, demonstrating individual interest is an important indicator of professional development in a domain. As described before, individual interest in a domain manifests in self-directed action and engagement as opposed to the situational interest which is stimulated by external factors. As individuals gain expertise in a domain, they engage in domain-related activities available in their daily experiences more frequently and pursue professional development opportunities [40]. In this study, therefore, interest aims to measure how much effort students invest and are willing to invest in learning about global issues. In order to assess students' interest in global awareness, a questionnaire with two types of items was developed by the research team with the help of the undergraduate student panel. The first group of 12 items asked students how frequently they engaged in activities related to global awareness in the last two years. Including this group of action-oriented items was recommended by our SMEs. We referred to the group of these items as Engagement Interest. Each item of the Engagement Interest group was operationalized using a five-level rating scale (1 = none, 2 = once or twice, 3 = three or four times, 4 = five or six times, and 5 = more than six times). The second group included eight items measuring students' intentions to take part in professional development activities such as attending a workshop or taking a course. This group of items was referred to as Intentional Interest. These eight items were operationalized using sliding bars on a scale from 0 (not interested at all) to 100 (very much interested). In the measurement of self-efficacy, continuous scales with a 0–100 response range are known to be psychometrically stronger and have better discriminating power compared to traditional discrete rating scales with several options [41, 42].

Because we did not have a priori assumptions about the structure of the Engagement Interest items, we first performed an EFA using Principal Component Analysis with Varimax Rotation to identify any latent variables underlying the 12 items of Engagement Interest. In this EFA, we used the secondary dataset for a better generalization of the results as recommended in the literature [43]. After determining the underlying factors of the items, we tested the fit of the extracted models on the engineering dataset using a multi-group Confirmatory Factor Analysis (CFA). Table 1 presents the items of Engagement Interest, the rotated factor loadings of the EFA, the standardized regression coefficients of the CFA for both class levels. The two extracted factors explained 49.40% of the total variance in the original items. The last two items were excluded from the final model because their communalities were less than 0.40.

In Table 1, the main difference between the two extracted factors is the relative effort that students need to put forward to perform. The items loaded on the first factor seemed to be performed easily by undergraduate students. On the other hand, the items that loaded on the second factor required more deliberate (or concerted) effort. For example, students are more likely to have a casual conversation among themselves than to ask questions to a professor about global issues. Therefore, the latent variables corresponding to the extracted factors are called Engagement Interest-Casual and Engagement Interest-Deliberate, respectively.

After the EFA, we tested the extracted measurement model for invariance across the two groups of

Table 1. EFA Rotated Factor Loadings and CFA Standardized Regression Coefficients for the Engagement Interest items

Items	Factor Loadings		Regression Coefficients	
Factor 1: Engagement Interest-Casual	**1**	**2**	**Lower Level**	**Upper Level**
Q3. Read an online article about global issues.	0.84		0.70	0.81
Q9. Performed a web search to learn about global awareness/issues.	0.82		0.80	0.84
Q5. Had a conversation with your friends about global issues.	0.79		0.72	0.71
Q4. Read a newspaper/magazine article about global issues.	0.69		0.52	0.70
Q6. Watched a video clip or foreign film outside of class work about global awareness/ issues.	0.65		0.72	0.65
Factor 2: Engagement Interest-Deliberate				
Q11. Attended a cultural dinner or event on campus.		0.70	0.51	0.55
Q12. Coordinated or taken part in a fundraiser for a global issue		0.70	0.64	0.52
Q1. Attended a seminar or speaker event about global awareness/issues.		0.65	0.68	0.80
Q8. Asked questions to a professor about global awareness/issues.		0.50	0.57	0.68
Q2. Read a book about global awareness/issues.		0.46	0.55	0.74
Items Excluded in the Final Model				
Q10. Sampled the cuisine of a different culture (e.g., Korean, Moroccan)	0.58	0.12	-	-
Q13. Attended a diversity training class	0.28	0.48	-	-
Percent of Variance	30.13%	19.27%		
Eigenvalue	4.2	1.72		

students (Lower Level and Upper Level) on the target dataset. When a study involves comparing multiple groups with respect to latent variable means, the literature recommends testing whether the measurement model of latent variables is equivalent across groups because different groups may interpret the underlying constructs and items differently [44]. This process is called measurement invariance testing. Next, we briefly summarize our procedures and justifications for invariance tests based on the recommendations from others [44–46].

We used multi-group CFA in AMOS to demonstrate configural, metric and scalar invariance of the measurement model of latent variables Engagement Interest-Casual and Engagement Interest-Deliberate. These invariance tests are performed by gradually adding constraints on the parameters of the measurement model. Configural invariance indicates whether participants in different groups conceptualize the underlying constructs in the same way. Configural invariance is typically tested by multi-group CFA. If configural invariance is supported, then the same measurement model can be used for different groups. Metric invariance indicates whether the individual items have the same meaning across different groups. Metric invariance is tested by constraining the regression coefficient of each item to be equal for all groups. If metric invariance is supported, then the item scores are comparable across the groups, and any difference between the scores can be attributed to the groups [45]. Testing scalar invariance is recommended when latent variable means are to be compared across different groups. Scalar invariance indicates that a value of a latent variable represents the same magnitude across groups. Scalar invariance is tested by constraining both intercept and regression coefficient of each item to be invariant across groups. The literature notes that a full scalar invariance test is a very stringent requirement and tends to fail frequently with real-life data [47].

As shown in Table 2, the Engagement Interest measurement model had good configural invariance and demonstrated evidence for metric invariance,

Table 2. Measurement Invariance Tests for the Engagement Interest Measurement Model on the Target Data Set: Lower Level (n = 275) vs. Upper Level (n = 150)

Invariance Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	CFI	RMSEA	*p* of close fit
Configural	160.17	68				0.93	0.057	0.16
Metric	169.58	76	9.41	8	0.30	0.93	0.054	0.26
Scalar	190.98	86	21.40	10	0.01	0.92	0.054	0.26
Partial Scalar*	180.43	82	10.84	6	0.09	0.92	0.053	0.29

CFI: Comparative Fit Index; RMSEA: Root Mean Square Error of Approximation; df: Degrees of freedom; * two items for each latent variable had variant intercepts.

meaning that the model had an acceptable fit for both groups, and the regression coefficients of the items were invariant across the groups (had the same Comparative Fit Index (CFI) > 0.90), χ^2/df $\leq$ 3, Root Mean Square Error of Approximation (RMSEA) measure $\leq$ 0.08.

The Engagement Interest measurement model failed scalar invariance when the intercepts and loadings of all items were set equal across the groups. It is important to note that although the full scalar invariance model had acceptable levels of CFI and RMSEA, the goodness of fit deteriorated significantly ($p = 0.018$). If scalar invariance fails, it is recommended that researchers use a partial scalar invariance test to compare the latent variable means across the groups [46]. Partial scalar invariance was supported ($p = 0.093$) after removing the requirement of invariant intercepts for two items of the Engagement Interest-Casual latent variable and two items of the Engagement Interest-Deliberate latent variable.

We also used the same model exploration and validation procedure for Intentional Interest. In the preliminary EFA using Principal Factor Analysis with Varimax Rotation, the two extracted factors explained 63.97% of the total variance in the original items. Table 3 presents the results of the EFA and CFA. The last item was excluded from the final model because its communality was less than 0.40.

The extracted factors were called Intentional Interest-Easy and Intentional Interest-Effortful, respectively. The items that loaded on the Intentional Interest-Effortful latent variable require more effort to perform than the items loaded on the Intentional Interest-Easy. The statistics of the CFA and the invariance tests of the Intentional Interest model are given in Table 4. For the Intentional Interest measurement model, configural invariance and metric invariance were supported, but full scalar invariance failed ($p < 0.05$).
The fit indices of the configural invariance and metric invariance model provided evidence that the measurement model fitted the data well for both groups. Partial scalar invariance was established after relaxing the requirement of invariant intercepts for one item in each of the variables as given in Table 4.

Next, we present the internal consistency, convergent, and adequate discriminant validity of the extracted latent variables based on the results of the multi-group CFA. Table 5 summarizes Cronbach's Alpha (α), Composite Reliability (CR), Average Variance Extracted (AVE), Correlation Coefficients between the latent variables, and the heterotrait-monotrait ratio (HTMT) of the correlations of the latent variables for both class levels. In both measurement models, all standardized regression coefficients of the extracted latent variables exceeded 0.5 and were significant ($p < 0.001$). In addition, all CR and α values were greater than 0.70, indicating an

Table 3. Rotated Factor Loadings (EFA) and Standardized Regression Coefficients (CFA) for the Engagement Interest items

Items	Factor Loadings		Regression Coefficients	
Factor 1. Intentional Interest- Effortful	**1**	**2**	**Lower Level**	**Upper Level**
Q19. Rate your level of interest in attending a free workshop on global awareness.	0.85		0.84	0.82
Q22. 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.	0.83		0.9	0.91
Q20. Rate your level of willingness to take an elective course in order to improve your global awareness.	0.76		0.76	0.64
Q23. A cross-cultural dinner is being held on campus featuring food and music from different parts of the world, and it is free to attend. Rate your likelihood of attending the event.	0.69		0.58	0.58
Factor 2. Intentional Interest-Easy				
Q25. While you are browsing a news website, you have spotted an article entitled "Economic Problems in Europe." Rate your likelihood of reading this article.		0.83	0.75	0.71
Q26. How likely are you to follow, on your own, current news about terrorism in the world today?		0.83	0.54	0.58
Q21. Rate your level of interest in reading literature about global issues.		0.62	0.81	0.86
Items Excluded				
Q24. You are the guest of honor at a dinner for a company based out of China. You will be traveling to the company's headquarters for dinner. Rate your likelihood to research Chinese culture and customs, regarding dinner etiquette.	0.49	0.29	–	–
Percent of Variance	47.96%	16.01%		
Eigenvalue	3.83	1.28		

Table 4. Measurement Invariance Tests for the Intentional Interest Measurement Model on the Target Data Set: Lower Level ($n = 275$) vs. Upper Level ($n = 150$)

Invariance Model	$\chi 2$	*df*	$\Delta\chi 2$	Δ *df*	*p*	CFI	RMSEA	*p* of close fit
Configural	70.82	26				0.96	0.064	0.09
Metric	73.23	31	2.40	5	0.79	0.97	0.057	0.23
Scalar	88.68	38	15.44	7	0.03	0.96	0.056	0.23
Partial Scalar*	82.30	36	9.07	5	0.10	0.966	0.055	0.27

Table 5. Summary of Internal Consistency, Convergent Validity and Discriminant Validity of the Measurement Models

		Measurement Models			
		Engagement Interest		Intentional Interest	
Statistics	Class Level	Causal	Deliberate	Easy	Effortful
α	Lower	0.822	0.723	0.751	0.855
	Upper	0.857	0.796	0.781	0.820
	Lower+Upper	0.838	0.759	0.763	0.843
Cor. Coeff.	Lower	0.513		0.809	
	Upper	0.549		0.786	
AVE	Lower	0.493	0.356	0.507	0.617
	Upper	0.561	0.449	0.534	0.568
CR	Lower	0.827	0.732	0.750	0.863
	Upper	0.863	0.799	0.771	0.836
HTMT	Lower	0.469		0.333	
	Upper	0.488		0.312	

Cor. Coeff.: Correlation Coefficient between the two latent variables of the measurement models.

acceptable level of internal consistency of the latent variables. The AVE values of Engagement Interest-Casual, Intentional Interest-Easy, and Intentional Interest-Effortful were very close to or larger than 0.5, indicating their convergent validity. However, the AVE value of Engagement Interest-Deliberate was less than 0.5 for both class levels. The convergent validity of Engagement Interest-Deliberate can be considered as acceptable due to the facts that the AVE values were close to 0.50; the correlation between Engagement Interest-Causal and Engagement Interest-Deliberate was lower than 0.85 [48]; and the CR values were higher than 0.70 for both groups.

The correlation coefficients between the latent variables of Engagement Interest were lower than 0.85, which is considered a threshold for supporting discriminant validity [48]. The AVE values of the Engagement Interest latent variables were also higher than the squared correlation coefficient between them, indicating the discriminant validity according to the Fornell-Larcker criterion [49]. For Intentional Interest, the correlation coefficient of latent variables was also lower than 0.85 [48]. The HTMT values were less than the threshold value of 0.85 [50]. Therefore, discriminant validity was supported for both latent variables of Engagement Interest and Intentional Interest.

5. Results

We first compared the mean values of the knowledge, strategic processing, and interest variables across the class levels using ANOVA in Table 6. In addition, Cohen's *d* values are provided to gauge the effect size of the class level as well as the *F* and *p* statistics to indicate the statistical significance of the differences between the mean values across the groups. Several patterns emerged from the data presented in Table 6. First, the average scores in all MDL dimensions increased from the Lower Class Level to the Upper Class Level, and the mean differences were statistically significant for Knowledge, Strategic Processing, Engagement Interest-Casual, Engagement Interest-Deliberate, and Intentional Interest-Easy ($p < 0.05$ for all variables), but not for Intentional Interest-Effortful ($p = 0.103$). The Cohen's *d* values suggested small to moderate effects of the class level on the knowledge, strategic processing, and interest. Such increases in knowledge and strategic processing scores should be expected because students are required to take up to six credits of general education courses with an international component. In addition, upper-level students reported engaging more frequently in global awareness related activities (Engagement Interest) and indicated a higher level of interest for

Table 6. Means (*M*) and Standard Deviations (*SD*) of the Variables for the Class Levels, Effect Size (*d*), *F*, and *p* Statistics

	Lower Level		Upper Level				
Variables	***M***	***SD***	***M***	***SD***	***d***	***F***	***p***
Knowledge	61.58	17.46	67.57	15.65	0.360	12.25	0.001
Strategic Processing	67.56	14.06	70.71	12.80	0.23	5.16	0.024
Engagement Interest-Casual	3.31	1.06	3.64	1.11	0.30	8.92	0.003
Engagement Interest-Deliberate	1.67	0.67	1.85	0.84	0.23	5.78	0.017
Intentional Interest-Easy	53.32	23.75	58.73	25.14	0.22	4.83	0.028
Intentional Interest-Effortful	42.91	24.90	47.08	25.68	0.16	2.66	0.103

Table 7. Pearson Correlations among the Knowledge, Strategic Processing, and Interest variables (Note: for all correlations, $p < 0.01$, $n = 425$)

			Engagement Interest		Intentional Interest	
	Knowledge	**Strategic Processing**	**Casual**	**Deliberate**	**Easy**	**Effortful**
Knowledge	1	0.26	0.40	0.19	0.40	0.19
Strategic Processing	0.26	1	0.30	0.22	0.37	0.35
Engagement Interest-Casual	0.40	0.30	1	0.45	0.58	0.36
Engagement Interest-Deliberate	0.19	0.22	0.45	1	0.39	0.44
Intentional Interest-Easy	0.40	0.37	0.58	0.39	1	0.61
Intentional Interest-Effortful	0.19	0.35	0.36	0.44	0.61	1

Table 8. Means (*M*) and Standard Deviations (*SD*) of the Knowledge and Strategic Processing Variables for Acclimation, Competency and Proficiency Levels, Effect Size (*d*), *F*, and *p* Statistics

		Lower Level		Upper Level				
		M	***SD***	***M***	***SD***	***d***	***F***	***p***
Knowledge	Acclimation	89.05	16.33	91.33	14.03	0.14	2.09	0.140
	Competency	67.38	24.24	74.86	19.37	0.34	10.59	0.001
	Proficiency	33.81	22.07	41.26	22.77	0.33	10.80	0.001
Strategic Processing	Acclimation	78.88	20.53	83.28	18.09	0.22	4.84	0.02
	Competency	72.38	19.04	74.44	17.56	0.11	1.19	0.27
	Proficiency	55.39	16.81	58.44	16.42	0.18	3.24	0.07

Table 9. Pearson correlations among the interest latent variables and the knowledge and strategic processing scores across the developmental stages of the MDL ($n = 425$)

	Knowledge			Strategic Processing		
	Acclimation	**Competency**	**Proficiency**	**Acclimation**	**Competency**	**Proficiency**
Engagement Interest-Casual	0.28	0.38	0.31	0.21	0.20	0.26
Engagement Interest-Deliberate	0.09*	0.09	0.25	0.12	0.13	0.23
Intentional Interest-Easy	0.25	0.33	0.36	0.27	0.23	0.33
Intentional Interest-Effortful	0.11*	0.09	0.24	0.26	0.20	0.32

taking advantage of professional development opportunities compared to lower level students (Intentional Interest). As predicted by the MDL in other domains, the findings of this study supported that knowledge, strategic processing, and interest increased together for global awareness.

Table 7 presents the Pearson correlation coefficients among the knowledge, strategic processing, and interest variables. Observing positive correlations among the three components of the MDL is important for the research questions in this study. The correlations between Knowledge and Engagement Interest-Casual ($r = 0.408$) as well as Knowledge and Intentional Interest-Easy ($r = 0.400$) were notable.

In the next step of the analysis, the knowledge and strategic processing scores were analyzed based on the three developmental stages of the MDL. Table 8 presents the ANOVA results comparing the means of the knowledge and strategic processing scores in each MDL developmental stage across the two class levels. We anticipated that both class levels would perform similarly for the acclimation level questions, and the upper-class level would do better in the competency and proficiency level questions. This prediction materialized for Knowledge but

not for Strategic Processing. Although the mean scores of the upper-class level were higher in all developmental stages of Strategic Processing, the only significant difference was observed for the acclimation level ($p = 0.028$). The mean difference at the proficiency level, which was significant at a level of $p < 0.10$, was noteworthy considering the limited number of strategic processing questions.

Table 9 presents Pearson correlation coefficients between the interest latent variables and knowledge and strategic processing achieved at the three developmental stages of the MDL. These results indicate that the participants who performed well in the proficiency level knowledge questions also reported a high level of interest.

6. Implications and limitations

6.1 Implications

In this investigation, Research Question-I explored whether engineering students' global awareness would manifest development as a result of their educational experiences. Our analysis showed that there was a significant difference in global awareness of the students in the Lower Level and Upper Level of the targeted engineering programs. For one, the average scores of the global awareness knowledge and strategic processing tests were significantly higher in Upper Level compared to Lower Level. Further, the knowledge test scores, particularly for the questions that were categorized as proficiency, improved from Lower Level to Upper Level, and this improvement paralleled the increase in Intentional Interest and Engagement Interest as given in Table 9. This result not only supported the MDL's predictions but also confirmed the other researchers' findings that individuals who attain a high level of knowledge in a domain also demonstrate a strong personal interest in that domain [51] and [52]. In our analysis, the higher the participants scored in the knowledge test, the more willingness they manifested for attending professional development activities (e.g., $r = 0.367$ and $r = 0.245$ between Knowledge at the proficiency level and Intentional Interest-Easy and Intentional Interest-Effortful, respectively). In addition to Intentional Interest, participants who scored relatively high on the knowledge test reported higher levels of engagement in activities related to global issues as indicated by the correlations between the knowledge score at the proficiency level and variables Engagement Interest-Casual ($r = 0.316$) and Engagement Interest-Deliberate ($r = 0.225$) as given in Table 9.

The activities and concepts represented by the items that loaded on Engagement Interest-Deliberate and Intentional Interest-Effortful are naturally harder to achieve for many undergraduate students. For example, students are more likely to read an online article about global issues than to read a book. Therefore, the participants rated the items that loaded on Engagement Interest-Deliberate and Intentional Interest-Effortful lower than the ones that loaded on Engagement Interest-Casual and Intentional Interest-Easy, respectively, as summarized in Table 6.

We did not observe correlations between the knowledge score at the acclimation stage and latent variables Engagement Interest-Deliberate ($r = 0.098$) and Intentional Interest-Effortful ($r = 0.115$) in the analysis based on the three developmental stages of the MDL—acclimation, competency, and proficiency. Similarly, the knowledge score at the competency stage was not correlated with latent variables Engagement Interest-Deliberate ($r = 0.098$) and Intentional Interest-Effortful ($r = 0.095$). On the other hand, moderate correlations existed between these knowledge scores and latent variables Engagement Interest-Casual and Intentional Interest-Easy, which involved items that undergraduates were expected to perform more frequently. More interestingly, the mean score of the knowledge questions at the proficiency level was correlated with latent variables Engagement Interest-Deliberate ($r = 0.255$) and Intentional Interest-Effortful ($r = 0.245$) while the mean knowledge scores at the acclimation and competency levels were not as discussed previously. This finding is noteworthy in supporting the MDL because it implied that participants who had high ratings for the interest items that are associated with the behaviors of professionals also performed well in the knowledge proficiency questions. On the other hand, the participants who performed well at the acclimation stage but not at the proficiency stage did not rate these interest items highly. According to the MDL, as individuals gain more in-depth knowledge in a domain, they develop individual interest, which is the long-lasting interest that motivates them to acquire more knowledge in that domain and maintain a high level of engagement with the domain [40]. Our findings related to Research Question-II indicated that the participants who had high knowledge scores at the proficiency level also demonstrated a greater level of personal commitment to improving their global awareness. The relations of the interest latent variables with strategic processing followed a similar pattern to the ones with knowledge and supported the MDL predictions. One notable difference was that latent variable Intentional Interest-Effortful was correlated with the mean scores of the strategic processing tests at all three stages, not only at the proficiency stage.

In summary, pertaining to Research Question-I, our findings supported that engineering students in

the last two years of their education demonstrated higher levels of global awareness than students in the first two years did in all three components of the MDL, and the instrument presented in this study was able to detect this difference. More importantly, the differences between two groups were higher in the proficiency level. Pertaining to Research Question-II, we observed that the differences between the Lower and Upper Class Levels followed the patterns predicted by the MDL, i.e., the participants who performed relatively well at the proficiency level knowledge and strategic processing questions also reported much higher individual interest. These two findings have implications for the assessment of global awareness. Firstly, performing well in one of the dimensions of knowledge, strategic processing, or interest alone does not indicate development in global awareness. Progress in all three dimensions should be evident for professional growth in a domain of learning. Therefore, we recommend using interest as an additional dimension for assessing global awareness. The proposed assessment approach can be used to evaluate the effectiveness of curricular efforts that aim to incorporate global awareness into the engineering curriculum. For example, educators can judge whether new knowledge gained by students make an impact on their professional development by tracking individual interest levels.

6.2 Research limitations

Contemporary global issues play a big role in global awareness. The knowledge and strategic processing tests used in this study may need to be updated over time. Remaining current is a concern not only for the instrument developed in this study but also for all global awareness and competency instruments. In general, instrument scales are evaluated for internal consistency. Although we have followed rigorous methods to show internal consistency, we did not have subjects re-respond to the instrument questions to show test-retest reliability. Considering the survey fatigue our subjects might have, we did not risk losing the number of participants. We believe that through a thorough literature and discussion and reviews by subject matter experts, we provided sufficient evidence on the content validity. The proposed assessment approach and instrument were tested in only one institution. Further data collections and testing will increase generalizations of the findings in this study. Another limitation is that the analysis included only 10 strategic processing questions. In addition, the average knowledge score at the acclimation level was high, which reduced the discriminating power of the knowledge questions at this level. Increasing the number of the strategic processing questions and the difficulty of acclimation level knowledge questions may lead to a more reliable classification of participants into the MDL developmental stages. Finally, the participation in the study was voluntary, and therefore, the students who completed the study may already have an interest in global issues. However, it should also be noted that the demographics of the engineering students who participated in the study was representative of the student population within the context of data collection.

7. Conclusions and future work

In this article, a new approach and an instrument are introduced to assess the development of engineering students in global awareness using three dimensions: knowledge, strategic processing, and interest. Based on the theory of the MDL, we argued that students should demonstrate progress in all of these three dimensions as they move from a beginner stage of global awareness to a more advanced stage. The results showed that upper level engineering students had higher levels of global awareness compared to lower level students. The analysis supported that the theory of the MDL can be applied to model the professional development of engineering students in global awareness. This finding of the study opens up the opportunity of classifying a student's development into three levels as acclimation, competency, and proficiency by reviewing where the student stands on the three dimensions of the MDL. Furthermore, the proposed assessment approach can be used in other professional skills, such as teamwork and ethics. This will provide a uniform way of assessing various professional skills in engineering programs. Studying the applicability of the method and results in other disciplines can be considered as further research. Herein proposed MDL-based assessment approach promises a new approach to compare the development of global awareness in different disciplinary contexts, programs, and settings. Finally, the developed instrument can be used to study how students' development in global awareness affect their future career choices and outcomes.

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Appendix

Sample Knowledge Questions:
(Acclimation) Q40. Which nation's currency is the Yen?

(a) Thailand.
(b) Sweden.
(c) Philippines.
(d) Japan.
(e) Not sure.

(Competency) Q60. Which of the following human right activist is known for fighting against institutionalized racism in his/her country and receiving the Nobel Peace Prize for it?

(a) Nelson Mandela.
(b) Malcolm X.
(c) Ayodele Awojobi.
(d) Indira Gandhi.
(e) Not sure.

(Proficiency) Q45. In which country did Falafel originate from?

(a) South Korea.
(b) Egypt.
(c) Greece.
(d) United States.
(e) Not sure.

Sample Strategic Processing Questions:
(Acclimation) Q67. You are working in a group. A group member mentions that during one of your meetings, he will be unable to attend because it is the first day of Passover, a Jewish holiday. Then, he asks, if everyone would mind rescheduling that particular meeting. How do you react?

(a) get upset and refuse to reschedule the meeting.
(b) you ask about Passover and proceed with a conversation to reschedule the meeting.
(c) stay silent, while the other group members discuss what actions should be taken.
(d) get upset but work with him to reschedule the meeting so you do not offend him.

(Competency) Q63. You are assigned to a project with an international student. The student speaks English with an accent. Do you think that:

(a) the experience will be interesting because you can learn about his/her project.
(b) the project will fail due to your partner's possible poor speaking capabilities and grammar in English.
(c) based on your experience, you know that while he/she speaks with an accent his/her preparation will help the project immensely.
(d) the international student does not know anything and you ask for a new partner.

(Proficiency) Q69. If you are working with a person from Venezuela, would you research about Venezuelan business and team culture?

(a) yes, as time permits.
(b) yes, you make it a priority as you believe it might benefit team performance.
(c) no, you feel that he/she should learn about the work culture in the US.
(d) no, you think that cultural differences will not affect the teamwork.

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