Culturally-Sensitive E-Learning Practices For Engineering Education

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Abstract: - Increasingly, people are seeking distance education delivery options in order to get the engineering training needed from experts who may reside continents away. Therefore, engineering educators need to address and accommodate cultural realities. Hofstede's model of cultural dimensions provides a framework for examining culturally-sensitive engineering training implications. Culturally-impacted issues and solutions are explained relative to the relationship of engineering training to the workplace, and to online teaching and learning. Specific strategies are suggested to address language barriers, student-teacher relations, choosing resources, learning activities, technical issues, and assessment.

Key Words: - distance education, culturally-sensitive, engineering, training, language, technology, learning, workplace

1 Introduction

As globalization impacts economies, it impacts people's careers – and the preparation for those careers. Concurrently, people are seeking distance education delivery options in order to get the training needed from experts who may reside continents away. Particularly as Western educational philosophies do not reflect the preponderance of educational approaches worldwide, it behooves U. S. engineering and other technical educators to address cultural nuances, particularly in online learning environments.

2 Background

Culture may be defined as "the customary beliefs, social forms, and material traits of a racial, religious, or social group" and "the set of shared attitudes, values, goals, and practices that characterizes an institution or organization" (*Webster's Dictionary*). In career and technical education, cultural issues apply to the learner, the instructor, the intended workplace, and the profession itself.

Cutler refers to the cultural "onion" as he explores the impact of culture on teaching and learning. He asserts that core cultural assumptions consist of basic truths below awareness, while norms and values refer to behavior standards [1]. Cutler also asserts that culture may be objective or subjective relative to visible behavior, organizational structures, and communication styles. For instance, a hierarchical organizational structure is a fact, but it might not actually be the most efficient model for a workplace although it might reflect the social norms for a particular culture. Cutler further contends that teaching tends to operate at the surface level, not confronting core assumptions, so that aspects of culture might be misaligned. When learner, teacher, workplace and profession represent different cultures, misunderstanding can easily occur.

Hofstede's cultural dimensions model and Biggs' teaching and learning model provide useful frameworks for examining culturally-sensitive engineering training implications (*noted in italics*) [2, 3].

1 **Power distance.** What is the degree of equality between people? How equitable is power distribution as defined by low-status people? In low-power societies, status is less important. *Power distance impacts teacher-student relations.*
2 **Individualism vs. collectivism**. People in individualistic societies tend to belong to many groups, each of which is loosely-knit, while collectivist societies tend to have a few, well-defined groups who are very loyal. In-group refers to a collective of highly interdependent members with a sense of common fate; groups to which they do not belong are out-groups. *Learners and teachers have preconceived attitudes about individual vs. cooperative efforts.*
3 **Masculinity**. To what degree are genders differentiated? Are traditional gendered roles supported in terms of achievement, control and power? How are women valued relative to men? *In training, males might be more competitive or*

need more praise.

4 **Uncertainty avoidance**. How tolerant is society of uncertainty and ambiguity? Are different options acceptable, or are strict rules the norm? *How structured should learning activities be? Does assessment ask for one right answer or does it encourage new answers? Do learning activities focus on accuracy or on perspectives?*

More specifically, different cultures tend to reinforce different learning styles. For example, collective societies tend to reinforce field dependent and non-linear learning. Instructors need to start a unit by giving the Big Picture, and they provide such learners with more guidance along the way [4].

The impact of culture in engineering teaching and learning may be analyzed using Biggs' 1978 3P model of teaching and learning. Presage deals with experiences before learning takes place (i.e., learning characteristics, prior knowledge and experience), process occurs during learning (i.e., learning conditions, activities), and products focuses on the outcomes of learning (e.g., assessments, application, context). Thus, learner experiences are interdependent with situational elements such as teaching factors (style, institutional procedures, assessment) and the learning environment (e.g., learning activities, social climate). Biggs differentiates surface approaches to learning (i.e., reproducing information), deep approaches (thorough understanding), and achievement orientation (i.e., focus on grades). Biggs, Kember, and Leung emphasize the importance of identifying which factors are universal and which are culturally-defined. Most significant are those practices that are imposed as if universal (e.g., outlining) that reflect cultural norms (e.g., North American); learners outside that teacher-centric culture may feel discounted or under-prepared [5].

Examining the learner leads to cultural factors impacting engineering education effectiveness:

1 Language (idioms): native/primary language skills of reading and writing; the quality and quantity of second language experience and skill; formal vs. informal language usage; vocabulary and idiomatic knowledge
2 Educational philosophy and experiences: role of education; curriculum and instruction practices; student behavior norms (which might differ from the institution's expectations); learner-specific experiences
3 Gender issues: sex-linked educational, career, and workplace expectations/norms that are culturally defined
4 Age-linked cultural norms: generation-specific roles and expectations; familial roles and norms; roles and expectations impacted by global/social realities (e.g., digital natives)
5 Knowledge of career: transmission of information patterns (e.g., family, academic counseling, libraries); cultural expectations and norms relative to specific careers; community needs and practices (e.g., local agricultural economy vs. globalized knowledge economy) [6].

In an e-learning environment, technology significantly impacts student learning, and also is subject to cultural influence. For instance, learners might have different degrees of access due to cultural attitudes about technology, socially-constructed gender role expectations, and socio-economic values. World experience and knowledge impacts learners' ability to locate and evaluate online information. Even social attitudes about language acquisition and attitudes about English can impact online use.

As they work in cross-cultural settings, or at the very least work with learners from different cultures, engineering educators should strive for cultural competence. Kalyanpur and Harry list several benchmarks in this endeavor [7]. **Cultural knowledge:** familiarity with cultural characteristics, history, behaviors and values of people of another cultural group. **Cultural awareness:** understanding of another culture, changing attitudes about culture, and open flexibility in relating to people of another culture. **Cultural sensitivity:** realization that cultural similarities and differences exist, without assigning relative value to those differences. **Cultural competence:** congruent set of behaviors, attitudes and policies to enable one to work effectively in cross-cultural situation. **Cultural proficiency:** a way of being that enables people to interact with others who are different from them. Kalyanpur and Harry further assert that the following elements should be established at every level of a system to facilitate cultural sensitivity and eventual competency as it is manifested in resources and services: a belief in the value of diversity; the capacity for cultural self-assessment; awareness of the dynamics of cultural interaction; institutionalization of cultural knowledge; service adaptation and accommodations that respect diversity within and between cultures.

3 Connecting Training to Workplaces

Engineering education may consist of a lengthy set of courses, such as a university degree program, or specific, just-in-time technical information. Education options largely depend on the person's career status: *pre-career preparation*: foundational principles and practices; *beginning entry-level position*:

company-specific processes and minor technical gaps; *mid-level position shift*: advanced study or new aspects of the industry (e.g., management issues); *mid-life career change*: condensed information in order to switch careers efficiently, perhaps with suggestions on transferring knowledge from one domain to another; *senior years*: refreshed/ new information in the field [8]. Overall, the student population is increasingly diversified in age, cultural background and experience. All too often, cultural sensitivity is overlooked when designing e-learning curriculum and delivery. Instructors should be aware of the impact of culture in their training, and they should leverage those cultural differences to provide a richer educational experience.

In considering culture as they design training, instructors need to know where learners intend to work. If the job is close to them geographically, they are likely to know local cultural norms if they have lived in that area for a while, even if they personally do not agree with those norms or hold lower status (e.g., a societal caste system). Those learners and the instructor can focus on the content. A geographically remote instructor, no matter how qualified he or she is, needs to be aware of the target population's culture so that the content and its application will align with local practice.

Training has to balance corporate ethos with local cultural ethos. Some vocations have strong universal values and ethics, such as engineering, while other careers, particularly in the service industries, may manifest themselves differently depending on the localized cultural norms. Instructors need to socialize students to assume those professional credos, helping students link their prior knowledge and customs to the engineering expectations. While it might not be necessary to know each student's background, taking predispositions into consideration can facilitate the instructor's efforts to acculturate the neophyte into the targeted field's norms. In the latter case, the instructor needs to incorporate cultural factors into the training.

Instructors of diverse students need to help those learners navigate within the dominant or target culture successfully: learning social expectations and norms, identifying the cultural assumptions being made about presented (and missing) content, and communicating in socially acceptable ways (e.g., avoiding jargon, understanding social space). Educational practice itself reflects culturally-defined philosophies. For example, a belief in the professor as the all-wise transmitter of knowledge opposes the idea of the instructor as a learning environment co-constructed with students. The student who is used to rote memorization may feel uncomfortable with inquiry-based learning.

As learners straddle two (or more) cultures, they need to interpret information in light of differing perspectives, and negotiate the relevant application of such information to their workplace, be it local or remote. Particularly if career ethos contradict familial values, learners might artificially separate those two worlds, try to integrate the two, or reject one set of values. Instructors should respect each student's cultural stance while noting the importance of learning about the social climate to be experienced as an employee. Instructors should also contextualize content in terms of students' local reality or at least build on those realities as students need to assimilate new cultural understandings [6].

4 Solutions to Language Problems

International students may have taken English courses before they start engineering education, but that instruction is typically provided by teachers whose primary language is not English. British English is more likely to be taught than American English, which can also impact the meaning of common terms, such as "bonnet" for car hood. Additionally, the English taught is unlikely to address technical or engineering educational vocabulary.

Fortunately, e-learning tends to be text-based (with some visual support), which enables learners to consult dictionaries and peers to understand concepts. Additionally, asynchronous discussion enables learners to take their time crafting their responses in their primary language and then translating their words with less time stress. The anonymity of online communication can also make females from masculine-dominated cultures feel more comfortable voicing their opinion.

The following specific tips, largely from Sarkodie-Manash, apply to engineering education [9]. Make the structure of the class explicit. In all communication, use plain English and short sentences, and avoid idioms. Rephrase and simplify statements. Define new terms. Use meaningful gestures. If using audio files or online speech, speak clearly and slowly without accent. Make documents comprehensive. Use repetition, paraphrasing and summaries. Focus attention on essential vocabulary needed for the specific training or profession. Provide bilingual glossaries and visual references. Use visual aids and graphic organizers to help learners understand content organization and relationships. Include frequent comprehension checks and clarification questions. If you can't understand a student, don't pretend to. If possible, instruct the learner's primary

language (unless learners represent several native languages). Pair students linguistically. Provide resources in primary languages. Check the readability of written sources, and locate materials that include visual or aural cues. It should be noted that some images may be unrecognizable, demeaning, or have different meanings to difference cultures.

5 E-Teaching Factors

Hofstede's model of cultural differences can aid engineering educators in creating culturally-sensitive online learning environments. Domer and Gorman also offer several useful suggestions [10].

Student-teacher relations. Learners from high power-distance cultures expect formal, hierarchical relationships with their teachers. To ease their stress in more egalitarian or constructivist courses, instructors can clearly and explicitly define their roles, and work with students to make clear decisions about course expectations. Personal acknowledgment rituals and relationships can also counterbalance power distance formality [11]. They can also tell students the appropriate term of address to use (e.g., Professor Ramirez, Dr. R, Paulo). Traditional males may feel uncomfortable having a female instructor, although e-learning environments tend to mitigate this issue. Providing information about the instructor's expertise and status, along with testimonials from high-status males, can further elevate a female teacher's credibility. Students who are shy about asking for help should have several options available: confidential email, intermediation by a course student representative/spokesperson, peer assistance, referrals to resources such as online tutorials. Instructors can preemptively help this situation by frequently checking for understanding (e.g., short online quizzes and quick writes) and giving all students immediate feedback.

Topics of discussion. Instructors should be aware of possible taboo subjects. This issue might emerge in health occupations where gendered practices might inhibit practice. Instructors would do well to consult their peers in relevant countries to find out ahead of time what topics might be sensitive to their learners. Accommodations for alternative topics, resources, or ways of learning should be provided so as to not disadvantage affected learners. In almost all cases, connecting course concepts with real world context and applications helps all learners, not just field dependent ones.

Choice of resources. In most cases, instructors choose the material to be covered in a training. That selection or filtering process may reflect cultural bias that might disadvantage some international students; specific ideas might be supported and other omitted, thus shutting down opposing viewpoints. Even a simple factor of choosing examples reflecting only urban practice might ignore the needs of students working in rural areas. At the least, instructors should enable students to choose from a wide spectrum of reading materials reflecting a variety of perspectives. It should be noted that students tend to find and understand web-based information more quickly when content is created by designers from their own cultures [12]. Alternatively, instructors should permit students to seek self-relevant sources, which can trouble instructors who want to control students' reading materials (in itself, reflecting a cultural value). In some cultures, such as China, students typically read only what the instructor chooses, so self-determination of materials can be uncomfortable for them at first. As they seek relevant resources, many non-U.S. students have little experience using academic libraries and may hesitate before asking librarians for assistance.

Learner participation. Clear expectations and course norms from the first contact will help reduce learner confusion and distress. If the student population includes a mix of cultures, then a corresponding combination of individual and collaborative activities would be appropriate. Likewise, a mix of cooperative and competitive activities allows learners from different backgrounds to excel at different points. Alternatively, instructors can provide students with options to do work independently or with others. To accommodate learners from collective cultures, instructors may need to initiate discussion or start groups off when introducing problem-based learning; step-by-step guidelines also facilitate field dependent learners. In sum, e-learning environment should be safe and comfortable for all learners.

Learning activities. Probably the best solution for culturally-sensitive activities is inclusive instructional design that accommodates *all* students. Here are some other specific suggestions. Some students are not used to self-directed learning. Rather than telling students the answer, the teacher can model the process required to find it. Students may be accustomed to rote learning facts, rather than applying skills. Instructors can help students apply general principles to a variety of research situations. Students might not be used to critically evaluating information. Teachers can provide checklists or criteria for students to use in evaluating sources. Many students are only interested in what is needed to pass exams (achievement orientation). Teachers can emphasize the importance of knowledge and skills for lifelong success as well as immediate career ad-

vancement. In some cases, students need to adjust to the targeted culture, be it the specific workplace or profession. Lopez-Valedez, *et al*. offer the following ideas that can facilitate the transition [13]. Produce videotapes of appropriate and inappropriate workplace behavior, which can facilitate student discussion. Listen to or read job interviews. Seek opportunities for students to combine course e-learning and internships.

Technology issues. On one hand, technology enables learners from around the world to get engineering training at the click of a button. On the other hand, physical and intellectual access to technology remains uneven globally. Some areas still lack electricity or a stable Internet infrastructure. While cell phones have become ubiquitous, desktops and software programs may be less common. Hardware still is too costly for many people, and even educational institutions may have little equipment. Particularly with the increased use of multimedia, which drains broadband signaling power, learners in developing countries may be severely disadvantaged. Even time zone differences can be a challenge for students who have to log in at 3 am in order to participate in live chat. Furthermore, learners reflect a vast spectrum of technological experience and expertise; Millennials may be used to the Internet since childhood, but other learners may still have problems navigating with a mouse. Additionally, learners may have an unrealistic idea of their own technical ability; instant messaging does not constitute technological fluency. The deeper issue of evaluating online information also poses an issue, particularly for learners who are not world-savvy. In sum, engineering instructors should find out what technological access their students have, and aim for the lowest common denominator, which might consist of a frameless set of text-based web pages accessible via cell phone. In a couple of cases, educational institutions have developed partnerships so that equipment could be loaned. Application programs should be free and web-based, such as Google's suite. Learners should be able to get technical assistance at any time, hopefully, in a language that they understand. Instructors should show learners how to navigate online training, and use the required technology tools. Additional support may be in the form of a list of online tutorials, tech buddies, local tech center help, and alternative ways to demonstrate competence such as phoning in responses.

Assessment issues. Culture impacts student performance when literacy skills are required. In terms of language, even following directions can disadvantage some students. Some measures to mitigate cultural discrepancies include: giving shorter tests and recall items rather than tasks that require language and literacy skills, provide accurate translations in those cases where language ability is not being tested, provide bilingual glossaries, let students demonstrate their skill kinesthetically (e.g., video recording their performance or having a local expert verify their ability) [14]. Instructors also need to make sure that tests are not culturally biased, that is, one cultural group does not outperform others systemically. Bias can occur when cultural knowledge is assumed (e.g., bidets use, knowledge of July 4, eating habits). Images may have culturally-defined meanings or connotations (for example, owls connote different attributes in different cultures). The easiest approach is to check with students via non-test activities about their understanding of textual and visual information. The writing process is another area of possible cultural misunderstanding; while U. S. students are taught to write sequentially, often relying on an outline, other cultures prefer for writers to build arguments starting with a general stance and ending at the specific issue, and still other cultures use an argument/counter-argument structure. Thus, instructors should focus on content more than style, or specify the written style and provide the needed support needed for students to succeed. Furthermore, non-U. S. cultures sometimes have a different attitude about intellectual property; many students are not used to crediting their sources, and do not know about citation styles. A blanket punishment for plagiarism is obstructive without explicit instruction and support to help student comply with copyright laws. Assessment also needs to address affective elements. For instance, non-cognitive variables accounted for about a quarter of the variance in grade point averages for African Americans at predominately white universities; at black universities, non-cognitive variables accounted for about 18 percent of grade average variation [15]. The author concluded that the relationship between students and faculty influence self-confidence and self-efficacy. Even though e-learning might mitigate such differences in perception, language use may indicate a person's cultural background, and might influence perceptions either of the instructor or the interaction. Zhang found that deep understanding correlated significantly with achievement (as opposed to surface reproduction of information), and therefore recommended that instructors assess accordingly [16].

7 Conclusion

The following strategies summarize the key points

for engineering educators to follow in designing culturally-sensitive e-learning.

1 Provide clear information and expectations about the training, including content, technical aspects, procedures, participation, assessment, available support.
2 Get to know the students, and help them learn about each other. Obtain and share demographic information. Provide opportunities for students to share their perspectives and experiences, thus enriching the course content.
3 Create a positive class climate. Make learning safe and comfortable so that students who are not used to voicing opinions or taking intellectual risks will be supported in their efforts.
4 Structure learning for meaning. Bring in cultural differences rather than mask them. Help students connet content to their own environments.
5 Provide access to resources, and give students choices about types of resources to use. Offer instruction or support if students are not used to locating resources independently.
6 Provide support and scaffolding for students as needed: tutorials, expertise, peer help, translation tools, technical help, time management, etc.
7 Give students time to process and evaluate information. Foster critical thinking by modeling analytical information processing.
8 Help students clarify and justify their understanding. Encourage study groups and study buddies as a way to refine their knowledge.
9 Give timely, specific feedback throughout training.
10 Help students self-monitor and express their learning. Give them opportunities to demonstrate competencies in several formats.

In any case, in order to provide meaningful online training, both engineering educators and their students need to become culturally competent: open to learning about other cultures and sharing one's own culture, able to change personal perspectives, and able to communicate effectively across cultures [17]. Ideally, engineering educators around the world should work together more closely with each other and their institutions in order to provide culturally sensitive content and instructional design, leading to a true global, culturally-proficient economy.

References:

1 Cutler, J., *The Cross-Cultural Communication Trainer's Manual,* Gower Publishing, 2005.
2 Hofstede, J., *Culture's Consequences,* Sage Publications, 1980.
3 Biggs, J., Individual and Group Differences in Study Processes, *British Journal of Educational Psychology*, Vol. 48**,** 1978, pp. 266-279.
4 Chen, S., & Macredie, R. (2002). Cognitive styles and hypermedia navigation, *Journal of the American Society for Information Science and Technology, 53*(1), 3-15.
5 Biggs, J., Kember, D., & Leung, D., The Revised 2-Factor Study Process Questionnaire R-SP2-2F. *British Journal of Educational Research,* Vol. 71, 2001, pp. 133-149.
6 McMahon, C., & Bruce, C., Information Literacy Needs of Local Staff in Cross-Cultural Development Projects. *Journal of International Development,* Vol. 14, No. 1, 2002, pp. 113-137.
7 Kalyanpur, M. & Harry, B., *Culture in Special Education,* Paul Brookes, 1999.
8 Mullowney, T., *Policy Paper for the Evaluation of Programs for Indian Tribes and Organizations,* Department of Education, 1980.
9 Sarkodie-Manash, K. (Ed.). *Reference Services for the Adult Learner*. Haworth Press, 2000.
10 Domer, D., & Gorman, G., Information Literacy Education In Asian Developing Countries, *IFLA Journal,* Vol. 32, No. 4, 2002, pp. 281-293.
11 Gurubatham, M., Cognition, Culture and Effective E-Praxis Guiding Principles, In P. Nicholson, et al. (Eds.), *E-training Practices for Professional Organizations* (pp. 121-128). Kluwer Academic Publishers, 2005.
12 Faiola, A., & Fatei, S., Cultural Cognitive Style and Web Design, *Journal of Computer-Mediated Communication,* Vol. 11, No. 1, 2005.
13 Lopez-Valadez, J., Friedenberg, J., Lucas, N. Kremer, N., & Reed, T., *Immigrant Workers and the American Workplace,* Clearinghouse on Adult, Career, and Engineering Education. 1985.
14 Teresi, J., Holmes, D., Ramirez, M., Gurland, B., & Lantiqua, R. (2001). Performance of Cognitive Tests among Different Racial/Ethnic and Education Groups, *Journal of Mental Health & Aging,* Vol. *7*, No. 1, 2001, pp. 79-89.
15 Lockett, C., & Harrell, J., Racial Identity, Self-Esteem, and Academic Achievement, *Journal of Black Psychology,* Vol. 29, No. 3, 2003, pp. 325-336.
16 Zhang, Li-Fang, University Students' Learning Approaches in Three Cultures, *Journal of Psychology***,** Vol. 134, No. 1, 2000, pp. 37-56.
17 Liaw, S. (2006). E-learning and the Development of Intercultural Competence, *Language Learning and Technology*, Vol.10, No. 3, 2006, pp. 49-64.