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The Impact of Role-Playing Simulations on Global Competency in an Online Transnational Engineering Course

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Abstract

Successfully interacting with those from different cultures is essential to excel in any field. However, higher education engineering students are not explicitly taught to do so, which limits their professional opportunities. This is in part because current coursework in engineering does not emphasize the importance of displaying global competency skills by successfully interacting with those from different cultures. Further, many institutions struggle with determining which strategies and activities are universally effective and allow students to practice the global competency skills now crucial for success.

Students have an increasing number of opportunities to learn to display global competency due to the prevalence of transnational education methods where students learn online alongside students located in different countries. Future engineers will spend substantial amounts of time in these environments, and learning to work with those from other cultures using transnational platforms is essential. Current coursework must now employ strategies, such as embedding interactive role-playing simulations, in order to encourage students to develop and illustrate global competency skills in transnational settings. These role-playing simulations provide environments where students adopt roles, interact with other students, and explore and address realistic global problems.

However, no studies have addressed whether or how role-playing simulations can help students display global competency skills in a transnational engineering course, nor have they measured students' perceptions regarding the effectiveness of using role-playing simulations for this purpose. To address this gap, this study assess the use of role-playing simulations in a transnational course involving students from the University of Virginia in Charlottesville, Virginia, and from Technische Universität in Dortmund, Germany. It does so by focusing on tone U.S. student and one German student, Ben and Manuela, and using survey information, observations of class sessions, analysis of student projects, and interviews with them to illustrate their experiences.

Data indicate the U.S. student, Ben, adjusted the methods he used to communicate with German students and expressed an increasing awareness of the connection between engineering solutions and cultural differences. The German student, Manuela, increased her participation levels throughout the simulations as well as increasingly expressed her curiosity to know more about other cultural engineering practices. It is hoped the findings from this study informs future courses on how to instruct students in how to display the global competency skills that will help them succeed in the world that awaits them.

Introduction

Today's engineers require a skill set that was not nearly as important to possess even 10 years ago. Practicing engineers work with others from many different cultures, which means they interact with people who have different acquired behaviors, characteristics, and values than

their own[50]. Engineers therefore now have a constant need to display global competency in order to be hired and thrive in their professions[8, 25]. This means they must be able to need to display global competency toward those they work with, which means they must be able to respect and recognize differences among those from different cultures. This also means they must be able to adjust their behavior and integrate others' ideas when working with those with cultural backgrounds other than their own.

Charles Vest[49], president of the National Academy of Engineering, noted that successful engineers must "face the stress of competing in the fast-paced world of change we call the knowledge-based global economy of the 21st century" (p. 235) and that the industry needs nimble engineers in the workforce who can work in teams to respond to the inevitable pressures they will face. He and others underscore that, given the skills needed in the increasingly globalized team-based engineering environment, the engineers that will be hired will be the ones able to can display global competency skills that will make their companies attractive business partners[5, 26, 30].

ABET, the National Academy for Engineering[36], and the International Association for Continuing Engineering Education[23] are some of the many organizations that recognize the importance of giving future engineers the global competency skills they need to compete on a global scale. These organizations point out higher education engineering students should be taught both professional and technical skills if they are to play pivotal roles in changing how global systems operate. Surveys of engineering students additionally show the students recognize how much future employers value the importance of global competency skills[2, 5, 8]. However, many of the traditional international experiences such as those through study abroad programs are not available to students with work or family obligations. Students are consequently often attracted to engineering programs that offer contact with others from different countries through transnational programs, which are online education programs where one instructor teaches students who are physically located in two or more countries[20].

Engineering programs, however, often do not offer transnational programs. Many engineering programs are innovative and of extremely high quality: their successes should not be diminished. However, numerous programs are often structured to emphasize technical skills, are domestically focused, and are tailored toward educating those from developed countries[24, 18, 46]. Further, numerous engineering courses are taught by professors who indicate they are uncomfortable teaching using transnational or nontraditional teaching approaches to address students from other cultures with whose first language they might not be familiar[41]. Research shows programs also shy away from changing curricula and teaching students global competency skills by seeking international partnerships because of the differences among engineering practices from country to country and because of different accreditation standards[4, 20]. Many engineering programs subsequently often emphasize teaching rote skills instead of promoting transnational methods.

However, the transnational engineering programs and partnerships that do exist have often been fruitful. For instance, the Nanyang-Singapore-MIT Alliance, which was created in 1998 by the National University of Singapore, Nanyang Technological University, and the Massachusetts Institute of Technology has collaborated successfully to promote research and

collaborations in science and engineering education[35]. It has created five graduate degree programs focused on research in global engineering and is now one of the largest interactive transnational education initiatives in the world with plans to expand its programs and international outreach in the coming years[21].

Yet existing collaborations many times struggle with maintaining the quality of their programs that give students the opportunity to display the global competency skills they will need upon graduation[18, 44, 45]. For instance, some institutions regularly transfer materials from a classroom to an online transnational format without modification, which fails to take advantage of the platform that can connect students with others and practice honing their global competency skills[38]. Research indicates this missed opportunity to benefit from transnational education platforms can stem from a lack of knowledge regarding what activities to use in transnational classes, particularly when addressing students' multiple cultural backgrounds[16, 37, 47, 51].

Role-playing Simulations

Employing simulation activities is an increasingly popular way to give students transnational environments to display global competency while immersing them in inquiry-based, decontextualized situations when learning principles in science, technology, engineering, and math (STEM) fields[6]. One reason for this popularity is because they have proven to help students develop higher-order thinking skills and see multiple perspectives in ways that cannot be easily replicated in other environments or with other activities[10, 13]. Using role-playing simulations in engineering has also become popular because simulations have shown to strengthen practical skill development[33] and to help students develop global competency skills such as the ability to communicate clearly and work in cross-cultural teams[3, 31].

Although engineering simulations are often technical, this present study focuses on role-playing simulations where students assume a character or perspective for educational purposes because role-playing simulations are more frequently used in helping students display global competency. This study also focuses on role-playing simulations and not role-playing games, which many researchers use as synonymous[42]. The difference is that role-playing games are set in artificial environments where there is a clear "winner," whereas simulations are set in symbolic realities where the objective is to solve a realistic problem[12, 40].

The same affordances role-playing simulations offer engineering students have shown to transfer into benefits for their use in transnational education. For instance, research findings have shown role-playing simulations in transnational environments are beneficial because students can build relationships with others from different cultural backgrounds when all students explore new environments together[6, 48]. The opportunity to build cross-cultural relationships is one of the reasons many surveys indicate engineering students generally enjoy role-playing simulations[32, 33]. The venue to build these relationships is also why researchers suggest employing longer or multiple simulations to strengthen those ties[15].

Research findings regarding the use of role-playing simulations in engineering are rare, and findings regarding the use of role-playing simulations in online or transnational environment in engineering education are likewise uncommon. Further, researchers are only beginning to

explore the potential of using role-playing simulations for building cultural understanding or global competency skills[10, 27], and there are no data regarding whether specific activities such as role-playing simulations could be useful[3, 14, 39]. There is also little information regarding whether students enjoy role-playing simulations or whether having successive role-playing simulations is helpful in allowing students to learn and to display global competency.

Therefore, this study addressed the following questions:

1. What changes, if any, occur in students' abilities to display global competency when using role-playing simulations in a transnational engineering course?
2. How do students change their abilities to display global competency when using role-playing simulations in a transnational engineering course?
3. What are students' perceptions about the use of role-playing simulation to change their abilities to display global competency in a transnational engineering course?

Methodology

This mixed-methods study used observations, interviews, surveys, and portfolios to address whether and how students display global competency using role-playing simulations, if at all, in a transnational engineering course involving students from the University of Virginia (UVa) in Charlottesville, Virginia, and from Technische Universität Dortmund (TU) in Dortmund, Germany (n = 26). It also addressed students' perceptions of the use of role-playing simulations to display global competency and whether there are any changes in students' abilities to display global competency from one simulation to the next in this transnational environment. Employing a wide range of methods to address these subjects is necessary because global competency assessment examples are scarce or biased toward a particular culture, and using multiple methods diminishes the subjectivity of using only quantitative or only qualitative tools[11, 28, 43].

Results also included data from large-group interactions yet highlighted case studies with follow-up interviews with the instructors and select students near the end of the course; this paper will focus on two of those students who have been given pseudonyms to protect their identities. These select students were targeted in order to select a diverse group of learners representing different cultures, ages, genders, and experiences. Due to the limitations of the Blackboard Collaborate Bridge platform, it is only possible to observe a select group of students at one time when they work in small groups. It was therefore not possible to observe all focal students at one time; however, focal students were shadowed as much as possible.

Further, although the focal students were selected to represent a wide range of attributes such as cultural background and age, the limited sample size made it difficult for every attribute to be represented. However, diverse sampling by pairing students with multiple contrasting characteristics can help determine any changes in a larger group resulting from an intervention. Students who have significantly different attributes follow the same growth patterns in their abilities to display cultural competency, which indicates the simulation independent of outside factors may cause differences across many diverse groups[29].

Observations were held in the Blackboard Collaborate Bridge online environment where the

whole class was observed, and the screen was recorded using Camtasia Studio as well as Camtasia for Mac software. Other observations focused on select students when students divided into small groups; these focal students were then interviewed at the end of the course. Taking both a broad view of a group of students and their products as well as a more focused view of a smaller group was necessary to obtain representative data from students of all the subsets of different cultures in the course. Making broad generalizations or failing to acknowledge the perspectives of all students enrolled in the course would bias the study, diminishing the credibility of any conclusions[9].

Surveys used in this study provided students' demographic information and self-reports about their abilities to display global competency. The surveys additionally provided information regarding students' perceptions of other students' abilities to display global competency and students' overall impressions of the course. Data collected from observations, interviews, and surveys were analyzed alongside students' final papers they submitted at the end of the course as well as their final exam. The software tools NVivo and IBM SPSS Version 20 were used to organize and analyze all materials.

Theoretical Framework

This study is informed by the transactional distance theory. The transactional distance theory is appropriate in part because it has been used as a systemic lens to examine the relationship between students and online international higher education[19, 34]. It is also appropriate because it has been used to highlight how geographical and psychological distance among students in online higher education settings can be bridged through learner autonomy, dialogue, and course structure in many disciplines. For instance, in a study regarding the use of virtual laboratories in a STEM-focused biology class, researchers used the transactional distance theory to illustrate how virtual laboratories may have positive impacts on the relationships between the learner and the content as well as the learner and the interface[17]. That same study also used the transactional distance theory to illustrate how virtual laboratories may have negative impacts on the relationships between students and the relationships between students and their instructors.

The transactional distance theory has not often been applied to multicultural transnational settings. However, studies have shown that students from different cultures may reduce transactional distance in different ways. Students from one culture, for instance, may do best when the course is highly structured and there little need to dialogue with peers, whereas students from another culture may typically thrive with courses that have little structure when a large amount of dialogue is expected[1]. Findings from a study by Benson and Samarawickrema[7] supported this and emphasized how the transactional distance theory can be used to show instructors the importance of context of learning in transactional education involving students from multiple cultures.

Results

This section will describe the results of this study. First, this section will introduce the focal students in this study. The next section will describe what changes occurred in students'

abilities to display global competency and how they changed. It will then address the perceptions students had regarding whether role-playing simulations can change their abilities to display global competency.

Focal Students

This paper will concentrate on students I will call Ben and Manuela who were chosen because they represent different backgrounds, beliefs, and behaviors during the role-playing simulation exercise. Ben was a 2nd-year U.S. student who lived in a rural city near Charlottesville, Virginia. He studied mechanical and aerospace engineering at UVa and had worked in the engineering field for more than 3 years. According to a survey taken before the role-playing simulation, he is proficient in only English and reported he had no previous cultural experience. Ben also reported a strong interest in learning about other cultures: he was interested in studying abroad in Germany. He agreed he enjoys role-playing simulations and strongly agreed they are useful educational tools. Further, his survey responses indicated he enjoys playing roles that go against his beliefs. Ben's teammates in both simulations indicated he went "above and beyond" in group assignments and facilitated times when group members could meet outside of class.

Manuela was a 3rd-year student studying at TU and who lived in Dortmund, Germany. She was studying logistics engineering and had no work experience in the field. According to information she provided in a survey before role-playing simulation, Manuela was proficient in three languages; she had studied abroad and reported an interest in learning about other cultures. Manuela strongly agreed that role-playing simulations are effective tools and did enjoy them, yet she indicated she did not enjoy playing roles that go against her beliefs. Her teammates in the first simulation reported she made no attempt to contact them or contribute in class, and one teammate did not recognize her as part of the group. In contrast, her teammates in the second simulation reported she gave valuable input in discussions and brought up topics that otherwise would not have been discussed.

Ben and Manuela, like all students in the class, had slightly different definitions of global competency. In an interview after the role-playing simulations, Ben indicated global competency meant having a personal understanding and respect of the views of people from different cultures. He stressed that the most important attribute of a globally competent person is to be able to see and understand something from someone else's perspective. In this way, Ben said a person is globally competent when someone from a different culture says something that people from another culture are not familiar with but he can understand why people from another culture thinks the way they do. Ben reported that displaying the skill is difficult and that a person cannot try to display global competency. He indicated expressing global competency is a skill acquired over time and then "just has to happen."

Manuela also expressed it is difficult to define or know how to display global competency but said it has to do with trying to get knowledge and learn different perspectives quickly in order to work together. In an interview after the role-playing simulations, Manuela indicated being globally competent means expressing your own thoughts and comparing them with others, and she stressed that globally competent people should always be sensitive to the differences

among people with different backgrounds. Manuela found that these simulations required students to be global competent and know about nuclear energy around the world; she described the different opinions on nuclear energy in four countries. In an email sent to the researcher after the role-playing simulations, she referenced how her parents' work in a hydropower plant increased her interest in nuclear energy. This is because any attempt to introduce nuclear energy in the region where her parents worked failed, in part because the nuclear power plant company did not consider the "geography and society" of the area before they proposed a plant.

Ben and Manuela's definition of global competency represent two of the many definitions offered by students in the class. However, students used similar words to describe how to display global competency such as communication, knowledge, understanding, compromise, respectful interaction, and working together. These terms that were most often used align with the definition of global competency given above where people who are globally competent must be respectful, recognize cultural differences, adjust their behaviors, and integrate others' ideas when working with those with cultural backgrounds other than their own. These categories will therefore serve as the organizational structure when describing what changes occurred in students' global competency levels when using role-playing simulations in this environment and how they changed, if at all.

Defining and Illustrating Change

This section defines what changes occurred in students' abilities to display global competency in this role-playing simulation. In identifying what changes students made, this section also illustrates how students changed their abilities to display global competency.

Respect

Of the 26 students, 42.3% agreed and 58.6% strongly agreed they were respectful toward those from other cultures in a pretest taken before the simulation. In a posttest, 34.6% agreed and 65.3% strongly agreed they were respectful toward those from other cultures. The change is not statistically significant ($p = .574$), and students generally ranked themselves the same way in both the pre- and posttests. For instance, Ben strongly agreed he was respectful toward those from other cultures in both the pre- and posttests, and Manuela agreed she was respectful toward those from other cultures in the both simulations.

The most frequent topics mentioned in student surveys at the end of the course regarding how to respect other students related to time zone and language differences. Many students indicated allowing for time differences was a large factor in showing respect to group members but that problems were inevitable in working with international students. Some students notably avoided these problems. For example, Ben was rated a 5 out of 5 by his group members in both simulations where nearly all his group members indicated they appreciated that he was available for meetings and set up times for meetings when everyone was available. Ben stressed he found accommodating for time zones and different schedules was important and more of a problem when working with international students. He did not express irritation

when students did not communicate outside of class, however. Instead, Ben found problems related to "plain old 'not participating'" instead of difficulties communicating outside of class.

Manuela indicated different time zones negatively influenced having deep discussion and that it was a challenge to plan with other students when emails were not responded to right away. She was given a 3 out of 5 by the only team member that gave her a score in the first simulation where that team member said she did not participate outside of class and where her teammate speculated in class that participation from any team member may be heavily influenced by time differences. This comment may have been directed at Manuela, but time zones did not seem to impact Manuela's participation in the second simulation. Her two teammates there said she provided useful insights inside and outside of class as well as questioned points that would have otherwise been left undisputed.

How to account for and respect language proficiencies was also a challenge. Ben said it was important to show respect to other students by accommodating for difference in language proficiencies, and he indicated one of the most important things that he has learned from the role-playing simulation experience is that he needed to simplify his thoughts and language. He found, "[i]f you get too bogged down with bigger, harder words that aren't crucial to the meaning of your thoughts, you're going to confuse someone in a hurry."

In contrast, Manuela was often one of the TU students where the U.S. students showed respect toward by adjusting their language and in order for her to understand their meaning. Communicating in English was more difficult for Manuela than most others in the class because of her relatively low level of English: a teammate in the first simulation reported it was often difficult to understand her and that she did not participate. Therefore, they often did not address her in discussions. Manuela did contribute much more in the second simulation where she often asked questions when she asked if she did not understand something, and the U.S. students tried to clarify their meanings for her:

November 14, 2012, second simulation:
Anthony: But uh, do you guys wanna talk about what you found?
Jeff: Um, uh.
Manuela: Um. I, I don't understand um, the last question that our task is how much resource we can, we can use to, to produce electricity or...
Anthony: Um, what what what. Your question again? Sorry?
Manuela: Um, the last question I was ask is for the first presentation is how much resource we can use to generate electricity or, or some words, uh, I don't understand it very clearly.
Anthony: The uh, the question in the, in the handout thing that we got emailed to us? Is that what you're talking about?

Manuela reported in the post-simulation survey that she wished she had contributed more in the first simulation because she had done presentations about nuclear energy before. Her lack of contribution seemed to impact the amount of time students reacted to her comments and therefore respected her contributions. Yet based on the number of contributions and points she raised in the second simulation, she respected other group members by making an effort to change how much she added to the group, and they respected her by reacting to her questions and contributions.

Recognize

Recognizing or showing an interest in different cultures did not significantly change after participating in the simulations (*p = .232)*. For instance, students generally maintained their interest in people from different cultures with over 80% in the pretest agreeing or strongly agreeing they are interested in other cultures and 84.6% in the posttest agreeing or strongly agreeing. One factor that could impact these consistently high percentages of students interested in other cultures may be due to students having chosen to enroll in this transnational course they knew involved students from more than one culture. It is important to note some students reported they became more interested in other cultures after the simulation: more people strongly agreed they are interested in different cultures from the pretest (30.8%) to the posttest (50%). Ben, for example, maintained he strongly agreed he was interested in other cultures while Manuela shifted from agreeing to strongly agreeing from the pretest to the posttest.

Another way students recognized the opinions of people from different cultures is by listening to all viewpoints. In this study, students primarily agreed or strongly agreed they listen to others' viewpoints when determining how to find solutions to a problem in both the pretest (92.3%) and the posttest (96.1%). This is statistically insignificant (*p = .136*) and may indicate that students who enrolled in this transnational course may be more inclined to listen to others' viewpoints because of the discussion-based structure of the course. The focal students rated themselves as listening to all viewpoints: Ben strongly agreed he listens to others' viewpoints to solve a problem in both the pre- and posttests, and Manuela agreed and then strongly agreed she does so.

An additional factor in recognizing differences among students from other cultures is considering the relationship between engineering solutions and cultural practices. When asked about whether they agreed engineering solutions are independent of cultural practices, more students disagreed or strongly disagreed in the posttest (69.2%) versus the pretest (57.7%). Most of the students did not change their opinions regarding whether they disagreed or strongly disagreed, such as Manuela who disagreed with the statement in both the pre- and posttest.

The number of students who agreed or strongly agreed that engineering solutions are independent from cultural practices also remained nearly the same from the pretest (23%) to the posttest (19.2%). Any change may have been due to confusion over the phrasing of the statement, however. For example, Ben's shift from strongly disagree to strongly agree when his other survey responses and interest in all German students' suggestions to engineering problems during the course indicate he may have been confused about how the statement was phrased.

A further aspect of recognizing differences is recognizing the importance of knowing engineering practices of those from different cultures. Interestingly, the number of students who agreed or strongly agreed that it is important for engineers to know different engineering practices of those from different cultures decreased from the pretest (92.3%) to the posttest (80.7%). This change was accounted for by the increase in students who reported they were

neutral on the topic in the posttest (15.4%) to the pretest (3.8%). This change is statistically insignificant ($p = .691$) where the course did not considerably impact students' previous beliefs about the importance of knowing engineering practices of those from other cultures. This trend held true with Ben and Manuela who strongly agreed with this statement in both the pre- and posttests.

Lastly, students' self-ratings of their global competency levels are important in determining whether they recognize others from different cultures. Students' scores taken after the simulations were nearly always 4 or 5 out of a 5-point scale. For instance, Ben rated himself a 5 out of 5 in his level of global competence. He said he would like to think himself as an open-minded and culturally-aware person and that the simulation helped enforce these skills. He did not see any difference in how he treated people from different cultures from one simulation to the next but indicated that any difference in how he interacted with German students may be due to the German student in his first simulation not participating outside of class. Therefore, Ben's communication with the German student was stilted in the first simulation because the other teammates did all of the assignments.

In contrast, the German student in the second simulation participated as much as the others. Ben's interactions with him in class consequently focused less on the assignments and more on asking him about German popular culture and how to study abroad in Germany. It is therefore difficult to tell whether Ben's recognition of differences changed throughout the simulation.

Manuela's experience was quite different. Manuela rated herself a 2 out of 5 when asked to rate her level of global competency said she did not have a "recognition of society and technology systematically" at the beginning of class. She wondered why a U.S. student at the beginning of class asked about German engineering in general, and Manuela did not know what to say. However, she noted at the end of the simulation that she "jumped out of the fixed mind" of what she believed most Germans thought, and she thought she learned more about differences between Richmond and Dortmund cultures through discussions and teamwork in the second simulation.

Adjust

Determining whether and how students adjusted their behaviors in response to behaviors from students of other cultures was primarily determined by qualitative data because responses to surveys were quite similar in the pre- and posttests. For instance, when students were asked if they were willing to change their opinions, over 80% in the pre- and posttests agreed or strongly agreed. Over 15% were neutral or disagreed they were willing to change their opinions, and there was very little shift after the simulations except for students shifting their opinions between agree and strongly agree ($p = .788$). Ben, for instance, strongly agreed he is willing to change his opinion and agreed he is willing to change his opinion on the posttest. Manuela reported she was neutral both on the pre- and posttests.

Students also did not report a significant change in whether they would play a role that conflicted with their personal beliefs ($p = 1.0$). Nearly 3 out of 4 students agreed or strongly agreed they were willing to play roles against their beliefs on the pretest (69.2%) and the

posttest (73%). Ben, for instance, strongly agreed he would be willing to play a role that went against his beliefs in both the pretest and the posttest while Manuela disagreed she would be willing to do so in both the pre- and posttests.

Even though survey data do not show significant differences across student scores, comments made throughout the class and survey responses suggest they adjusted their behaviors during the class. For instance, Ben and Manuela both adjusted their behaviors during the class, yet each adjusted in different ways. Ben focused on adjusting his language and how to communicate with German students. He reported he did use colloquial expressions where he did not think about whether people could understand, but he reported he tried to use more simple words and correct himself during the second simulation. Nevertheless, the difference in how he was understood by German students is difficult to determine. The German student in his first group did not often ask for clarification in any U.S. terms, but the German student in the second simulation "was good about inquiring what the meaning was" where Ben then said he tried to explain as best he could.

Ben also adjusted how he communicated in the second simulation in using Google Plus Hangouts so his U.S. and German teammates could communicate during and outside of class. In this way, he said he could use video and other features to help facilitate communication using a platform that German students can install and access for free. Ben expressed that the other form of communication helped him understand his group members' meanings more so than he would have using only the Blackboard Collaborate Bridge platform.

Manuela primarily adjusted how much she spoke and how much she asked or shared her opinion in her groups. While she seemed hesitant to share her opinion in the first simulation, she frequently shared her opinion in the second. Manuela reported that this adjustment in sharing her opinions and the teamwork among her group members helped her enjoy the second simulation much more than the first.

Integrate

The role-playing simulations had little impact on students' beliefs about whether engineers need to learn how to work with those from other cultures. Almost 90% of students reported they agreed or strongly agreed that this skill was important in the pretest (88.5%) and posttest (88.5%) where 11.5% of students reported they were neutral about this statement in both the pre- and posttests. This is a statistically insignificant finding ($p = .802$), and students seemed to merely switch their scores from agree to strongly agree and vice versa if they made any change at all. The high percentage of students who agreed or strongly agreed engineers need to learn how to work together with those from other cultures may be due to students' initial decision to join a class that has many team-based projects involving students from different cultures.

Ben strongly agreed that working with teams is important in both the pre- and posttests and found the simulations helped him learn how to compromise in order to further the organization or company he will work for in the coming years. Because he was in a group representing alternative energies and then a group representing nuclear energies, Ben reported in a survey

after the simulation the "opposite end of the spectrum" helped him see issues how others might see them and how to negotiate. He found this need was more apparent in the second simulation where the different stakeholder groups had "very isolated views" where all groups needed to reach a solution.

Manuela agreed knowing how to work with those from other cultures is important in the pretest and then strongly agreed in the posttest. Along with learning to share her opinion more often, she indicated the most valuable thing she will use in future work is her new knowledge about nuclear energy and the different perspectives people have about whether to use it. She found that, in the first simulation, she considered only "single aspects" and that she had an "immature mind." Manuela indicated the transnational environment and discussing with international teammates allowed her to see many creative ideas about nuclear energy she will use in the future. She additionally learned and thereafter frequently used the term NIMBY (not in my backyard) as well as terms more relevant to nuclear energy.

Student Perceptions

The role-playing simulations positively impacted how much students enjoy them. Over half of the students reported they enjoyed role-playing simulations at the beginning of the simulation with 38.5% agreed and 15.4% strongly agreed they enjoyed them. Nearly 40% were neutral toward them, and 7.7% disliked them. These numbers shifted in the posttest where 42.3% agreed and 34.6% strongly agreed they enjoyed role-playing simulations. Less than half of the students who were neutral or disagreed they liked role playing simulations in the pretest (46.2%) reported they did not like them in the posttest where 19.2% reported they were neutral toward them and 3.8% strongly disagreed they enjoyed them. This difference is statistically significant ($p = .019$) and indicates students these role-playing simulations did impact students' enjoyment of them.

One aspect Ben and Manuela enjoyed about the role-playing simulations is that they gave them a chance to work with students who have different viewpoints. Ben found, "I think I improved my global competence through this simulation… I think the more exposure and experience you have with people of cultures other than your own, the more globally competent you will be." Both he and Manuela believed that long discussions with others during small-group sessions was the most important activity in giving them practice in displaying global competency, and they emphasized how role-playing simulations gave them substantial practice in working with those from other cultures.

Another aspect the students enjoyed was being placed in different roles in each simulation where they reported they learned a significant amount about how to work with others and about nuclear energy in general. However, Ben and Manuel had different reasons for their opinions. Ben began the simulation being very pro-nuclear and then became very anti-nuclear during the first simulation where he was in a group representing alternative energies. He then was placed in a group supporting nuclear energy, and after the second simulation, he found "It's hard to say what my personal stance is at this point."

Manuela enjoyed playing different roles and having a chance to interact more with her second group; she said she learned a lot about voicing her opinion by changing her interaction style from group to group. She also reported she learned different things about U.S. students in each simulation, such as how direct they are or how to interact effectively with them. Manuela was "neutral for technology, also for nuclear" at the beginning of the simulation, but throughout the two simulations, she reported the interactions helped her solidify her thoughts and "developed the minds [*sic*] of considering the construction of power plants out of general thoughts."

Although students greatly improved their enjoyment of role-playing simulations, they reported they largely maintained their opinion about whether role-playing simulations are useful educational tools. A higher percent of students reported they agreed or strongly agreed where 69.2% believed they were useful before the simulations and 80.3% agreed or strongly believed role-playing simulations were useful educational tools after the simulations. However, the number of those who disagreed to strongly disagreed that role-playing simulations are valuable tools grew from the pretest (3.8%) to the posttest (11.5%). Qualitative data suggest students increased their belief that they were useful, although students who had more negative or neutral opinions may have not voiced their thoughts as opposed to other groups.

Both Ben and Manuela were among those who strongly agreed role-playing simulations are valuable teaching tools at the beginning of the simulations. After these simulations, both again strongly agreed that role-playing simulations are useful teaching tools. Ben observed, "I think the globally competent engineer is a concept that many Americans struggle with, but this [role playing simulation] is definitely something that promotes it in a very positive manner. I'm glad I was able to get this." He believes this will be very helpful is his future engineering career because collaborating with people for a common goal is a "situation that we are only going to see more of in future years." Manuela echoed Ben's comments in saying she wants to be in a role-playing simulation in the future because it is an interesting experience that will help her in her future work.

Discussion

These results indicate a closer look at students' comments and survey responses paint a much more detailed, valuable picture than quantitative survey responses alone can depict. Quantitative data show students significantly improved their opinion of role-playing simulations in general, yet other findings are statistically insignificant. This is perhaps due to the small sample size; a study with a larger sample size may increase the power and the accuracy of any results.

Given the small sample, a closer look at representative focal cases is necessary to draw any conclusions regarding whether these role-playing simulations in this transnational engineering course improve students' abilities to display global competency. Illustrating the experiences of select students in the class cannot perfectly represent the views of the whole. They can, however, shed light on how students illustrate global perspective in a transnational engineering course and how they perceive role-playing simulations in that environment.

Ben represented a student who considers himself globally competent, who expressed great enthusiasm about interacting with students from other cultures, and who was commended by students of all cultures for his efforts and communication style. These questions and enthusiasm for learning about other students combined with his relative lack of cultural experience may have prompted him to focus on other students' cultural differences. This attention to differences may also have led him to consciously respond to students' differences, such as using different words when someone does not understand a term. Changing his wording was the largest change he made throughout the simulations: while he did not significantly change his behaviors, he expressed a growing awareness of the relationship between engineering solutions and cultural perspectives.

In contrast, Manuela's multiple cultural experiences and desire to learn about nuclear energy may have shifted her focus to participate more in order to share what she knew about nuclear energy and learn the many different viewpoints students have about the topic. She did change her behavior from simulation to simulation, but she attributed that adjustment to a desire to share her opinion more often and not anything related to cultural interactions. Her teammates in the second simulation then became "nice guys" who had "creative ideas" that she did not attach to any cultural difference. Manuela highlighted differences between cultural approaches to situations, yet perhaps her multiple previous cultural experiences led her to focus on course content and pay comparatively little attention to cultural differences.

Future Research

This study adds to the literature on the concept and illustration of global competency, the use of role-playing simulations, activities in transnational environments, and activities in online engineering courses. However, these areas are all significantly underdeveloped, and further studies are needed to support or refute any current findings. Similar studies involving a larger sample size or reporting on a variety of different transnational engineering courses could be a next step in informing the findings reported here.

One area that is particularly in need of future study is the use of online role-playing simulations in engineering education or in other STEM-related fields in higher education. Many studies involving role-playing simulations are neither related to engineering nor are focused on students in higher education. Yet due to the growing number of engineering students who are educated online, educators are searching for effective activities for their students in these environments. Role-playing simulations have become intriguing to educators, but they need to know whether role-playing simulations are beneficial and are worth embedding in their curriculum.

Future research can also explore the growing field of transnational education. It is impossible to ignore the increasing need for those in all fields to work with others from different cultures and who are located around the world, and those entering the workforce need to be able to display global competency in order to be effective global partners. Therefore, studies focusing on activities that educate students how to display global competency when working with those from other cultures will benefit all involved.

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