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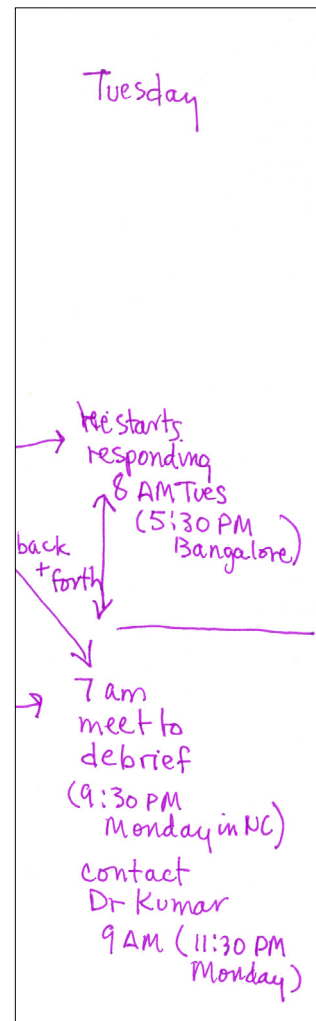
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connexions • international professional communication journal

Volume 1 • Issue 2 • 2013
International Engineering Communication

From the editors

INTRODUCTION TO SPECIAL ISSUE ON INTERNATIONAL ENGINEERING COMMUNICATION

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In her editorial in the inaugural issue of this journal, "International professional communication: An overview" (2013), Rosário Durão opens by reminding readers about our connections to each other, to the environment, and to the world in which we're living through the examination of Japan's tsunami disaster of 2011.

In distilling this poignant example, Durão's final summary resonated the loudest for us: "International professional communication is essential for humans to be safe, interact with their environments, engage with their fellow human beings, make decisions, and take action" (p. 4). In these very clear
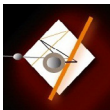
and simple terms is the valuable reminder that our relationships with each other and within the sociotechnical systems in which we operate depend on communication—clear communication—in order for us to live safely, responsibly, and ethically.

This dependence is abundantly clear in engineering fields, where clear communication plays a critical role in making decisions and taking actions, especially in regards to human wellbeing. Whether it is advancements in the medical field that help us heal or maintain health, agricultural innovations that ensure food makes its way from the field to our table, or power systems underlying technologies that we rely upon, engineering is intertwined with our daily lives. We travel on bridges and roadways, use machines and tools in our vocations and avocations, handle materials in common household items—all planned and designed by engineers. This reality is the case for individuals on all continents. All of humanity is impacted by engineering.

And within engineering, right alongside the software codes, equations, simulations, and problem-solving formulas engineers use is the additional tool of communication. Both as a process and as a product, numerous classroom and workplace studies have been devoted to developing theories and practices for effective engineering communication. Much of this work to date has focused on within-culture communication in engineering. Far less information is available on international engineering communication. While past IEEE Professional Communication Society conferences have included international engineering communication sessions and a recent conference (July 2013) focuses on communicating globally, sustained dialogue around this issue is in its early stages, and there is ample room for development in the ways we are thinking about and addressing engineering communication at an international level.

Especially within the last two decades, the engineering profession has experienced globalization thanks to mergers and international partnerships, NAFTA, and the development of the European Union. This special issue of the *connexions* journal aims to catalyze a more focused conversation about the role of engineering communication within global workplaces and among international audiences.

In doing so, the issue brings together a wide range of international perspectives and practices to help educators and researchers alike expand our understanding of what cross-cultural engineering communication entails, how faculty might incorporate it into a range of curricular and cocurricular experiences, and how students learn in these environments.

Kedrowicz and Taylor make a compelling argument for broadly rethinking our understanding of ways to integrate engineering and communication to encompass not only skills and document templates but also complex issues of relationships. In arguing for a robust approach in which educators help students understand that "communication [is] the very process through which knowledge is constructed" (p. 99), they demonstrate ways in which communication in the disciplines can create space for a holistic approach that encompasses global as well as local communication challenges.

The teaching cases and studies of student learning all enact this approach in various ways. At the assignment level, Fadde and Sullivan offer an engaging and highly usable case study that can be employed in a range of courses. Their article provides the case, essential background theories and studies, and a varied set of implementation strategies that create a flexible opportunity for both engineering and communication faculty.

At the course level, three of the articles offer approaches and analyses of courses at different levels of the curriculum and different levels of complexity. Allen, McCall, and Mike describe a collaboration among first-year composition faculty, engineering faculty, and a living-learning community to offer a first-year composition course with an international engineering focus. They present two different approaches to the course, analyze the strengths and limits of each approach, and highlight the importance of collaboration among the composition faculty as well as between the composition and engineering faculty—that led to the success of the course.

Hannah, Berardy, Spierre, and Seager describe an upper-level engineering course that paired U.S. and Indian students in a noncoooperative ethics game—The Externalities Game (TEG). In analyzing students' experiences, the authors highlight the particular kinds of cross-cultural communication challenges students faced as they attempted to work through ethical decision-making. They note the barriers created by distance and culture, the reliance of engineering students on quantitative approaches that discounted human relationships, and the absence of trust across cultures. Their work concludes with critical suggestions for future cross-cultural collaborations that can leverage communication to engage students in global ethics.

Most complex is the case offered by Maylath, King, and Arnó Macià in which engineering students in Spain, technical communication students in the US, and translation students in Finland collaborated to produce technical documentation in multiple languages for engineering projects. Their ambitious collaboration—built on several years of smaller collaborations—highlights the kinds of complex challenges engineers face

when working cross-culturally in nonnative languages—in this case, Spanish engineers writing in English. Their work highlights the ways in which both engineering and technical communication students needed to develop both technical and cross-cultural fluency to support the collaboration. They conclude with a series of concrete, actionable suggestions for educators interested in developing cross-cultural modules and courses to better prepare students for the global workplace.

Omachinski focuses on cocurricular experiences and, in particular, on study abroad as sites for students to develop international mindsets and cross-cultural communication practices. She argues persuasively for the value of short-term study abroad experiences for engineering students, particularly in light of curriculum demands that make long-term experiences more challenging. After laying a firm foundation for the approach, grounded in prior research, she explores the experiences of engineering students on a 25-day trip to Germany. Her findings identify both the barriers students face in terms of time and language and the kinds of strategies that help address those barriers, including routines, local norms, host families, and friendships. Her work highlights the kinds of global learning outcomes that result from even short trips and provides guidelines for educators who wish to implement such programs.

What is perhaps most striking about many of these articles is the degree to which they highlight the need for collaboration among educators—global communication in engineering does not happen in a vacuum. Similarly, engaging engineering students in the processes, practices, and theories that enable effective cross-cultural work requires faculty who are willing to come together across boundaries—both within and across universities and countries—to create effective learning environments. ■

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Research articles

BEYOND THE "I"

Framing a model of participatory ethical decision-making for international engineering communication

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The article reports on findings of an ethics education unit in a cross-institutional partnership—an American university and an Indian university—that uses noncooperative gaming theory to extend ethics education to take on a global, group/systems perspective. Authors assert that a role of engineering communication at the global level is to position stakeholders to see ethical decision-making as participatory. The authors also comment on four deliberative challenges that students face as they assume participatory roles in ethical decision-making: (1) anticipating and imagining cultural interaction; (2) coordinating the group decision processes primarily through quantitative means of persuasion; (3) cultivating trust; and (4) coping with the challenges of articulating fairness. To address the communication challenges related to fostering participatory ethical decision-making, the authors conclude by opening a conversation about potential avenues for pursuing participatory ethical decision-making in international engineering contexts.
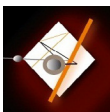
Keywords. Ethics education, Participatory decision-making, Rhetoric and engineering communication.

While engineering is increasingly a global profession, models for educating engineering students about the ethical implications of their work have generally remained locally focused. As Seager et al. (2010) explain, "dominant approaches to . . . engineering ethics education share a common focus on the proper conduct that individuals, defined as individual members of a profession, should exhibit." As we begin to examine the role of engineering communication within global workplaces and among international audiences, we are presented with an occasion to reposition engineering ethics education to take on a global, group or systems perspective. This article reports on findings of a curricular unit in a cross-disciplinary research partnership—English and Sustainable Engineering—designed to extend ethics education in this way.

We argue that a role of engineering communication at the global level is to position stakeholders to see ethical decision-making as participatory—as operating beyond the individual level to that of the group or system. To support this argument, we provide examples from a curricular unit in an upper-division engineering course in which students from an American university and students from an Indian university were instructed on participatory ethics via a novel, noncooperative game-based module (aka The Externalities Game, or TEG) implemented in a distance education framework. Drawing from early work in noncooperative game theory (Sadowski, Seager, Selinger, Spierre, & Whyte, 2012; Seager et al., 2010; Spierre, Seager, Selinger, & Sadowski, 2011), we argue that using a noncooperative gaming theory model

positions engineering students to learn to appreciate and be sensitive to the global impact(s) their decisions have as they experiment with and experience participatory ethical decision-making. In particular, we extend this early work by focusing our analysis on four deliberative challenges students face as they assume participatory roles in ethical decision-making in TEG:

1. Anticipating and imagining cultural interaction.
2. Coordinating the group decision processes primarily through quantitative means of persuasion.
3. Cultivating trust between game players.
4. Coping with the challenges of articulating fairness.

With each of these items, we discuss the communication challenges students faced when attempting to negotiate ethical choices that would affect themselves and also the other players in the game. To address the communication challenges related to fostering participatory ethical decision-making, we conclude the article by opening a conversation about potential avenues for pursuing participatory ethical decision-making in international engineering contexts.

The Externalities Game

TEG is designed to experientially teach students about ethics related to the problem of environmental externalities, where the behaviors of a few impact otherwise uninvolved parties. For example, a company's manufacturing processes cause air pollution that imposes health and environmental costs to society as a whole. Analogously, TEG immerses students in a situation where their personal interests are at odds with group success. In TEG, students play with grade points for the TEG assignment, knowing that improving,

their grade comes at the cost of decreasing the grades of all other players—including players located internationally.

The game consists of two simultaneous decisions. First, students must decide how many grade points they want to produce. This establishes an initial grade that is negatively influenced by the production decisions of other players—externalities. The impact of a player's production decision depends on the production class randomly assigned to the player, as described in Table 1 (p. 17). Second, players decide whether or not to transfer grade points earned in the first part of the game to other players. Prior to gameplay, students are encouraged to strategize and negotiate about how to play, but are also informed that there is no third party enforcer for agreements made. The game is calibrated in a way that makes it necessary for players to cooperate in a production and sharing strategy to optimize the overall class grade. Students who realize this must determine if they trust their classmates enough to follow such a strategy as it poses both a risk and an opportunity to every student involved, and then convince their classmates that it is worth undertaking. Alternatively, students might not see the value in cooperation or fail in convincing their classmates, leading to a free-for-all and lower overall grades for the class.

Generally, the aims of TEG are threefold:

1. To create opportunities for ethical discourse and action.
2. To force participants to deal with injustice as part of the decision-making process.
3. To allow ethical leaders to emerge.

As part of the game design, instructors intentionally create ambiguity, surprise, risk, unfairness, and uncertainty to support these aims. Whereas typical ethics instruction deals with passive analysis of concrete case studies,

involvement in a game like TEG provides students with an opportunity to actively deal with ambiguous moral problems with uncertain outcomes, much like those they are likely to encounter during their career, where the right answer is difficult and unclear.

To foster emotional involvement in the strategies and outcomes of the game, instructors tie game outcomes to the grade that students will earn in the TEG unit. Students earn their TEG grade by participating in various activities in each of the game's three phases: Pregame, Gameplay, and Postgame. Each phase lasts approximately one week.

Pregame

Students prepare for TEG by watching an introductory video, reading a game guide, working with an Excel spreadsheet that will calculate production scores during the second and third phases of TEG, and participating in a pregame exercise. The video introduces the concept of noncooperative game theory—games without third party enforcers—and explains that the game is based on Tragedy of the Commons—rational actors using a shared resource will ultimately deplete that resource.

To help students imagine what is involved in the final two phases of the game, they read a game guide that provides a detailed schedule outlining what students must do in chronological order to participate fully in the game. To contextualize the activities in the game guide, students must watch and read material related to the two concepts supporting TEG: externalities, which are unintentional consequences of actions that affect other people; and Coase theorem, which is a theory regarding externalities that states that, with no transaction costs, trade will lead to an efficient outcome, so long as property rights are well defined. In addition to these readings, students

take a pregame survey regarding trust in classmates, and make a hypothesis regarding their prediction for how TEG will play out. Students are asked to share their hypotheses with other students by posting them as responses to the video explaining TEG.

While engaging in each of the above pregame activities, students also have an opportunity to play with the Excel spreadsheet that will be used to calculate production scores in the last two phases of TEG. The spreadsheet allows students to experiment with different gameplay strategies by immediately generating the possible outcomes from any decisions the students make (i.e., do the students underproduce or overproduce with respect to the production strategy negotiated between the game participants).

Finally, students engage in a pregame exercise to test the level of trust they have in their classmates. When organizing the exercise, instructors divide students into several groups and tell each group they can choose to "cooperate" or "compete." If all students cooperate, they receive a passing grade for the exercise. If one or a few groups compete, they hurt the grades of those who cooperated, but improve their own grade substantially beyond just earning a passing grade. If all students compete, they all fail the exercise.

Gameplay

TEG gameplay consists of player assignments, deliberation, a production round, more deliberation, and a sharing round. Points earned during the game—a maximum of 100 per student—are treated as part of a 100-point assignment that counts towards the students' final grades in their class. In this phase, instructors intentionally limit their interaction with students to encourage them to handle issues independently.

Table 1

Production classes and their characteristics

Class	Points per unit production	Externalities per unit production	Production limit (units)	Percent students in class
Luxury	High	High	0– 10	10%
Intermediate	Medium	Medium	0– 50	30%
Subsistence	Low	Low	0–240	60%

Production classes and their characteristics are subject to diminishing returns as production is increased

Players are assigned to one of three production types, as described in Table 1, and are provided an anonymous player code number. Each role has strategic advantages and disadvantages, but Luxury is typically considered as having an advantage, as this is the only role that can pass the assignment independent of the other players' actions. Instructors intentionally introduce unfairness by arbitrarily assigning these roles, and instructors assign roles so that there is the correct percentage of students in each production class. During gameplay, students are allowed to deliberate between institutions and within their own classes to persuade each other that they should produce a certain amount or go along with a certain plan, but no enforcement mechanisms are provided by the instructors. Lack of enforcement forces students to deal independently with the injustice inherent in certain production roles and provides an opportunity for ethical discourse and action as well as for ethical leaders to emerge.

After deliberating between and/or amongst the classes at the two universities, students anonymously submit their final production decisions. This is followed by results being posted via private player codes for the class

to see. Anonymity introduces an aspect of uncertainty and ambiguity, as it is not clear what decisions were made, and if students kept to their agreements or betrayed the class. If a production decision was not submitted on time, or a technical error resulted in the instructor not receiving the decision, the player is assumed to produce nothing and receives no grade points. This allows for unfair situations to emerge naturally during gameplay.

Following the posting of production results, players are allowed to deliberate once more regarding potential voluntary sharing of points. Strategic deliberation involving arguments for fairness or justice can be used to persuade classmates to share, once again providing an opportunity for ethical leaders to emerge and support discourse and action. Point sharing deliberation is followed by anonymous submission of final sharing decisions from specific players to specific players. After sharing decisions are submitted, final game results are revealed to students.

Postgame

Activities include a postgame survey regarding trust in classmates, class discussion, and a reflective essay. The class discussion focuses on the experiences of gameplay and is moderated by instructors, but led by students. Key ethical issues that arose during gameplay are a vital part of this discussion. This allows students to reflect on their actions or inactions in the face of injustice when they had an opportunity to intervene. The reflective essay provides an opportunity for students to think critically about their experience in TEG and how it relates to the course, ethics, and sustainability.

Methods

Participants

Game participants were distributed across two universities and two disciplines: 70 engineering students in the US and 153 management students in India (See Figure 1). The U.S. students were enrolled in an Engineering Business Practices course and the Indian students were enrolled in either a course in Game Theory (23 students) or Policy (130 students). The primary means of cross-institutional communication provided to the U.S. and Indian participants were discussion board posts on the site Ethics CORE, an NSF-funded online ethics resource center.

Figure 1.

Framework of TEG
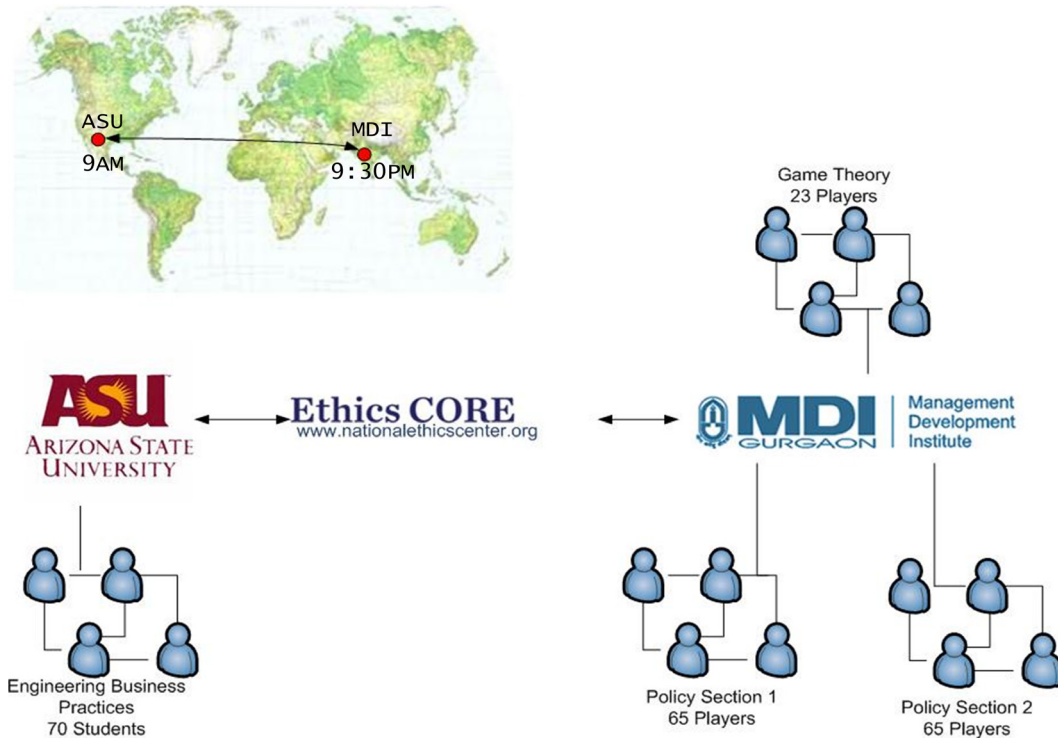
Data Collection

The data for this analysis came from three sources. First, data came from the three written assignments the U.S. students were asked to complete during the game. These assignments included

1. The hypotheses the students wrote in the pregame phase about how they anticipated the game would play out.
2. The tweets the students composed during the three phases of the game.
3. The reflective essays the students wrote in the postgame phase.

Second, data came from the authors' field notes and their attendant, reflective write-ups. Third, data came from the posts, responses, and exchanges that the U.S. and Indian students composed on Ethics CORE. Due to issues with access to the Indian students, related primarily to the difference in time zones, data from the Indian students was only collected via Ethics CORE. The authors' Institutional Review Board approved the study.

Data Analysis

The authors hypothesized that the U.S. and Indian students would struggle to deliberate and articulate a clear plan for minimizing externalities. In particular, the authors speculated that limited opportunities for traditional face-to-face interaction during the game as well as the 12.5-hour time difference between the two universities would pose significant barriers to successful deliberation. Compounding these two factors was the concern the non-Luxury students had regarding the grade they would earn playing the game. Specifically, the felt lack of control these students would experience over their grades would likely heighten tensions in and between the different

production classes of students and thus ultimately undermine trust between them.

In light of these issues, the authors were uncertain about how the students would interact and deliberate during the game. As such, the authors did not define specific data categories for analysis regarding deliberative challenges prior to the game. Therefore, the authors decided to take a qualitative approach to data analysis. The authors each recorded their observations and impressions of the participants' written and oral deliberative interactions, and then convened after the game was completed to share their observations and develop a coding framework for the deliberative challenges the participants faced.

During the authors' postgame meeting, they noted the limited amount of interaction between the U.S. and Indian students on Ethics CORE and, as a result, determined that there was insufficient data to comment specifically on the Indian students' deliberative practices. Accordingly, the primary focus of the data analysis was the U.S. students' deliberative practices as reflected in their written assignments and in-class discussions. To categorize these practices, the authors shared their observation notes and reflective write-ups and identified 8 categories related to the U.S. students' deliberations about production and sharing decisions. Through further discussion about the 8 categories, the authors identified redundancies between them and narrowed the total down to four:

1. Anticipating and imagining cultural interaction.
2. Coordinating the group decision processes primarily through quantitative means of persuasion.
3. Cultivating trust between game players.
4. Coping with the challenges of articulating fairness.

Discussion

TEG provided many opportunities for deliberation amongst students on several ethical and logistical problems. We intentionally designed the game to allow deliberative conversations to spontaneously emerge as students encountered different problems and disagreements throughout the process of playing the game. However, the four deliberative matters we identified did not receive as much attention from the U.S. students as we expected. These matters therefore could be considered missed opportunities for cultivating high quality deliberative practices in TEG. In the sections that follow, we describe these deliberative challenges and comment on their impact in foreshortening the process of participatory ethical decision-making.

Anticipating and Imagining Cultural Interaction

The U.S. and Indian students tended to treat one another as an aggregate group, preferring to use ambassadors rather than interact as individuals online. Also, during gameplay, there were no international point transfers; all transfers occurred between students at the same institution. Consequently, communication between groups was limited in quantity and focused mainly on game strategy in preparation for the production aspect of TEG. We offer two possible explanations for this limited online interaction between the U.S. and Indian students.

The lack of online discourse may be explained by a well-established social psychology concept known as *evolutionary tribalism*, which describes the human tendency to connect with and act more altruistically with members of an *in-group*, or with people that have something in common with them. Alternatively, members of an out-group may be seen as outsiders or even competitors that do not need to be dealt with cooperatively (Bornstein,

2003). For example, tribalism may be explicitly observed among members or fans of team sports and, at the extreme, may be a driver of racism and religious conflict. Sadowski et al. (2012) discuss the role of in-groups and out-groups in a multiclassroom ethics game modeled after the Tragedy of the Commons where there was a similar tribalism dynamic exhibited among students in different classrooms, but all located within the United States. In TEG, U.S. students originally thought their in-group was their production class and their out-group was the other production classes, but when faced with the out-group of Indian students, U.S. students considered their entire class as their in-group and the Indian classes as an out-group. This in-group/ out-group distinction was exemplified in a post from a U.S. student writing:

> It will be interesting to see what happens but you don't know that the Indian students will agree with your class on how to work together. Try to brace yourself for any decision or result that may occur, including your own actions. Good or bad.

This student is identifying Indian students as foreign, unknown, and unpredictable, but giving honest advice to U.S. students. Another two posts specifically expressed fear of the Indian students saying, "we did a good job cooperating together today. BUT, i do still have some fears from the Indian side of the world!" and "players can now point to the threat of India and claim that any guarantee of optimization is frivolous at best." These suspicions were countered partly by other more optimistic posts. One U.S. student wrote:

> I think that people in our class especially will be more apt to work as a group since we have experienced proof that it can work. As far as the classes

in India, as I previously stated, I believe that as people & as students we all have very common basic desires.

A second U.S. student wrote: "India may be a problem, but are they not thinking the same thing about us? They will reach out to us as much as we are willing to reach them. Communication is key."

One Indian student attempted to break down the tribalistic barrier by calling for students at both institutions to introduce themselves in a discussion on Ethics CORE. Unfortunately, the student framed it in a strategic rather than normative way, saying:

> It is most important to know how many of us are luxury, intermediate, and subsistence so that exact effect can be calculated and we can jointly decide who will produce how much. So let's Introduce each other with production role.

Responses to this post were minimal, most including just player ID or production class. The rest of the discussion on Ethics CORE was primarily about strategy for TEG, unfortunately missing an opportunity to humanize the players involved across both institutions[1]. Consequently, less formal and conversational dialogue was more natural and comfortable for students in a classroom with students they could identify with in terms of attending the same university and/or pursuing the same degree[2]. We argue that the U.S./Indian tribalism may have hampered individual interactions and discussions beyond game strategy between the two groups.

Social psychology research also tells us that individuals are more likely to be morally apathetic to geographically distant people than they are with those living nearby. Introna (2001) reports that individuals tend to

behave morally when they feel morally obligated to others, especially when the others are people that we name and see face to face. Also, Markowitz and Shariff (2012) attribute individual inaction towards climate change in part to the fact that people in developed nations believe—correctly—that climate change will most negatively affect individuals in distant developing nations. Thus, spatial distance may enhance the tribalistic tendency for humans and reduce the ability of humans to perceive climate change as an important moral imperative that inspires life-style changes. Analogously, students at the U.S. and Indian institutions seemed much less concerned about helping individual players at the other university than they were with transferring points to needy students in their own classroom. The geographic distance between the physical classrooms as well as the time difference may have reduced the moral obligation they felt towards both communicating with and helping students at a foreign university.

Ultimately, enhancing the quality of cross-institution deliberation may lie in breaking down the tribalistic and spatially distant barrier that exists between groups. This may involve greater efforts and opportunities to interact before, during, and after TEG is assigned[3]. Perhaps a video of one group of students can be sent to the other as a form of a pregame "ice-breaker," or perhaps the students could interact in a series of games and cooperative assignments[4]. Repeated opportunities for interaction will likely build trust and would allow students to identify commonalities that may begin to alleviate the tribalistic tendency and/or spatial disconnect. Furthermore, emphasizing TEG as an exercise in ethical decision-making would likely change the tone and quantity of discourse. It is clear the students at both institutions generally approached the game as a numerical exercise and failed to apply the ethical concepts presented in class. Placing a grade

value on students' ability to apply ethical concepts and reasoning in their online communication would likely encourage more meaningful interactions between groups.

Tension Between Quantitative and Qualitative Persuasion

During the pregame phase, students were slow to work together. Partly, this was due to a lack of familiarity with the game. Also, the students were concerned with how gameplay might impact their grade. Furthermore, there were no predetermined game leaders. Generally, the students sat around waiting for something to happen as was evidenced in one of the student's postgame reflection where she commented "We needed in a way a person who could tell us how to work together." What is most telling about this student's comment is her desire for specificity (i.e., "do this," or "don't do this"). Granted, this reading of the student's comment may be oversimplified, but the student yearned for some form of rule-based framework from which to begin negotiation and decision-making. This yearning was evident in other students' reflections where they offered advice to future students about how to gameplay. More than once, students noted the need to "develop a plan," or "find a way to get everyone on board." Where students turned for such guidelines was their mathematical, quantitative abilities.

During the practice game activity in the pregame phase, students worked in small groups to determine how to proceed in the game. After about ten to fifteen minutes of nervous, quiet chaos—students whispering to one another in their groups, the occasional student branching out to other groups to see what they were doing, and a few tentative leaders standing up and passively proposing a course of action—one student walked to the board to write a production optimization formula. After writing the formula, the

student calmly explained how it would work to optimize everyone's grade so long as all groups abided by the class' collective production decision. What was noteworthy about the student's performance was the sense of collective calm that set over the room after his explanation. It became very quiet and activity stopped until a few minutes later when another student stood up to explain how the class ought to play out the formula in the game. In the writing of hypotheses during pregame, some students commented about how the student's optimization formula was "beautiful" and "perfect." In a way, these comments suggested that math was some kind of therapeutic narcotic; that it settled the unrest in the game. One student even surmised in his hypothesis that, based on this math example, he believed more students would be "apt to work as a group since [they] experienced proof that it can work."

Overall, statements like these dominated the student hypotheses and reflective essays; however, there were a few students who commented about the need for nonquantitative, nonmath forms of persuasion. Though these students' statements were not explicitly framed as "we need nonquantitative persuasion," their instinct for such nonquantitative means can be inferred from the language in their hypotheses. For example, one student flatly noted that, regardless of what was decided regarding the class' production decision, the sheer number of Indian students compared to U.S. students could potentially overwhelm any collective decision the students made. That is, the proposed optimization equation would not even matter if the Indian students decided to produce in a contrary manner. In addition to this example, other U.S. students commented about the limits of the group's mathematical focus. One student remarked in his hypothesis that there were more variables that needed to be addressed besides the optimization issue,

and two other students mentioned in their hypotheses that there would be few moral leaders in the game. In these latter examples, we infer a rhetorical instinct in the students regarding the limits of quantitative reasoning in persuading others to act. As the one student noted, other variables needed to be attended to, yet the student, as is evidenced by his lack of commentary, did not know where to turn to locate the means for addressing such variables. The student in this example was unable to see the available means of persuasion. All that was available or made visible was the class' collective computational ability as expressed in the optimization formula.

The general inability to recognize and develop nonquantitative or qualitative means of persuasion was particularly troubling for us considering that the students were explicitly prompted by one of the teaching assistants to search for other deliberative means. The teaching assistant, outside the direction of the lead instructor, wrote in response to a student hypothesis:

> Communication can be a great hurdle to jump when attempting collaboration across different cultures. Unpredictable adversity can arise not only in getting your message halfway across the world but also [in] making sure your message is clear, translatable, and applicable. Small variance in language patterns, tones, use of idioms and many other linguistic variables can serve to open the gap of the communication rather than close it.

Yet, despite this direct call for attention to the qualitative aspects of their communication activities within the game, the U.S. students ignored this dimension of their deliberative activities and relied on math as the primary factor for guiding their thinking about how to produce ethically.

Ultimately, the effects of the observed overreliance on quantitative persuasion played out in two specific ways. First, the students were unable to

see the broad impact of their quantitative decision-making. Put another way, quantitative reasoning did not position students to see the big ethical picture but, instead, prompted them to view decision-making on an individual level (i.e., how would my individual production decision be calculated on the TEG spreadsheet?).

Second, the recognition of leaders in the game stemmed from one's ability to articulate a workable optimization formula. In the hypotheses, students clearly identified the game leaders as those individuals who created and/or planned the execution of the formula. Furthermore, in a number of the reflective essays, students expressed a desire to be leaders in the game, but were unable to do so because they could not formulate a plan—interpreted to mean an equation. One student in particular tied his lack of leadership to his inability to "have a miracle idea" for organizing the group's work. Overall, the tying of persuasive capacity to mathematical savviness short-circuited the students' ability to garner momentum for participatory ethical decision-making. They simply let math do the talking and relied on it to build trust between players in the game[5].

Cultivating Trust

Given the absence of a third party enforcer and the ability to make anonymous decisions in the game, many U.S. students expected some of their classmates to go against the group for selfish reasons. As one male student explained in his hypothesis, "I believe that towards the end of the game, students that have the opportunity to boost their grade up will take advantage of that because they can act anonymously." One student even went so far as to characterize as "deviants" those peers that worked against the group because of the promise of anonymity. Theoretically, a student who betrayed the

agreed-upon group plan would not be forced to reveal his or her identity or decision and could not directly be asked to explain his or herself, or attempt to rectify any betrayals of the group consensus.

In anticipation of such betrayal, many U.S. students began insisting on transparency—through players revealing their identifier codes—as an accountability measure. Following the credo of leading by example, students who demanded transparency revealed their own player codes and spent a large portion of their class time arguing for others to do the same. However, as we observed, they were unsuccessful partially due to arguments over the need for privacy for true trust to emerge. The class was divided into two camps—one that argued that trust is only achieved through honesty and transparency, and another that argued that trust means not having to be transparent. Two students addressed this idea in their hypotheses. One female student wrote:

> The key to this working though, is transparency: transparency in our position (luxury, intermediate, or subsistence), transparency in our decisions, transparency in our communications . . . . The reason that people will be more apt to "defect" . . . is because of the anonymity offered in this setting versus an in-person classroom setting where a person can be called out on their actions. Anonymity breeds suspicion whereas transparency breeds trust.

In this example, we witness the student positively characterizing transparency as a panacea for all deliberative ills that may arise. Taking a more negative tone towards those peers that did not value transparency in the same way, another male student wrote:

Many who were intent on screwing the class over on Thursday were halted by the wave of uninhibited transparency, something which will be much more difficult to achieve across our class this time around.

Ultimately, no hypotheses explicitly attempted to defend the idea of remaining anonymous, possibly because doing so would make other students expect them to use that anonymity to betray the class and open them to arguments against this idea from students advocating for transparency. What was noteworthy for us about the calls against remaining anonymous was the limited manner in which students defined what it meant to be anonymous. Specifically, anonymity was narrowly understood as having never "met" someone formally, or not "knowing" each other fully. In casting anonymity in this manner, the transparency advocates foreclosed themselves to the possibility of cultivating working relationships in the game. That is, they made anonymity too high of a hurdle to overcome and missed opportunities to identify available means for fostering relationship building and working towards group ethical decision-making that limited externalities.

In the end, most students revealed their identifier codes, but several did not—enough so that their anonymity was maintained when they went against the group consensus. This meant that the rest of the class was then unable to hold them accountable for their actions, since they did not know who they were. The only response available to them was to attempt to shame them by addressing the class as a whole, but this was ineffective, as they continued not to reveal their identity or change their decisions.

The Challenges of Fairness

Tied to the relationship between trust and transparency in TEG were competing understandings of what constituted fairness in the game. Specifically, the outcome of the first two deliberative phases of the game led to the emergence of three types of problematic players who either disregarded concerns with fairness, or were in a position wherein they hoped some form of kindness could be extended to them through a sense of fairness in the game. The three types of players were described as followed by the class members:

1. *Cheaters*. Cheaters produced more than what was allowable per the optimization strategy agreed upon by the group, giving themselves more points at the expense of others.

2. *Unfortunates*. Unfortunates attempted to submit production decisions, but technical difficulties with the game technologies resulted in their submissions not being received, resulting in them obtaining no credit.

3. *Screw-ups*. Screw-ups did not submit a decision because they did not understand the game, did not care about the game, or failed to follow the game's instructions.

These three groups of students arose due to the way TEG was set up. There were some basic rules that were enforced, such as student decisions having to be submitted in a certain way by a certain time or they would be invalid, but for the most part we allowed students to create their own norms to operate by in TEG. This allowed cheaters to get away with what they did and allowed the class to react to unfortunates and screw-ups in whatever way they deemed as appropriate. The absence of rules in favor of norms also encouraged leaders to emerge and make persuasive arguments for others to

go along with a plan. If there had been an enforceable agreement system, such arguments would not be as vital—as long as someone agreed to a plan, it could be enforced. Instead, without enforcement, leaders had to make sure they had not only a promise of cooperation but that the promise seemed genuine. This was especially important in the game since an effort to achieve transparency—which would have allowed some rule enforcement—failed. This process helped some students understand what it takes to be a leader and what is effective in guiding people.

The students' responses to these different groups of players were interesting and varied. The primary way that students reacted to the cheaters was by attempting to shame them into rectifying their violation of the social norm that had been established by the group's agreed-upon plan. Examples of the shaming *modus operandi* (MO) included statements made in class such as "don't be greedy," "do it for the greater good," and "it's nicer to cooperate than compete." One female student in her reflective essay characterized the shaming MO as an act of condemning those who cheated in order to bring them back in line with "morality." What was noteworthy about the shaming MO was how easily it became the default deliberative tactic for students. In fact, only one student noted in a reflective essay that, early in the game, the class should have made "a much greater effort to appeal to the luxury players and convince them to follow along."

The response to the unfortunates was two-sided. Some blamed the technology or instructors for causing the failure of their production submissions, whereas others blamed the unfortunates themselves for not having better accountability and keeping evidence that they submitted a certain decision. In working with the unfortunates, there was also evidence of a bystander effect. Specifically, through all of the blame-placing, few

students stepped forward to fix the problem and, instead, simply continued along and did nothing to remedy the injustice.

Regarding the screw-ups in the game, they were not given any sympathy from the class since they admittedly failed to follow instructions. In fact, one of the screw-ups seemed to prize that title and wear it as a badge of honor and, in doing so, made it very easy for the students not to extend her any kindness (i.e., point sharing).

Cultivating Sustainable Deliberative Practices for Participatory Ethical Decision-Making in International Contexts

In light of the foregoing discussion of the deliberative challenges students faced in collaboratively making ethical decisions related to externalities, the question before us now centers on the potential impact of these communication challenges to advancing a practice of ethical decision-making for engineers in international contexts. Since we all play a role in educating tomorrow's engineers, in the remainder of this section we will discuss two pedagogical items we believe will position engineering students to successfully adopt this important practice.

One suggestion for advancing a pedagogy of participatory ethical decision-making is to discuss with students the different opportunities that are available for cultivating their authority and asserting their expertise in international contexts. Stated bluntly, equations, schematics, or any other type of computational activity are insufficient for crafting one's credibility when assuming a participatory role in ethical decision-making. Throughout TEG, we witnessed students miss out on various opportunities for crafting a robust and credible identity as they continually deferred to the successful example of the optimization formula both in garnering attention and,

ultimately, in devising a plan of action for proceeding in the game. Granted, as engineers, it is unsurprising that the students gravitated to mathematical expression as their preferred means of expression and persuasion. However, as these students begin to work on the wicked problems (Seager, Selinger, & Wiek, 2011) facing our global society—problems that know and honor no geographical or cultural limits—they will require an ability to recognize the limits of mathematics and seek out supplementary means for furthering their claims and/or arguments for addressing such problems.

Accordingly, we ought to work with students and attune them to discovering other available means for cultivating their credibility as emerging engineering professionals. In doing so, we will improve engineering students' learning experience more explicitly by providing them with a communicative and/or rhetorical language for conducting such inquiry.

An avenue for providing engineering students with such language is their writing. To illustrate, let us look at TEG. In the game, the instructional team created various opportunities for students to communicate and deliberate with their peers via writing (i.e., hypothesis stating, tweets, Ethics CORE), yet students generally missed opportunities for cultivating a robust and credible identity when writing in these activities. That is, they answered the questions in a limited manner and only noted how, or what types of problems would arise in the game.

The question for us as instructors is how could we have cast the writing activities differently so as to prompt students to see their writing as a means for establishing their credibility in the game? For discussion purposes, let's use the hypothesis writing activity. Rather than emphasize the need to make a prediction about how the game would play out (i.e., "I think we will all cooperate"), what would happen if we instead emphasized the

need for students to map the outcome for readers; that is, lay out for readers the different tensions at play in the game as well as comment on the impact of particular types of decisions (i.e., "I anticipate a tension between items A and B and, as such, I think the best way to approach this problem is Avenue Z"). The relevance in this subtle difference in framing the question is that participatory ethical decision-making does not rely on ultimate decisions but, instead, on the coordination of decisions. Put another way, rather than simply allow students to rely on the common saying "the ends don't justify the means," we now draw attention to the processes of ethical decision-making, which is just as important as the outcome itself. Furthermore, we prompt students to exercise their connective thinking abilities—the ability to coordinate and link different approaches to outcomes.

As a final suggestion for advancing a pedagogy of participatory ethical decision-making, it became clear through the gameplay that the students had an impoverished notion of what leadership looks like in practice. Repeatedly in the hypotheses and the reflective essays, students attached leadership ability simply to a person's capacity to stand up and speak. Often couched in terms such as "I stepped up," or "Person X stepped up," leadership expressed in this way relies on visible and overt action.

A pedagogical challenge we face with students is learning how to articulate leadership as operating in realms beyond the visible and overt. A mechanism for forwarding the nonvisible aspects of leadership can be found in one of the fundamental canons of ethics expressed by the National Society of Professional Engineers (NSPE). In particular, one of the NSPE's fundamental canons is for engineers to "act in technical matters for each employer or client as faithful agents or trustees." Generally, it is understood that trustees have some type of advisory or supervisory role over some

item—trustees hold something in trust for another party. Without playing too much of a semantic game here, let us imagine the students as trustees in TEG and ask ourselves what their leadership behavior might have looked like had it been framed in this manner. In particular, how might the students' actions have differed had we asked them to reflect on what it was exactly they held in trust for their peers at the U.S. institution, their peers at the Indian institution, and even the environment? While any answer to this question would be speculative at this point in time, we are curious about how students might have expressed what it might mean to act and deliberate as a leader without stepping up and speaking in front of an assembled group—as leadership is traditionally understood. Put another way, how do leaders deliberate with a disassembled and dispersed audience in different locations? As with the first suggestion in the opening of this section, we contend that recasting leadership in this way for engineers will draw attention to the processes of ethical decision-making—which is as important as the outcome itself.

A Possible Future for Participatory Ethical Decision-Making in International Engineering

TEG was designed to motivate students to work together, allow leaders to emerge, and give students the opportunity to figure out how to cooperate in the absence of an enforcement mechanism. Though the game was limited by its academic nature in that the students were never able to let go of their concern for their grades, the game was valuable for the manner in which it positioned students in explicitly social settings that required both coordination of decision processes and effective deliberative skills to ensure group success at an international level.

While this example of TEG did not foster the type of cross-cultural collaboration that we hoped for, the students' work was revealing to us in the way it suggested how the students would likely have benefited from additional rhetorical and/or communication training prior to playing the game. Though the call for rhetoric in engineering education is not new, the outcomes of our partnership's TEG game suggest we ought to be more explicit in helping students learn how to recognize and draw from the available means for persuading others to action. Such an ability will be required if we want our engineering students to act as leaders in addressing the wicked environmental problems of the world in international contexts. ■

Notes

[1] Greenberg, Greenberg, and Antonucci (2007) argue for the need to encourage more social conversation rather than task-related communication to foster trust in virtual teams. In TEG, there was an absence of social conversation between the U.S and Indian students.

[2] Drawing from Wilson, Straus, and McEvily's (2006) discussion of trust, we attribute the ease of intraclass communication to the availability of social information between the U.S. students.

[3] To support this claim, we draw from McNair, Paretti, and Davitt's (2010) suggestion that "classroom instruction and assignments directed toward building relationships quickly in virtual settings . . . have the potential to increase the degree of knowledge sharing between students" (245).

[4] Examples of interactions such as these represent the kind of early interaction recommended by Coppola, Hiltz, and Rotter (2004) to foster the development of swift trust.

[5] McNair, Paretti, and Davitt (2010) comment on the necessity of talk and discourse as foundational for building relationships in virtual teams (p. 244). In TEG, talk was limited between the U.S. students after the optimization formula was developed as there was no felt need to develop relationships for the game. Math was enough. Future TEG game play ought to encourage more talk between players so as to facilitate trust and relationship building. Following Coppola, Hiltz, and Rotter (2004) and Jarvenpaa, Shaw, and Staples (2004), the encouragement of talk ought to occur as soon as the game begins.

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COMMUNICATION AND CULTURAL IMPLICATIONS OF SHORT-TERM STUDY-ABROAD EXPERIENCES ON ENGINEERING STUDENTS

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Study abroad is an important international learning component to add to students' university experience. As programs of study become more rigorous and detailed, it is difficult for students to incorporate study abroad into their schedules, especially those in engineering programs. Short-term study abroad provides engineering students with an opportunity to view engineering on a global scale and to gain cultural awareness. This research study examines the cultural adjustment, communication issues, and experiential learning of a group of engineering students who studied abroad in Germany during their winter break.

Keywords. Cultural adjustment, Engineering students, Experiential learning, Short-term study abroad.
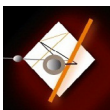
For years, students attending institutions of higher education have studied abroad. During the 2010–2011 academic year, approximately 273,000 American students studied overseas (Institute of International Education, 2012). As programs of study become more rigorous and detailed and outline specific courses for each semester, it is difficult for students to incorporate long-term study abroad into schedules, especially students in engineering programs. As a result, short-term study-abroad opportunities increased tremendously over the past decade. Study-abroad programs are typically faculty-led, take place during winter, spring, or summer breaks (Guyer, 2011), and allow students to incorporate an international learning component during their university experience. Study abroad provides students with a chance to discover new cultures and environments (Drexler & Campbell, 2011) and to reflect on their own culture's shortcomings (Miller, 1993). A chance to travel to another country to see how engineering is used in another culture is an eye-opening experience for students. Global corporations seek culturally aware individuals (Henthorne, Miller, & Hudson, 2001), which encourages this transformative international experience for engineering students.

Engineering students have predesigned programs with specific course requirements each semester. Short-term study abroad offers students an overseas opportunity they may not otherwise experience without falling behind in the degree program (Donnelly-Smith, 2009). Future engineers must learn to adapt to global changes and trends and assist developing and developed countries (National Academy of Engineering, 2004). They are globally competent with both global teamwork and global sustainability skills (Baker & Ağar, 2011). Short-term study abroad is valuable for students to develop critical thinking skills (Shupe, 2013) and to analyze current issues in engineering. Baker and Ağar (2011) stated that engineers face global

challenges they need to solve including energy security, pollution, access to clean water, poverty, resource depletion and climate change. Overseas experiences educate current engineering students with new ideas to enable a solution to these global challenges.

González, Rodríguez, Olmos, Borham, and García (2013) emphasized the need for research studies on the impact of education changes on engineering students. Students earn academic credit through study abroad and benefit in significant ways (Salisbury, Paulsen, & Pascarella, 2010). An overseas experience expands students' perspectives by removing them from established networks and routines, and placing them into new situations (Haines, 2013). It is imperative to reflect on the study-abroad experiences of engineering students to determine the impact on their future career. Few studies analyze the outcomes of short-term study abroad with engineering students. This study specifically looks at the cultural adjustment, communication implications, and experiential learning of engineering undergraduate students studying abroad in Germany during their winter break in 2012.

Review of Literature

Short-term study abroad leaves lasting educational effects on students (Ritz, 2011). To learn to communicate with others that come from different cultures is an invaluable skill for any college graduate (Waco, 2008). Future engineers are no different. As students, it is essential to prepare themselves for work in a dynamic intercultural workplace and to possess the communication skills and cultural awareness to be successful engineers. It is important to explore the impact of study abroad on engineering students in order to help faculty design programs that foster global engagement and experiential

learning. Additionally, these transformative experiences provide educators with opportunities to link class concepts with real world application (Ritz, 2011). Intercultural communication skills are beneficial to the engineering profession. Studying the development of such skills through study abroad offers insight on future possibilities for institutes of higher education.

Short-Term Study Abroad

Short-term study-abroad programs are typically eight weeks or less, and are the most common type of program for students to study abroad (Donnelly-Smith, 2009). Short-term study-abroad programs generally delve into a specific subject at the host location such as culture, history, language, or environment (Guyer, 2011). Other study-abroad programs enhance skills related to specific majors on a global level such as nursing, business, or engineering. Through a sojourn abroad, students develop intercultural and social skills that are oftentimes used both overseas and back at home. Short-term study-abroad programs are usually structured to accommodate the specific needs of a degree program, to enhance language skills, and to promote individual growth.

Students obtain a number of life changing skills as a result of study abroad. Shupe (2013) observed the development of critical thinking skills by students while studying abroad. Students adapt to new situations, interact with native people, navigate new transportation systems, and undergo an intercultural transformation (Gardner, Steglitz, & Gross, 2009). In addition, Clarke, Flaherty, Wright, and McMillen (2009) found that students studying abroad possessed increased openness to cultural diversity and greater intercultural proficiency. One of the goals of study abroad is for students to transform into global citizens (Doerr, 2013). As a result of each of the

encounters and explorations overseas, students start to evolve into global citizens. The skills students acquire while abroad are invaluable to their success back home not only academically, but for their future careers as well.

Students who study abroad can easily transfer their overseas experience on the job. Employers believe that study abroad enhances many of the skills employees need to possess to be successful on the job (Gardner, Steglitz, & Gross, 2009). The workplace seeks students who possess global competencies and understand cultural differences. Short-term study-abroad participation helps students achieve these skills to become more marketable upon graduation. Critical reflection helps students articulate their overseas experience to meet the needs of a company during an interview. Structured journals provide ongoing reflection for students during and after the study-abroad program (Donnelly-Smith, 2009). Students use their journals to reflect on their experiences and translate them into valuable examples for employers. Additionally, they transfer skills learned abroad to market themselves upon completion of their program of study. When students reframe their experiential learning, it demonstrates their global competencies and marketable skills to employers. For the engineering profession, the overseas experience enhances students' résumés and furnishes them with encounters to reflect on as they work to resolve global engineering issues.

Experiential Learning

Experiential learning is part of the overall study-abroad experience. This term has been coined in education to signify that experience with reflection is learning (Dewey, 1938). Fowler (2008) stated that the outcomes of experiential learning can span from gaining a new skill to personal growth. Glaze (1999) stated that observing in the field stimulates wanting to know

more. From a study-abroad perspective, experiential learning is defined as a reflection on one's own experience overseas that generates a path of discovery and personal growth no classroom can provide. Experiential learning can take place in many forms, but this definition is used for the current study.

Part of experiential learning in study abroad is adjusting to a new culture. Prior to departure, intercultural proficiency is difficult to teach in a classroom since students aren't necessarily exposed to other cultures in that setting to prepare them for when they graduate (Munoz, Wood, & Cherrier, 2006). There is added value to learning when expanded beyond the traditional classroom walls, in an international setting (Clarke et al., 2009). Fowler (2008) found that reflection on experiential learning became more significant to overall learning itself when used in nursing education. Johns and Thomspon (2010) conducted research with nursing students who studied in Guatemala and found their worldviews had changed as a result of study abroad. Glaze (1999) stated that "there is more to learn in the field than is ever incorporated into an in-class lesson plan" (p. 442). Short-term study-abroad programs allow students to actively engage in experiential learning every day. When students apply classroom readings and discussion to real-world experiences, they make connections in the learning process. In a study-abroad setting, students oftentimes use a foreign language, eat different foods, and engage in activities they might never try back at home. These experiences make a strong impact on their personal development, and are the core of experiential learning.

Study-abroad programs offer one of the best ways for students to engage in experiential learning. Only 2% of American students at the college level study abroad each year (Institute of International Education, 2012). The globalization process today makes it imperative that more students

study abroad. Experiential learning through study abroad gives students an opportunity to hone their intercultural communication skills and expose themselves to a new environment.

Study Abroad and Engineering Programs

Specialized programs should be offered at universities to meet the growing needs of the economy and employers, and to generate more experiential learning. Curricular demands are arduous in many degree programs, and do not allow students a semester away (Guyer, 2011). As a result, short-term study-abroad programs are structured opportunities for students to engage in experiential learning while meeting degree requirements (Donnelly-Smith, 2009). In degree programs such as engineering, nursing, and business, students fall behind if gone for a semester. Nursing students, for example, benefit from study abroad with increased intercultural awareness, ability to adapt to unfamiliar cultures, and increased personal growth (Edmonds, 2010). Engineering companies seek graduates with the ability to adapt to a multicultural environment (Haddad, 1997).

As the world moves toward a "more sustainable energy economy" (Baker & Ağar, 2011, p. 3724), it is essential that engineering students build their global competencies through experiential learning abroad. Short-term study abroad offers engineering students an opportunity to hone in on their engineering skills while applying them at a global level. Witnessing engineering from a new perspective abroad can invigorate students to improve their own engineering competencies and skills, and to apply them in a larger scale, whether at home or abroad.

Short-term study abroad has lasting effects on students across all disciplines. This experiential learning process gives students a chance of a

lifetime to actively engage in a new environment, and to explore the world around them with curiosity. Several studies have investigated intercultural competencies and cultural awareness as a result of study abroad, and more specifically in long-term programs. As short-term study abroad has increased in popularity over the past decade, it is imperative to analyze how students experience cultural adjustment and transition in this short period of time overseas. In particular, it is important to determine if engineering students gain communication and cultural skills as a result of participation in short-term study-abroad programs.

To date, few published studies use qualitative methods to evaluate the outcomes of students' experiences in short-term study-abroad programs. Students' narratives provide specific examples of cultural adjustment and transition during their time overseas. Cultural adjustment can be reflected in narratives from students who discuss their experiential learning process. This research study specifically focused on engineering students who participated on a three-week winter program in Germany. The following research question was the basis for conducting the study:

> **RQ**: How do engineering students experience cultural adjustment through a short-term study-abroad program?

Methods

The International Winter University (IWU) in Kassel, Germany, offers a short-term study-abroad program during winter break with a focus on culture or engineering, lasting approximately 25 days. Students who attended this program took structured German lessons together in the morning, and culture or engineering classes in the afternoon. This study analyzes the experiences

of those in the engineering track only. Some engineering classes were off-site excursions to places including a wind park, SMA—a company—and a bioenergy plant to see renewable energies in action. The engineering courses and excursions were led by experts from Germany and included topics such as climate change, wind energy, geothermal technology, hydro power, low energy housing, solar thermal technology, and photovoltaics. In addition to the German and engineering courses, students also participated in optional cultural exchange activities held in the evenings after class. These included German folk dancing, German cooking, international movies, and day trips to Frankfurt and Marburg on Saturdays.

An academic advisor from the College of Engineering and Applied Science at the home institution led the group for the first 10 days of the program until a transition was made to Kassel from Berlin—all but two students paid an additional cost to participate in a guided tour in Berlin prior to the program; the two students who did not pay the additional cost to participate in the tour went to Berlin on their own. Grades were administered by a faculty member at the home institution when the students returned, based on a combination of their final exam scores in Germany, journal entries, and a final presentation in the US regarding their experience in the program.

Participants

Thirteen students participated in the study-abroad program at International Winter University in Kassel, Germany, during the winter break of 2012 as well as this research study. All of the participants were American students with an engineering or computer science major who attended the same midsized Midwestern university. The students ranged from 20 to 28 years

old, three were female and 10 were male, and none of them studied abroad previously. Students spanned from sophomores to fifth year seniors in their program of study. All students stayed with host families for the majority of the time in Germany, with the exception of the optional Berlin program for three days prior to the academic portion of the study-abroad program. Five of the students did not have a roommate with their host family, and eight had either an American university student or another foreign student as a roommate.

Data Collection

Prior to departing for Germany, students had predeparture orientations with the group leader and the study-abroad office. During this time, the researcher was present to explain the project and to seek their permission to participate in the study. Participation in the study was voluntary, although writing in their journal was worth 25% of their overall grade for the program. All students signed the Institutional Review Board (IRB) approved informed consent forms and agreed to participate. Data was collected through structured journals, narrative interviews with individuals and small groups, and participant observation during the first ten days of the program.

Journals were a required part of the program, and asked specific questions for students to respond to regarding their host family experience, observations about the host culture, interactions with other students, challenges and surprises in the host culture, how free time was spent, how the study-abroad experience enhanced their engineering skills, communication issues, and culture shock (e.g., Why did you decide to study abroad? Describe your first interactions with your host family. What has been the most challenging to adjust to while studying abroad so far? How has your

study-abroad experience enhanced your engineering skills?). Given the short time abroad, a total of 10 entries were required starting from predeparture to returning to the US. Each entry had a minimum requirement of 200 words, but allowed for students to elaborate on anything they deemed important to express about their study-abroad experience. All journals were formatted the same prior to conducting data analysis. Pseudonyms were used to report the results to maintain the confidentiality of the participants.

Following the end of the program when students returned to the US, the researcher conducted narrative interviews with all students within one month of reentry. Participants were interviewed individually, in pairs, or in one group of three to accommodate their schedules and availability. A private interview room in the College of Engineering and Applied Science and a vacant classroom provided the backdrop for the interviews. Twenty-one open-ended questions solicited narratives about the students' study-abroad experience (e.g., What was the biggest surprise that you experienced or observed while studying abroad in Germany? Give me an example of a cultural misunderstanding you experienced while studying abroad in Germany. How did you see yourself change as a result of studying abroad? Describe your experience living with a host family.). Several questions probed for an elaboration of the questions they answered in their journals. A total of eight interviews were transcribed by the researcher including four individual interviews, three interviews with two participants, and one interview with a small group of three students. All 13 study-abroad students participated in the interviews as well as submitted journals for this research project.

Additionally, the researcher attended the first 10 days of the program while the group leader was in Germany and took notes about the interactions with students and observations on their behavior each day. Each night the

researcher typed up the notes and elaborated on the observations made during the day. These notes were used to support themes that evolved in both the journals and interviews.

Data Analysis

Data triangulation was used to review multiple perspectives in order to establish credibility using qualitative research (Pitts, 2009; Schwandt, 1997). The researcher read and reread the journals, interview transcriptions, and ethnographic notes to analyze the data for themes. Responses generated a wide range of words used to describe the same phenomena. To analyze the data from the transcripts more deeply, the researcher listed descriptive words and phrases used to answer each journal entry and narrative response and clustered for themes (Edmonds, 2010). Some questions from the journals overlapped with questions during the interview. Longer, more descriptive narratives were provided in the interviews that supplemented the responses from the journals. These responses were combined together as similarities surfaced in the transcripts.

Data analyzed from students' journals, narratives from postprogram interviews and observation field notes demonstrated several predominant categories related to personal adjustment, communication issues, and experiential learning. Themes appeared for each category that are discussed in the following section. Analysis of data revealed one dominant concept that crosses all three themes—friendship—which played a critical part in responses.

Results

Study-abroad programs promote intercultural, social, and language skills (Doyle et al., 2010). In a short-term program designed to foster global exchange in engineering ideas, there is the hope that students also gain skills in engineering as well. The data from this research study found three categories of themes, with sub-categories for each. This section will explore what engineering students shared about their experience on a short-term study-abroad program to Germany in both their journals and through narrative interviews. The three categories discussed include barriers faced, strategies used for adaptation, and learning outcomes.

Barriers Faced by Students

Participants observed a number of differences between U.S. and German culture that related to time and language. The program structure was rigorous and full of activities, which allowed for limited free time for students to engage in additional endeavors and adventures. Students made many comments on the extensive agenda that left them with little time on their own. In addition, many journal entries and comments during the interviews focused on the students' lack of communication skills while in Germany. In particular, students expressed their frustration about the absence of German skills to use in public and host-family members who did not speak enough English while at home. In addition, communication issues arose with fellow classmates from Australia when speaking English. Australians used idiomatic expressions not known by the U.S. students, and caused a number of "funny" situations in conversation. The following sections explain how both time and language caused barriers to their cultural adjustment in their study-abroad program.

Time. The interpretation of time was a dominant theme among all students while studying abroad. The concept of time, how they spent time, the lack of free time, and being on time were among this theme. Each student shared different stories about how time impacted their experience abroad and affected day-to-day events. This barrier students did not necessarily allow students to fully immerse themselves in the culture as they had imagined. Given the time constraints of the full schedule, students had little time to participate in other activities in the community or to explore on their own.

Students interpreted the concept of time differently as the days progressed during their sojourn. Time passed slowly the first several days, and began to pass quickly towards the end. As students adjusted to the schedule and to their host families, time went by faster, and many students noted this change in their journal entries. To this affect, Aaron commented:

> We are now half way through the second week. Just earlier in the week I was thinking about how it feels as if we have been here so long already, and now it seems just the opposite. We have to leave in just 10 days and now it seems like we haven't been here long enough.

Students indicated they spent their time together as a group for most of the program. Class started in the morning and ended in the early evening each day. They ate together, rode the tram together, and participated in excursions and field trips as a group. The little free time they had they went shopping, ate dinner, or explored the city—usually late at night. Andrea explained:

> I have been spending the majority of my time walking around downtown and checking out stores and things around City Point. I have typically been hanging around with most of the people from the (university's) group.

In contrast, Jill reflected on how she spent time and noted that she wished she had spent some time on her own to take in more of her surroundings. She indicated this would give her time to think away from the group so she could better process the experience. Jill never said that time spent with the group was not good, but that, had she spent more time alone in the city, her experience would have been different.

Participants also noted the lack of free time during their program. The structure of the schedule contained so many activities that they felt they did not have time to study or do much outside of the program schedule. Students received eight hours of instruction each day with scheduled breaks and lunch, and concluded at 5 p.m. each night. Extracurricular activities included in the cost of the program were available to attend frequently, and students felt obligated to take advantage of these opportunities, especially since they had paid for this part of the program. Robert commented at the end of the second week in Germany that:

> The free time between classes are still really non-existent. We get done with class around 5, then I go home and eat with my family. After dinner I can either go back the 30 minutes to the town or stay and chat with my family.

Andrea noted "The IWU program is so packed full of social events to fill the little time we have after class that I am not home very much at all." And Jessie added that there is no time to relax because "We are always on the go." This time barrier to integration into the German culture prevented many students from actively engaging in more outside events on their own, or spending more time with their host families.

Additionally, many students lived at least 30 minutes away from school via public transportation. If they missed the tram, they had to wait another

30 minutes for the next one. The trams ran less frequently in the evenings so students had to make choices on whether to go home and spend time with their host families, or stay close to school to explore and talk with friends. Each student had different host-family experiences that helped make their decisions on how to spend their free time. If they had a host family they enjoyed or who spoke English well, many students chose to spend more free time with their host family. Those who did not have a closer connection with their host family chose to spend time in the city to hang out with fellow classmates after classes. Overall, the majority of the time issues pertained to the program structure itself and its intensity of scheduled events. Despite other challenges during their short-term study-abroad program, students most often explicitly expressed frustration with the time barrier.

Language. Language was the other predominant barrier that students faced during their overseas experience. Three of the study-abroad participants studied German previously in high school, which proved helpful in their daily communication. The remaining students emphasized how much fun they had in German class, but did not use their German skills a lot outside of the classroom. They used their language skills to order food and beer, and to make purchases at stores. While some students felt they lacked language skills to get by, others began to feel confident after a short period of time. This was exemplified by Scott:

> My German skills are developing pretty well. I am able to understand a great deal of what my host family is saying while they talk to me in German but I am still having trouble trying to formulate sentences while talking to Germans. Most of my high school German knowledge has come back and

I'm fairly confident in my ability to ask how much an item is and being able to order drinks.

Scott rekindled his German skills through class and felt he could use them with native speakers. He was not afraid to try to use what little he knew, and had a positive time adapting to the new language.

Greg and Chris individually shared a story they experienced that described when they realized their lack of German language proficiency. The language barrier prevented them from getting the food they anticipated as they tried to order in German. They went to get dinner after class with limited time to eat, and found a food stand that featured pictures of food with numbers. Greg explained:

I tried to order in German and I must have been horrible because we got the wrong food . . . And it was vegetarian food . . . but we had a good laugh about it later, and still today.

Greg also described how he pointed to the sign and assumed the vendor understood what he was asking for. Chris also seemed perplexed by the situation when he told his version of the story. He thought he knew his numbers and it later appeared he did not know how to order in German after all. This illustrated the frustration students experienced when their German language skills did not develop as well as they had hoped. Dave also vented his frustration regarding his language skills. He shared:

I think I'm burning out in my German language class. For the first week I was really pumped to learn German. I thought that it would progress faster than it has, and that I would be able to use it more with my host family. Unfortunately that has not been the case for me. Realizing now that I set

my goals a bit too high for my German-speaking proficiency, I feel less motivation to learn than I did previously . . . It's still cool to be able to speak a small amount.

The language frustration occurred with many of the students who had never studied a foreign language previously. This may have had an effect on their learning process. Renewable energies—engineering—was the main reason to study abroad on the program. German classes assisted with basic communication skills for some, but not for others. This may be in part due to their general lack of interest in learning the language. This barrier hindered some students from wanting to speak with natives in German. Other students compared their experience in German class to their high school Spanish classes. A few indicated they started to take notes like they had in Spanish class so that it was more useful to them. In some cases, if a teacher used real-life situations for the lesson, students paid more attention. Jessie commented:

> The first couple of classes I have taken in German are very fast paced . . . [The teacher] has done a good job of answering all of our many questions we have for him. He is gave us the two main verbs, to be and to have, which I thought was really helpful since we do use those two verbs all the time while also giving us more things that we would need to say to cashiers and vendors. I am trying to structure my notes like I did when I took Spanish in high school with the verbs that I learn which is helping me out a bit.

The few students who had previous language classes applied this skill to German classes. This demonstrates how some students had an easier time communicating than others. A few students struggled with their language skills, and others tried to use these skills in public with restaurants, bars, and

shops when they could. Students had a limited vocabulary and struggled in many situations, but embraced the short period of time in Germany and made the most of their novice communication skills. Despite the language barriers, students found ways to communicate their needs by helping each other when necessary.

Finally, several students discussed their communication with fellow students in the IWU program in Germany. Students from various parts of the world also attended the German and engineering classes. Many participants commented on how speaking to native English speakers from Australia had a host of unexpected communication and language issues. For example, Jill explained that one of the Australians told her that she "forgot her jumper in the classroom" and Jill had no idea what the Australian student was talking about. She later learned that "jumper" meant "hoodie" in American terms. This generated regular exchanges of American and Australian terminology that required interpretation and led to laughter in many cases. Students found it shocking that although they all spoke English, they still were unable to understand each other at times. This illustrated how students overcame communication difficulties to build relationships with others in the program and built a new "foreign" vocabulary base in their own language to break down this barrier.

Strategies Used for Adaptation

Students employed a number of strategies to successfully navigate the barriers and challenges throughout their short-term study-abroad program. Despite their struggles with time and language, they learned to adapt to the new culture through their daily routines, adhering to local norms, and forging relationships with their host families and each other. Even though

the program was just over three weeks in length, each student found his or her own way to adjust to the experience abroad.

Routines. Overall, students expressed how daily routines affected their study-abroad program experience. Acculturation—or cultural adjustment—is defined as the ability to physically and mentally adapt to a new environment until feeling comfortable enough to operate "normally" again (Berry, Kim, Minde, & Mok, 1987; Ward, Okura, Kennedy, & Kojima, 1998). Cultural adjustment takes many forms, including adjusting to a new schedule. Participants on the study-abroad program experienced cultural adjustment through their adaptation to time and routines. Their interactions with their host family, instructors, and other German natives they met also influenced part of this adjustment process. The arduous schedule each day left students tired, but excited to see one another and to explore with the little free time they had at the end of the day.

Students attended regularly scheduled classes for the duration of their short-term study-abroad program. German classes took place in the morning, and engineering courses and lectures took place in the afternoon. In addition, excursions and extracurricular activities were a part of the program's offerings. Every Saturday an excursion via train brought students to a nearby city, and several nights of the week students participated in cultural activities including German dancing, German cooking, intercultural exchanges, movie nights, and a hockey game. Chris reflected on this routine and stated he would miss "having a set schedule" even though they did not get enough sleep. Kevin echoed the latter part of this and stated "the thing that has been the hardest to adjust to is the lack of sleep." Students commented that they slept much less than they would have liked or needed,

but it became part of their routine while in Germany. Their schedules were "so busy" that they adjusted to this routine, because they realized it was just a short-term adjustment while abroad. Students utilized a routine to overcome the time barrier. Despite being "jam-packed" every day, they embraced the opportunity to try something new if it was available and were involved in almost every activity offered through the IWU program itself.

Adhering to local norms. One of the local norms emphasized by students was punctuality. Arriving on time to classes, public transportation, and excursions was stressed to students during the program, and they noted this in both their journal entries and during the interviews. A few students elaborated on a discussion with the German team that organized the classes. These German natives explained how punctuality is important, and the students respected this for the duration of the program. This strategy to adapt relates back to the barrier of time as students found ways to maximize their time on the program by adhering to the local norm of punctuality.

Although punctuality was emphasized during the program, students also learned that "getting a quick bite to eat" was not possible. Many students expressed their frustration with the long wait for dinner if they went out to eat as a group. It would take up to three or more hours to order, eat, and pay the bill at local establishments. However, as time went on, students also noted in their journals that going out in a large group could affect this long wait, and that they started to observe their host families sitting together for long periods of time at home as well when eating dinner. They realized that this local norm of enjoying dinner together was something they could be a part of, whether with friends out in the community or at home with their host families.

Host families. Students expressed good and bad experiences with their host families. Those students who expressed that they did not like their host family typically had difficulty communicating with them in German or English. Students who had a positive experience conveyed that their host families would commend their German skills and teach them additional phrases. Tom exemplifies the latter as he reflected on his experience using German:

> Taking my beginning German class has really helped me around the house at my host family. Even though my family speaks English really well, it is still fun to try and talk with them in their natural language. I figured they are making a big sacrifice; we should at least try as well. I am sure others have benefitted even more if their host families don't speak much English.

This participant had a positive experience with his host family, and realized their contribution to his study-abroad experience. He gave his best effort to use his German language skills, even if his host family spoke English. This demonstrates how a short-term study-abroad experience helps students adapt their behavior to receive more from the sojourn, and this strategy helped him build a better relationship with his host family.

Kevin also engaged in regular use of German with his host family. He echoes the positive experience that Tom had:

> My German language has been coming along pretty good. I am able to formulate small sentences and basic sentences, which helps me order food and talk to the children at home . . . The only places I really use German are at home, trying to speak with my host parents and their children, and at restaurants, while ordering or paying . . . The most exciting place that I used German was at the hockey game last Friday night where my host dad told me some phrases to shout.

Host parents helped students learn phrases that applied to the conversations they had, the situations they were in, or that helped in common scenarios. This influenced how students felt about their language abilities and how they either continued or discontinued developing their language skills. Since host families were a part of the study-abroad experience, some students spent more time with their family than others. They utilized the little free time they had to learn more about Germany through spending their evenings and weekend time with the families. In the end, this helped a number of students adapt to some of the barriers they encountered while abroad.

Friendship. During short-term study-abroad programs, students often rely on their peers to adjust to the new culture (Edmonds, 2011). They go through similar experiences together and this causes a strong "bond." In Germany, it was no different for the engineering students. They used the terms "life-long friends" and "it feels like we were a family" to describe their time together. Students enjoyed the excursions and extracurricular activities organized by the program so they could talk with other students to get to know them better. Participants explained they did not know one another before studying abroad, but had met a few people in their classes in the US. Their initial fear of not having a good time was eliminated just days into the program. By far, friendship was the strongest strategy to help the students adapt overseas. Tom explained his thoughts on forming friendships abroad:

> Meeting other students from other parts of the world has been great and really fascinating. I have made many friends. They all seem very open to talk with and become friends with easily. I was pretty happy that there are not people that I have to physically work at to be friends with or try to talk with. I was afraid that there might have been some awkwardness with

someone. There is always that one person. But I am happy to say that here in Kassel, I have not met that one person yet.

Other students reiterated Tom's feelings, stating that they felt as if they had "known each other forever," and made plans to reunite during spring break. Students anticipated there would be an "outcast" in the group, but no one fell into this category. Their friendship deepened throughout each excursion, class, and outing they had together. Jessie displayed his excitement about his peers when he returned home:

> Having all these people to share the same experience with me in this program has definitely helped with not being too overwhelmed with everything around me. That's the biggest thing that I feel I took (home) with me, is the friendships I developed with the other students and even the IWU staff.

Students further reflected on their new "friends for life" back at home and indicated they easily maintained contact with these new friends through the Internet. The bonding experience abroad made every adventure memorable and reinforced their desire to work on a more global scale in engineering. Friendship helped all students get through the time and language barriers with ease.

Learning Outcomes

Finally, experiential learning evolved out of the excursions, lectures, and host families. Students compared learning engineering in the US to Germany. They felt that instruction in Germany was similar to the way they already learned back home, but enjoyed experts as lecturers about renewable energies—the

focus of the study-abroad program. Participants made observations about the way their host families live—including composting, closing doors to conserve energy, and using solar panels on their homes—the way the entire German community recycles, and how further ahead in engineering the country is in general. Additionally, some students commented on how it was easier to go to class in Germany and understand their English than to listen to international student teaching assistants (TAs) back at their home institution. Overall, through experiential learning, they gained a deeper understanding of the application of their engineering skills.

Real-world application. As engineers, students analyzed their day-to-day activities and classroom experiences. They observed closely and commented on the way Germans pay a deposit on their bottles and recycle regularly. Participants were shocked not to see litter anywhere, and compared this to their hometown where that is not the case. Students also discussed how the excursions and lectures inspired them individually, in regards to their area of expertise in engineering. Their enthusiasm to use what they learned grew throughout the program. Becky discussed her feelings of the program when she returned home:

> My overall thoughts of the IWU program are good. I feel this experience really helped me gain more knowledge on renewable engineering and was a great experience overall. I would definitely recommend this program to anyone. I feel this helps students see how different slash similar other countries or universities apply their engineering knowledge. I saw how in Germany they support renewable energy and how it has impacted their culture in many ways. When someone is done with a bottle, beer bottle, coke bottle, etc., they return the bottle back to the store or bar they bought

it at and get a refund on it. That way they know that people are recycling. I feel this is a start going "green" in the US, and that people should put that into consideration.

This participant looked at the entire study-abroad program and felt that she learned how renewable energies impact everyone each day. Her first-hand experience showed her how she is able to improve the world and culturally interact with others.

Other students reflected on how witnessing renewable energies in action from the excursions and experts in Germany versus from a theoretical perspective taught by the international TAs in the US was incredible because it showed them the power of renewable energies. They compared learning in the US from international TAs who only spoke from theory to how the excursions and experts in Germany showed them the power of renewable energies. Kevin explained what he learned as a result of participating on the program:

> Hearing from experts on multiple different renewable technologies was an awesome experience, because they are people that really care about what they are doing and are trying to advance the awareness and technology of their topic. The excursion to the biogas plant, the wind farm, SMA visit, and the silver mine were also great experiences where I was able to actually see these renewable energies at work and learn of them in not only a theoretical setting, but in a practical way was very beneficial . . . It seems to me the people in Germany are much more aware of how doing their part helps the overall good of the country. It seemed like recycling was bigger in Germany than in the US, and people actually did it. Also, even in Berlin there wasn't ever very much litter on the ground. Most places seemed cleaner than the US

For many students like Kevin, renewable energies was a topic they wanted to learn more about before participating in the study-abroad program. The experience overseas afforded them an opportunity to observe renewable energies in action and revealed how these energies make a more sustainable environment to live in. Several students observed how their host family kept doors closed to conserve energy. They misinterpreted this as the family not wanting to talk with them, but later learned this is how they cut their heating costs at home. Students found many homes with solar panels to help control the cost of energy as well.

The study-abroad experience enhanced their engineering skills and harnessed new ideas for their careers. Students gained skills not achievable in the traditional classroom. All of these observations made by students embody the true meaning of experiential learning through study abroad.

Discussion

This study examined how university students in an engineering program experienced cultural adjustment through a short-term study-abroad program. The results demonstrate that students gained engineering skills through experiential learning. Students also faced barriers, including time and language barriers, during their time abroad. To combat these barriers, strategies for adapting to the new culture also emerged that include embracing daily routines, adopting to local norms, and forging relationships with host families and each other. Adapting to a new culture is part of the study-abroad experience, even in short-term programs. It is imperative that researchers continue to study how short-term study abroad affects engineering students.

Implications

There are important implications from the findings that affect engineering education. Faculty and staff in engineering programs are challenged to provide a curriculum to students that empower them with the skills needed to step into their engineering career. Students also require cultural competence to enter the global workplace today (Gardner, Steglitz, & Gross, 2009). The use of short-term study abroad has an extraordinary impact on how future engineers build their foundation of knowledge. It is imperative to study engineering students' experiences abroad to develop appropriate curricula and opportunities overseas that cannot be experienced in the traditional classroom. This study used qualitative research that may not be generalized to all engineering students. However, the predominant themes suggest that short-term study abroad fosters global competencies and new communication skills for engineers, as well as the importance short-term study abroad plays in students' education.

Engineering educators use theories to instruct in the classroom. When real-world application can be applied, it changes how students view the skills they gain. Participants on this short-term study-abroad program focused more on the applicability of engineering projects to their area of expertise. Experts in the field lectured and showed examples of engineering work, and students connected this to theories learned from their home institution. They viewed engineering through a new lens and witnessed it on a global level. This research suggests that experiential learning can improve engineering students' understanding of concepts and ideas and expose them to global challenges first hand. An overseas experience enhances their education at home, and generates new ideas students can explore once they return.

In addition, administrators are able to benefit from the results of short-term study-abroad research. It is important to balance the program activities, classroom time, and special events so that students have enough time on their own to explore the host location and interact with locals. Exposure to the host culture allows students to integrate with people they may not otherwise meet, practice their novice language skills, and learn about the new culture at their own pace. Affording enough time with host families is also important for successful cultural adjustment. Students may not always have the best host family, but it does provide valuable opportunities for students to practice their language skills and to interact with locals who are usually friendly and willing to help foreigners.

Even with a demanding schedule, administrators must provide a routine for students to adapt to while studying abroad. In a short-term study-abroad program, there is a lot of material to cover in a short period of time. With an organized schedule, students know where to be when, and can develop a routine that is easy to adhere to, as seen with the engineering students in Germany. The daily routine helped students adapt to the local culture by providing a framework for their interactions each day. This was highly beneficial in this research study, and could be helpful to future study-abroad programs as well.

One implication faculty and administrators must consider with short-term study-abroad programs that are not focused on language acquisition is to prepare students for potential communication barriers. As students indicated, they used their novice German language skills with the staff at the university, ordering in restaurants, and with their host families. With little to no language skills, students aren't able to hold an in depth conversation or ask questions they may have at a restaurant or store. It is essential to prepare

students in advance of the study-abroad program for a possible language barrier, and how to cope with this barrier when overseas. A short course in basic communication skills prior to departure, or a printed "cheat sheet" of commonly used phrases can reassure students they can get around even when they aren't fluent in the host language. Furthermore, selecting host families that have some English language skills can help ease the transition for students once they arrive. A number of students benefited from conversations with their host families, and learned about the local culture, food, and phrases. In some cases, students unexpectedly learned about renewable energies from the way their host families lived. Host families are an asset in helping students adapt as they provide informal learning opportunities outside of the classroom.

Finally, an important implication to short-term study abroad is the relationship building that takes place overseas. Social interactions with peers help study-abroad students adapt and bond with one another, as Edmonds (2011) suggested. When students go through the same experience together, there is a transformative learning experience that takes place as they connect and relate, especially in a foreign environment. Part of the interpersonal growth study abroad students experience is in part due to the social interactions of the program, and the informal bonding outside of their classroom overseas that can't be replicated in the home environment.

As engineers face global challenges (Baker & Ağar, 2011), they must possess communication and critical thinking skills to solve these ongoing crises. Participants experienced a number of challenges and barriers when studying abroad that have provided useful implications for future short-term study-abroad programs. It is imperative that administrators and faculty utilize this in designing and implementing short-term study-abroad

opportunities for engineering students. Overall, students embraced the challenges and barriers they faced by developing adaptation strategies and believed they gained invaluable skills as a result of studying abroad.

Limitations and Future Research

This study offered a new perspective from engineering students through qualitative research, though it possessed limitations. First, the sample size was small and only examines one engineering short-term study-abroad program. Future studies need to examine larger sample sizes, or multiple short-term study-abroad programs to compare results. Additionally, triangulation of data, including journals and narrative interviews, produced a number of themes in students' adjustment process. This data came from one mid-sized Midwestern university and cannot be generalized across all populations. Further studies should include both quantitative and qualitative methods to determine themes not possible in qualitative research alone. Students also received prompts and questions to write about in their journals to help stimulate the process of reflection regarding their study-abroad experience. Future studies may ask students to write freely on their own in hopes they share stories about their study-abroad experience that are not covered in the specific questions. Finally, students provided stories through narrative interviews. Due to their schedules, some were conducted individually, in pairs, and in one group of three students. Telling their stories with additional students present may have influenced the responses of some students or changed how they answered the questions. In the future, individual interviews can eliminate the same response from students and potentially develop different themes.

Short-term study abroad has significant effects on global learning. Intercultural communication skills are invaluable to all college students (Waco, 2008). It is important to study the impact of study abroad on engineering students in order for them to become globally competent in their field. Discovering new ways to integrate engineering on a global scale helps students stand out from their classmates. Study abroad enriches the traditional classroom experience and connects students to real-world applications. Short-term study abroad offers engineering students the chance to engage in cultural-exchange opportunities without falling behind in the program of study (Donnelly-Smith, 2009). Engineers must possess cultural sensitivity and communication skills to solve global engineering challenges. Intercultural communication skills are beneficial to the engineering profession, and studying the acquisition of this through study abroad can offer insight on future possibilities for institutes of higher education. ■

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Focused commentary and industry perspectives

ENGINEERING COMMUNICATION AND THE GLOBAL WORKPLACE
Preparing professionals and global citizens

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Excellence in communication continues to be important for professional success in engineering. However, the norms associated with communication competence have shifted to include communicating with technology, impacts of the global market and social context on communication, and mutual respect and appreciation for disciplinary and cultural differences. These subtle shifts demand that we reimagine our approach to communication instruction to prepare engineers who can communicate in the global workplace across a diverse, international audience. Our purpose is to show how communication in the disciplines (CID) can be the avenue for preparing engineers for global participation and citizenship. We use the concept of metaphor to show how current CID work emphasizes communication as a tool to serve professional goals. We offer the metaphor of voice for (re)imagining a broader approach to CID that will prepare students for communication in
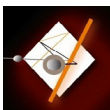
the global workplace by positioning communication competency as a powerful, consequential interaction.

The National Academy of Engineering (NAE) advocates an understanding of engineering education that is considered in a global context (2004). The new global economy impacts engineering work such that technology has changed information sharing, collaborative practices, and the nature of work and workplaces. Increasingly, engineers are working as parts of virtual teams comprised of expert knowledge workers across multiple disciplines located around the globe. Excellence in communication continues to be required for professional success, but the norms associated with communication competence have shifted to include communicating with technology, the impacts of the global market and social context on communication, and mutual respect and appreciation for disciplinary and cultural differences. This subtle shift in communication competence demands that we reimagine our approach to communication instruction to better prepare engineers who can communicate in the global workplace across a diverse, international audience.

Approaches to communication instruction in engineering can include requiring writing or communication courses, collaborating with communication and writing centers, and integrating communication and writing programs (e.g., Ford & Riley, 2003). Regardless of pedagogical approach, engineering communication initiatives typically incorporate the teaching of context-specific communication skills, or communication in

the disciplines (CID) (Dannels, 2001); that is, standards of professional communication are positioned within the norms of engineering work. Principles of situated learning provide the foundation for this theoretical approach that advocates locally constructed communication competencies, instruction in discipline-specific genres, and context-dependent assessment (Dannels, 2001). The primary purpose of CID is professional preparation, driven largely by recommendations from accrediting agencies and industrial representatives.

In current practice, CID instruction emphasizes communication skills training, in part because the primary purpose is professional preparation (Dannels, 2001; Sullivan and Kedrowicz, 2012). That is, CID practitioners work with engineering colleagues to develop instruction in oral and written communication competencies, teach various genres of communication, and provide assessment that takes into account the engineering norms of professional communication. Standards of communication competence, instruction, and assessment are situational and negotiated between communication experts and engineers to prepare students for the professional communication activities associated with their field.

While CID offers many benefits, critics of this approach (e.g., Fleury, 2005) argue that the focus is too narrow. Rather than emphasizing skills training or "how to," they argue the purpose of communication education should be to provide students with a liberal education that prepares them for (global) citizenship. In response to this critique, CID scholars and practitioners have begun to interrogate the "in the disciplines approach" in the hopes of embracing an expanded view of CID which fully realizes its potential by preparing citizens and professionals for the global workplace. For example, in the current CID approach students may learn how to deliver

a five-minute informative presentation on a current engineering topic. With the new articulation of CID, students would be given instructions for such a presentation that would allow them to imagine a larger scale presentation for their future jobs, job talks, or other professional settings (e.g., TED talks).

The purpose this paper is to show how CID can be the avenue for preparing engineers for global participation and citizenship. CID is a necessary beginning, but given the narrow, apprenticeship model of curriculum often characterizing CID work in engineering classrooms (Fleury, 2005), CID must move beyond just professional skill development to encompass a broad focus that will prepare students to be citizens of the world. Current CID work embraces a functional approach through invoking the metaphor of communication as a tool or skill to be mastered to serve professional goals. We offer instead the metaphor of voice as a starting point for (re)imagining a broader approach to CID that will better prepare students for communication within the global workplace.

Additionally, we include examples from our own institution to interrogate the tension between "situatedness" and the broad education necessary for global citizenship. The first author administers an engineering communication program that exemplifies the CID approach, and the second author was a communication instructor in that program for two years. We provide integrated, discipline-specific communication—oral and written— and teamwork instruction in required, core undergraduate engineering classes. We have seen the value of this program in preparing students for the local, professional communication demands of their future work, yet we also see a lack of broad understanding about communication as a process and a lack of connection to the importance of communication education to their ethical participation in the global economy. This led us to critically examine

the work we do in an effort to provide depth and breadth of communication instruction that will lead to more civically-engaged students prepared to be active participants in the global community.

First, we explain CID and highlight critiques of CID as currently at odds with the goals of a broad communication education. We invoke the organizing metaphors of tool and voice (Putnam & Boys, 2006) to show the tension that characterizes CID solely as professional preparation versus CID as global citizenship preparation. We conclude by offering a (re)imagined approach to communication in the disciplines that both attends to professional preparation and engaged, global citizenship.

Communication in the Disciplines: Professional Preparation

Communication in the disciplines is an outgrowth of the larger communication across the curriculum (CXC) movement. Historically, CXC included a variety of activities, including faculty development, campus-wide oral communication labs, and development of communication instruction and activities for specific courses (Hay, 1987). The driving force behind CXC initiatives was the need to provide all students, regardless of discipline, with competence in oral communication. Dannels' (2001) communication-in-the-disciplines approach reflects the reinvention of CXC scholarship (Dannels & Housley Gaffney, 2009) to embrace targeted, discipline-specific communication in context.

The development of communication competence occupies a central focus in engineering (e.g., Dannels, 2000, 2002; Darling & Dannels, 2003). The engineering profession adheres to standards of conduct and ethics mandated by governing bodies or formal associations. The Accreditation Board of Engineering and Technology (ABET) mandates that engineering

graduates meet specific performance outcomes, one of which is communication (www.abet.org), and the National Academy of Engineering points to the importance of communication for educating engineers prepared for all aspects of the profession (NAE, 2004). Thus, the importance of professional communication to engineering practice is widely recognized and accepted. But, what characterizes communication competence in the engineering discipline?

The goal of CID instruction is professional preparation—or moving students through the transition from novice to a member of a discourse community, or community of practice (Artemeva, 2007). Principles of situated learning and genre theory can be used to effectively teach students the professional tasks and communication activities characterizing engineering work (Artemeva, 2005, 2007; Artemeva et al., 1999; Poe et al., 2010). Thus, the CID approach embraces targeted, discipline-specific communication in context, whereby specific features of communication are privileged, and guide the instruction and assessment. Four principles of situated communication pedagogy provide the foundation for the CID framework:

1. Oral genres are sites for disciplinary learning.

2. Oral argument is a situated practice.

3. Communication competence is locally negotiated.

4. Learning to communicate is a context-driven activity (Dannels, 2001, p. 147).

With these principles as a backdrop, Dannels' (2001) communication-in-the-disciplines model posits the generation of locally constructed communication outcomes, identification and support of discipline-specific communication genres, and incorporation of discipline-specific assessment (p. 153). In short, CID emphasizes context and discipline-

specific communication instruction and evaluation, and offers more relevant instruction to facilitate student development of workplace communication skills.

Competent engineering communication is simple, persuasive, results-oriented, numerically rich, and visually sophisticated (Dannels, 2002). As a result, instruction and assessment of communication in engineering emphasizes these key features in discipline-specific genres like design presentations and oral proposals. Through teaching students the characteristics of competent communication in *their* discipline, CID instructors socialize students into the profession and contribute to the development of their professional engineering identity (Artemeva, 2005; Dannels, 2000).

To this end, the goal of CID is professional preparation such that, after earning their degree, students enter the workplace prepared for the specialized communication activities that are integral to their work (e.g., Artemeva, 2005; Dannels, 2003; Poe et al, 2010). But some scholars ask "at what expense?" Critics of CID (e.g., Fluery, 2005) claim that this approach privileges situated, skills-based instruction instead of attending to broader understandings of the communication process that are integral to preparing students for civic life. As Fluery (2005) states, "liberal education [should be] a central concern for CXC, in opposition to the compartmentalized specialization of CID" (p. 73), thus assuming CID to be an inherently narrow framework. In other words, in the most reduced form of CID, specialization of communication and a focus on discrete discourse communities is problematic because it instills in students a rather myopic view of communication, one that perpetuates the notion that communication can be reduced to a formula. For example, Paretti and McNair (2008) remind us that despite the emphasis on communication

throughout engineering curricula, students still struggle with the transition from novice to professional "due to the rhetorical and contextual complexity associated with communication" (p. 238).

In sum, Fleury (2005) notes, "In a CID approach—with its emphasis on singular, specialized disciplinary competence—students may miss the landscape, the multiple paths, perhaps even the multiple vehicles available to them as they move on in their academic work and beyond" (p. 74). In other words, in the most reduced form of CID, specialization of communication and a focus on discrete discourse communities is problematic because it reinforces singular thinking in that students engage the task at hand with no consideration of broader implications. Instead, Fluery (2005) advocates for an "against the disciplines" approach "designed to facilitate liberal education by having students question received wisdom, practice an array of communication styles, and play with established communication conventions" (p. 73).

For Fleury and others, engagement, or educating for citizenship, should be the goal of a liberal education. Students prepared for civic engagement can apply their leadership, demonstrate knowledge, awareness, and the understanding necessary to contribute to a culturally diverse world, and apply academic and disciplinary knowledge to addressing global problems (Stanton, 2008). Unarguably, communication competence is integral to liberal education and the goals of civic engagement. Communication enhances relationships with others, facilitates effective leadership, and affords individual's personal power through their learned skills (Morreale, Osborn, & Pearson, 2000); it is "the process through which democratic possibilities are shaped and social realities constructed" (Murphy, 2004,

p. 80). In short, communication is essential to democratic participation in a global community.

Yet, in many universities, the development of communication competence for noncommunication majors is left to an "across the curriculum" or "in the disciplines" model where students learn *through* and *about* communication in their majors. While CID is certainly valuable for teaching students communication skills, we would be remiss if we failed to point out the constraints characterizing these kinds of collaborations. Because the primary goal is professional preparation, significant effort is dedicated to teaching and assessing discipline-specific genres and features of communication. It has been our experience that given the integrated nature of communication instruction, time is at a premium, resulting in a negotiation of trade-offs between instruction in broad principles of communication and teaching to a specific assignment (e.g., Sullivan & Kedrowicz, 2012).

Tension exists between the "situatedness" characterizing CID and civic engagement as an outcome of communication education. We can look to metaphors as a way to (re)structure the seemingly contradictory aims of CID as discipline-specific professional preparation and broad communication education necessary for participation in a global workplace. This participation demands attention to social contexts, impacts of technology, ethical communication, and mutual respect and appreciation for cultural differences, all of which go beyond the formulaic view currently characterizing the CID approach. Making sense of CID through metaphors can organize new ways of engaging with material. The metaphors of communication as a tool and communication as voice are especially relevant to the tension between CID as narrow, professional preparation and CID as broad, global engagement.

Methodological Framework

This project was born out of experiences in the ongoing collaboration between the Colleges of Humanities and Engineering at a large western research institution. This collaborative program is designed to prepare engineering undergraduate students for the professional communication demands of their work in industry. Collaboration occurs in at least one required course for each engineering student from freshman to senior year. Communication and writing instructors are PhD students from the College of Humanities. These graduate students provide communication instruction in the classroom, consult with students on their writing and speaking, and work with the program director and engineering faculty on assignment (re)design.

The data was derived from regular classroom interactions and experiences associated with the instructor/student relationship and thus, according to IRB criteria, the study was exempt. Data collection processes occurred within the parameters of an ordinary teaching day, making the interactions true to everyday experiences within this context. Over one year's time, data was collected in semester-by-semester student evaluations, daily teaching journals, email interactions, and daily interpersonal communication experiences. The end-of-semester evaluations were administered in-class, respect to particular communication genres, and the focus of the evaluations was to gain understanding on how students perceived communication instruction and instructors. These questions were largely open-ended, requiring students to use their own discourse to describe their experiences and feelings. Both the teaching journals and email interactions are snapshots of teaching data in that they represent students' thoughts, questions, ideas,

and reactions. In all, this data set yielded approximately 87 pages of single-spaced text.

We conducted a qualitative thematic analysis of the data. Information from end-of-semester evaluations, journal entries, and interactions were interpreted using grounded-theory techniques (e.g., Lindlof & Taylor, 2011; Strauss & Corbin, 1990). To this end, the data was open-coded, and then constant comparative methods were used to draw interpretations through the words of the participants.

Preparing Professionals: Communication as a Tool

The goal of CID instruction is to create competent communicators, or what each discipline "want[s] their students to be able to sound like and do in terms of communication when they graduate" (Dannels, 2001, p. 153). As CID instructors, we strive to prepare professionals through the presentation of skills-based communication instruction. Current approaches to CID, with the emphasis on professional preparation, reify the tool metaphor of communication, specifically, communication as a skill—or competency necessary to accomplish particular organizational goals (Putnam & Boys, 2006).

We see this notion of communication reinforced both in the ways we, as CID scholars, position communication in relation to engineering, present communication through our instruction, and in the ways students explain the value of communication. For example, our efforts to secure "buy-in" from engineering faculty and students about the importance of communication typically centers around the link between competent communication and professional advancement. We often explain how communication skills are the key to moving into managerial positions.

Likewise, our current approach to instruction emphasizes a focus on "how to" communicate through introducing an assignment, explaining the communication conventions which characterize competent communication with respect to particular communication genres, and providing students with a breakdown of steps to follow to complete the assignment. One student acknowledged the specific tools: "I learned how to subdivide a project into distinct subsections for ease of presentations, which will be useful for my senior project." We explain how to prepare an oral proposal including requirements associated with content, organization, delivery, and visual aids. Thus, through our current pedagogical approaches, we are complicit in reinforcing the metaphor of communication as a tool or competency that is linked to organizational effectiveness.

From this functional perspective, communication is a means to an end, and students seek to master the tools that will help them perform a specific skill (i.e., engineering communication). For students, communication represents one tool among many that will help them succeed professionally. Further, our students equate professional success with financial success. We see their conception of communication as a tool when we ask them to explain the importance of communication: "Of course it's [communication] important; communication makes the money," and "despite the merit of any project, if you can't communicate its value, you will never get funding." These responses illustrate students' views of communication as a specific skill that serves the instrumental goal of enhancing their workplace effectiveness and, subsequently, their potential earnings. That is, communication is reduced to a set of skills and tools with little appreciation for the more sophisticated principles and processes of communication. While this view of communication might suffice when introducing communication instruction

and the importance of communication competence to professional demands, it is problematic in the sense that students begin to view the theoretically-rich concept of communication as common sense and therefore, useless until needed during specific moments.

Not only is communication instruction primarily skills-based, these skills are presented and understood in a rather formulaic way through the presentation of genres. In fact, students yearn for templates that they can model: "Give us examples of good engineering writing that we can try to emulate." This example points to students' desire for a formula or equation for *doing* communication rather than communication being the process of task accomplishment. Means-to-an-end becomes a point of contention when students start to resist the "ease" of the formula; and, subsequently, resist the instruction. During end of semester course evaluations, some students explain: "I already paid for an English class," "If I cared about communications [*sic*] I'd take a class on it," and "Enough with the writing already. This combination did not leave much time to actually work on our project." These examples—the last one in particular—illustrate the disconnect for the students in terms of how broad knowledge of communication principles and theory and critical thinking could enhance their ability to do, and be important, participative engineers in the global workplace. This resistance to communication invites us to rethink how we are introducing and "selling" communication in the engineering classroom.

As a consequence of the current presentation of communication components, students view communication application as a means to an end, "merely another hoop to jump through," or even a waste of their time. This is reflected in their views regarding performance feedback. Students justified this assertion: "I already know how to give a presentation and I

knew what they would tell me to improve on," "I haven't looked at most of the comments on our papers, so I guess I didn't utilize them at all," and "I might use [the feedback] to get a good laugh." These examples illustrate the lack of respect for communication principles, perhaps because current communication instruction is presented at the surface level, devoid of theory and rigor. These comments also point to a lack of respect and appreciation for the discipline of communication and the communication instructors who are trained to deliver the instruction.

Because communication is only viewed as a set of skills needed to get the grade, students do not see a need for specialized instructors (i.e., communication experts). Rather, they would prefer that technical experts teach communication. The students acknowledge: "I would prefer to have people who have more technical experience review my papers," "fire the communication consultants, and save the money. The professors teach it better," and the "[CID] program provides nothing that the current engineering professors can't already provide." This notion that technical experts can teach communication reifies the misconception that communication is a common-sense discipline, lacking in theoretical and empirical depth. Once again noted by an engineering student: "[the communication instructors] are [*sic*] not content and technical experts. You are all theorists. T crossers and I dotters." This final statement suggests that students lack appreciation for the complexity and rigor characterizing the communication discipline and also presents interesting issues regarding mutual respect for disciplinary differences.

Current approaches to CID have much potential to cater to the aims of a liberal education and the diverse global community. However, given the emphasis on professional preparation for specific communication tasks, as

Fleury (2005) notes, implementation of this framework can be reductionist in focus. In other words, this emphasis on skills—or communication as a tool—is at odds with a broader view of communication as engagement or preparation for active global participation. We offer the metaphor of communication as voice to open more possibilities for CID to attend to the goals of a broad liberal education necessary for participation in the global workplace.

Preparing Global Citizens: Communication as Voice

Appreciation for communication as a dialectic between suppression and expression, or communication as voice (Putnam & Boys, 2006), encourages discussion and instruction in the broader ideas of communication strategies, consequences, and power. This metaphor encourages an examination of discursive practices as informed by the language used for rhetorical sense-making (Fairhurst & Putnam, 2004) insofar that the words, expressions, and larger connections that we make inform the "voice" of the behavior in an organizational setting at large. As Putnam & Boys (2006) contend, "An organization within the voice metaphor becomes a *dialogic process of social formation* or a *radical engagement* in the process of constituting organizational life" (p. 38). It is through the new conceptualization of communication as voice that we are able to imagine new ways of teaching communication in the disciplines—because voices and perspectives that were once silent become a part of the conversation in a more theoretically rich understanding of what it means to communicate effectively.

We advocate a shift in CID instruction from an emphasis on the structural/functional transmission view of communication to an emphasis on communication as social interaction and meaning. The metaphor of voice

encourages not only consideration in immediate, local context, but also the potential for global application and critique. (Re)imagining the presentation or packaging of communication through the metaphor of voice expands the possibilities of what communication can accomplish. To this end, discourses of participation and responsibility will be encouraged within a classroom rather than an emphasis on basic tools with limited functionality outside of a single assignment or communication task.

Instead of reinforcing communication as a skill set to help students accomplish professional goals, we should treat communication as a complex process understood as the interplay between audience, context, and purpose. For example, in the current practice of CID writing instruction, students are taught a "how to" version of writing a proposal. The students are given a template to follow with a formula that encourages tasks of "delete this" and "insert here." With the new teaching strategy, students will be given a similar task; however, questions regarding intelligent rhetorical strategies—audience, context, purpose—will be brought to the foreground. In this view, our instruction can encompass a larger discussion of why specific features of communication are indicative of competence in specific circumstances. This shifts the conversation from "how to" to "why" and will result in a broader understanding of rhetorical sensitivity and the power of communication in both local and international contexts.

Shifting the conversation from "how to" to "why" also allows for the interrogation of the conventions associated with specific genres of oral communication. Genres are cultural artifacts representing ideological and disciplinary knowledge (Berkenkotter & Huckin, 1995). Students can be taught to critically examine genres of oral discourse and, in so doing, will develop more than formulaic knowledge that has been locally and culturally

applied. Genres privilege specific organizational structure, arguments, evidence, and conventions that, when critically examined, will point to what knowledge is valued, silenced, or ignored. As Dannels (2001) reminds us, "genres are rhetorical—laden with contextual motivations, purposes, audiences, and strategies" (p. 149). Framed in this way, teaching—and learning of—genres are not separate from learning broader intercultural communication competencies that can prepare students for international work.

The way to move to engaged CID is to teach students the theoretical principles underlying communication. In other words, while teaching students what counts as evidence in their discipline, we should emphasize how argumentative practice is context-dependent, and illustrate how particular forms of evidence (e.g., ethos, pathos, and logos) are more—or less—persuasive depending on the specific context and audience. We can also expose students to the ideas of invention and identification as they relate to their presentation preparation, to offer them a theoretically rich understanding of the strategies and consequences of their communication. After all, this will become especially important when they collaborate across disciplines and, of course, when they communicate cross-culturally.

Our assessment practices must move beyond a checklist indicating the presence or absence of specific communication features and the extent to which communication conforms to particular genre conventions. Instead, we must provide feedback and evaluation on students' ability to navigate the process of communication, as well as their understanding of the rationale involved in their decision-making, where communication is concerned. For example, portfolios—where students are asked to provide a rationale for

the communication choices they make—are representative of this kind of assessment.

If we position communication as a theoretically-rich process with implications for students both in the classroom and workplace, and outside these arenas, perhaps we can quell their resistance to communication instructors. Recent student feedback shows that they were seeking deeper instruction—"The instruction on teamwork was basic and seemed like common sense. More depth on the subject may be helpful"—and acknowledged its utility: "they [communication skills] are important because the engineer needs a way to communicate with other people," and "it is one thing to have a great idea, it is a completely different challenge to convey how great it is." If we make an effort to respond to students' desire for greater depth and breadth of communication instruction, students will come to understand the value of disciplinary expertise, both their own and that of their communication instructors.

In addition to a (re)imagined view of communication competence, genre, and assessment, we can also draw on principles of deliberation and link them to team communication, an area currently under-theorized from within the CID framework but of the utmost importance to global teamwork. Structured deliberation fosters critical thinking through analysis and evaluation of ideas, respect for diverse viewpoints, and multiple forms of listening, all of which are important for effective teamwork and decision-making (Murphy, 2004). We imagine that within the framework of communication as voice, students will engage in a more dialogic process of teamwork rather than a formulaic approach. In other words, the voice metaphor encourages thinking for context-specific situations, insofar that students will learn to respond and react according to the circumstance rather

than assuming textbook outcomes. This represents a broader approach to CID, such that we can teach students how to navigate interpersonal communication cross-culturally, thus enhancing both their appreciation of communication as a process and the development of important communication abilities, including perspective taking, cultural sensitivity, and critical evaluation and judgment.

Implications of CID for the Global Workplace

As CID practitioners, we must be mindful of the way we position and teach communication in engineering. Often, communication is treated as a skill that a novice can be taught to do (Artemeva, 2005, 2007; Artemeva et al., 1999; Poe et al., 2010). Instead, communication instruction should provide the necessary tools while also teaching students how knowledge *of* and competence *in* communication is necessary for participation in the global community. CID instruction is a useful avenue for preparing students for the communication demands of their work; however, we argue that the *way* we teach and talk about communication offers potential for attending to the unique circumstances surrounding the global sphere.

We see three key implications for instruction. First, as Palmerton (2005) suggests, we must teach that communication competence can be realized only through an appreciation of both skills and knowledge-based instruction. Rather than privileging skills-based instruction, we must teach communication as the very process through which knowledge is constructed, born out of contradictions, diversity, and (dis)agreements. This process is the conceptual understanding of communication as voice, allowing and encouraging all voices and processes to be a part of the conversation rather than just one (Putnam & Boys, 2006). For example, this process view invites

a level of critical thinking that is engaging in ways a skills approach can never be, foregrounding "the *process* of knowing over the *possession* of knowledge" (Canary, 2010, p. 182, emphasis in original), fostering an appreciation for communication as a process rather than communication as a formulaic product. This shift in focus facilitates appreciation of life-long learning rather than the "in-the-now" learning that characterizes the skills approach. For example, students will be tasked with the consideration of all rhetorical elements (e.g., audience, context) for each project rather than one formula for understanding that could be applied broadly across presentations or written documents.

Second, a "well-established phenomenon in contemporary American life is the growing dependence on experts and professionals to solve our social problems" (Wadsworth, 1997, p. 1), thus justifying the importance of well engaged and informed professionals with a commitment to contribute to the public good. Yet, the current skills-based format privileges professional training without instilling in students a wider appreciation of the power of their communication to transform society. By positioning communication as voice, we educate students about the potential implications of their communication within and toward global engagement.

Third, we can work from within engineering and attend to the unique demands of professional practice to make the case for communication and engagement. For example, there is a movement toward "holistic engineering education" (Grasso & Burkins, 2010) that emphasizes a multifaceted approach where students develop both technical knowledge as well as an understanding of the social and cultural circumstances surrounding their work. They must be able to engage in systems thinking and embrace life-long learning. Attending to the demands of professional practice allows us

to expand the position of communication from periphery skill to a more central place in the curriculum, one that generates profound understanding of the power and consequences of communication.

Conclusion

In order to create students who are more globally minded, the context of CID has the potential to be more fruitful than even a dedicated basic course. CID is characterized by the coming together of experts from different disciplines, requiring them to create shared meaning within one cohesive space. What happens within this space is and has been the factor in many debates within the viability of CID. However, we contend that it is precisely through CID that we are able to engage students and prepare more civically-minded adults.

We acknowledge that sometimes faculty and students' embrace of communication instruction can be challenging. As CID practitioners, we are complicit in this tension between situatedness and engagement because of the way we package and sell communication to our colleagues in other disciplines. We typically purport that we can help their students become more effective communicators, thus dually preparing them for specific class projects and the workplace. We sell communication to the students and faculty as a means to an end. We try to get them to buy in, showing how we can improve students' communication competence. Instead, we need to shift the way we talk from an emphasis on communication competency as an instrumental goal to communication as powerful, consequential interaction. In this way, we can prepare engineers to communicate in the global workplace across disciplines and cultures. ■

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Teaching cases

FIRST-YEAR COMPOSITION THROUGH A GLOBAL ENGINEERING PERSPECTIVE

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This teaching case describes three sections of first-year composition taught within a Global Engineering Cultures and Practices Learning Community. As members of a learning community, students were concurrently enrolled in two first-year engineering courses and one first-year composition course, while also participating in cocurricular events. These composition courses were designed to achieve the goals of the composition program while simultaneously supporting the goals of the learning community and meeting the needs of the first-year engineering students enrolled in the course.

Keywords. First-year composition, Learning communities, Engineering education, Collaborative teaching.

Internationalization of higher education brings opportunities and challenges at all levels. At our institution, Purdue University—a large public research university in the Midwest of the US—it manifests itself in numerous ways as the university expands its global presence through global collaborations and exchanges of students, instructors, and researchers[1]. Addressing
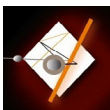
internationalization through the engineering curriculum is an especially compelling issue at Purdue, as international students comprise 25% of the enrollment of the School of Engineering, the highest percentage of any school on campus (ISS, 2012). The first-year composition (FYC) program at our university, known as Introductory Composition at Purdue (ICaP), faces a similar imperative because, as at most schools, nearly all undergraduates are required to enroll in an FYC course, which leads to high numbers of engineering students and international students in FYC courses. For most writing programs, dealing effectively with cultural and linguistic diversity in FYC has been an ongoing challenge (Matusda, 1999, 2006; Preto-Bay & Hansen, 2006; Shuck, 2006; Williams, 1995).

In this article, we provide an account of how we addressed the need to integrate international education in both engineering and FYC through our participation as writing instructors in a Global Engineering Cultures and Practice Learning Community (abbreviated as Global Engineering Learning Community, or GELC). In addition to describing course curriculum and assignments, we explore how global engineering issues and multicultural communication were addressed through course structure and cocurricular activities. As the FYC instructors in the GELC, we coordinated our composition curricula and assignments around issues in engineering to prepare students for their academic and professional careers by

1. Enabling students to explore engineering issues and discourse communities through their composition assignments.
2. Encouraging students to consider international audiences in their research and writing.
3. Promoting collaboration among diverse groups of students.

Overall, we believe that the combination of our theoretically-grounded course designs, curriculum-supporting activities, and focus on professionalization provided a rich learning environment where students were able to grow their knowledge about writing, engineering, and international communication.

Learning Communities and Global Engineering at our Institution

To help incoming students adjust to social and academic life on campus, Purdue offers a number of learning communities that students can join. A learning community consists of a group of first-year students who share a common academic interest, take two or three courses together, and (may) live in the same residence hall. The offerings span a range of colleges including Agriculture, Education, Engineering, Liberal Arts, Health and Human Sciences, Technology, and the School of Business.

Moreover, these learning communities are just one program among several within the Student Access, Transitions, and Success Programs (SATS), whose mission, vision, and values statements focus on the development of and collaboration between staff and students, a commitment to diversity, and an emphasis on integrity and accountability in order to

> assist students in progressive stages of development; and have as their ultimate goals an increased rate of student degree completion, future employment or study, dedicated citizenship, and responsible leadership in the state, nation, and world (SATS, 2012, para. 1).

In addition to achieving academic success, students are also encouraged to become responsible leaders and dedicated citizens while having the support of the university.

More broadly, learning communities have been part of a growing movement in higher education since the 1990s as a way to help student acclimate to higher education and to improve retention of first-year students (Zhao & Kuh, 2004). In addition to these benefits, Levine (1999, as cited in "Learning Community Description," n.d., para. 3) points to others, including "academically-based social networks among peers" and increased faculty-student interaction and student engagement in academic and social life on campus. Data gathered from surveys distributed to Purdue's learning community students show that this program does have an impact on student retention since its initial launch during the fall semester of 1999 ("Learning Community Successes," n.d.).

Of the 63 total learning communities at Purdue, the ICaP program participates in 18. In our case, the three authors were writing instructors for the Global Engineering Cultures and Practice Learning Community, one of several learning communities within the College of Engineering. This learning community engages first-year engineering students in the development of their communication, leadership, and technology skills within an expanding global network. By enrolling in one of the courses within the Global Engineering Program, in addition to another introductory engineering class, students "explore the meaning of culture and cultural sensitivity as they relate to engineering design and sustainability, [and] they will begin the process of developing global engineering competence" ("Global Engineering Cultures and Practice," n.d., para. 1).

For this reason, the learning community cultivates a multicultural, global community by creating contexts where students with similar academic and professional interests can get to know their peers from diverse cultural backgrounds. Students in the GELC enrolled in two engineering courses:

a general engineering course open to all first-year engineering students (Transforming Ideas to Innovations I), as well as an engineering course more specific to the goals of the GELC (Global Engineering Practice and Design), which was cotaught by the associate director of the Global Engineering Program—an assistant professor of engineering education—and a graduate research assistant, who served as the primary instructor of the course.

Curriculum Design

In designing our curricula, we wanted to tailor the writing courses to the GELC and to maximize the opportunities for our students to develop their writing knowledge and skills while simultaneously learning about engineering through their writing. On the one hand, as members of a mainstream introductory composition program, we were not operating in the context of an overtly interdisciplinary course (e.g., as in a WID [writing in the disciplines] or a WAC [writing across the curriculum] program). However, given the institutional partnerships created by the learning community, we tried to design our courses in a spirit of mutual engagement and interdisciplinarity (Leydens & Schneider, 2009; Paretti, McNair, Belanger, & Diana, 2009).

Our FYC program offers a variety of FYC courses; the core model is a one-semester, four-credit course with one instructor and 20 students , which meets five times a week with three 50-minute classes—including one day in a computer lab—and two 50-minute conference days. This model provides a structured environment that supports the writing process through the submission of drafts and final drafts while instilling in students an understanding of the basics of visual rhetoric that comes with multimodal instruction. The program gives instructors a good deal of autonomy in how they develop a curriculum to fit this model; instructors can choose from

one of eight alternative syllabus approaches that have been approved by Purdue's Introductory Writing Committee under the ICaP program—such as Writing Your Way into Purdue, Academic Writing and Research, Composing with Popular Culture, etc. Although the theoretical rationales of each syllabus approach differ, they are connected by ICaP's overarching Goals, Means, and Outcomes for English 10600 and the FYC Outcomes of the Council of Writing Program Administration, which emphasize an attention to rhetorical knowledge, critical thinking, reading, and writing, writing processes, knowledge conventions, and technology.

International students have the option of enrolling in a section of FYC for international students, which was created for students whose education was primarily in a language other than English and whose speaking and listening skills are not as strong as their writing and reading skills in English. Placement of second language writers into appropriate writing courses has been an ongoing issue for FYC courses—and writing studies more broadly—given the differences between L1 and L2 writers and the associated implications for curriculum and placement (Silva, 1994, 1997). To allow instructors to better address the distinct linguistic and academic needs of second language writers (Silva, 1993), the program's basic FYC model was adapted for international sections in several key ways.

Most notably, enrollment is limited to 15 students and there are fewer class sessions but more individual student-teacher conferences. In terms of curriculum, this model of FYC is designed around a sequenced approach developed by Leki (1998), in which students choose their own topic and research and write about this topic for four writing assignments, composing multiple drafts for each assignment and receiving instructor feedback throughout the composing process. This sequenced approach is based on the

belief that the students in the course will develop their language and writing skills best when each of their writing assignments builds directly on the experience and knowledge gained from the previous writing assignments.

As instructors in the ICaP program, we were required to design our curricula under the aegis of one of these approved FYC models; Mary used Writing about Writing, while Gracemarie and Matthew used the sequenced writing syllabus approach for international students. As instructors in the GELC, however, we wanted to adapt the "standard" FYC models to meet the needs of our GELC students and to provide a challenging, meaningful experience for them, especially given their linguistic and cultural diversity. Although we took two different approaches to our FYC sections, we maintained a fundamental cohesion among our courses by incorporating into our assignments and activities a focus on global engineering. Furthermore, all three sections followed the guiding principles of collaboration among instructors and students, consisted of both class meetings and student-instructor conferences, included both written and multimedia assignments, shared many extracurricular activities, and fulfilled the same number of credits for all students within the learning community.

Collaboration among instructors began informally during the preceding spring and summer, when we developed tentative curricula. It became more formal shortly before the semester began, when all three FYC instructors and the primary instructor for the Global Engineering Practice and Design course attended a Learning Community Instructor Training Workshop. In addition, all four instructors and the learning community assistant met twice before classes began and at least twice a month during the fall semester to share instructional activities, plan and schedule events, manage the budget, and prepare for the end-of-semester showcase. Because

they shared the same curriculum, Gracemarie and Matthew worked together more frequently and shared documents and resources through Dropbox , a cloud-based file storage service.

Writing about Writing Syllabus Approach

Mary taught one section of FYC under the Writing about Writing (WaW) syllabus approach, which borrows its theoretical rationale from Downs and Wardle (2007), who advocate for a revised FYC course that resists the misconception that a universal academic discourse divorced from content and context can be taught to students in one or two semesters. Instead, a WaW approach encourages students to see writing as a subject of scholarly inquiry. An experience instructor in this rhetoric- and composition-based approach, Mary adapted the syllabus to include a global engineering focus in her FYC section. Through discussions and readings centered on the discourse practices of their discipline, students considered how professional engineers communicate to both general and scholarly audiences within a global context, expanding their metacognition of research writing as conversation.

Mary's WaW syllabus featured five major projects that drew on students' experience with literacy and language to investigate how writing practices are situated within the varying discourse communities they belong to. Although definitions of discourse community vary, Swales (1990) proposes one understanding of the term to mean a group of individuals who share a "broadly agreed upon set of common public goals" (as cited in Wardle & Downs, 2011, p. 471). The course's assignments included a literacy narrative, a digital literacy narrative, an ethnography, an analysis of a scientific accommodation, and a digital portfolio. Following Downs and Wardle's suggestions, the assignments were designed to help students

build an awareness of writing to multiple audiences while understanding that writing is a rhetorical activity instead of a set of general skills. While the parameters of the first two assignments were left broad to encourage students to explore their own personal connections to literacy, the last two projects before the digital portfolio were adapted to direct students to investigate the communication and writing practices of their selected branch within the larger field of engineering. Although students worked on each project individually, they collaborated in small writing groups throughout the semester, during conference days. Students also broke into their writing groups during classes when engaging in group work or conducting peer review. By regularly commenting on others' work, they eventually grew familiar with one another's writing styles and became more receptive to receiving constructive feedback.

In the literacy narrative, students reflected on their own literacy histories while articulating their own understanding of literacy, which often departed from the conventional associations of print-based, alphabetic literacy. In the digital literacy narratives, students were then asked to remediate their written narratives into a video that they would post on YouTube for public viewing. Next, they used their newly developed understanding of literacy to investigate the discourse practices in a community of their choice through primary research, and discussed their findings in an ethnographic essay. Students then transitioned to explore the kinds of writing and thinking valued in a particular academic community by comparing them to more popular forms of writing and thinking and by considering what these differences suggest about the values of academic writers. For the last two projects, students read articles like Jack Selzer's (1983) "The Composing Processes of an Engineer" to learn how to conduct primary research as well

as how to discuss how engineers' writing practices have changed over time. Finally, students designed a digital portfolio showcasing the final drafts of the previous four projects while reflecting on the progression of their rhetorical knowledge and writing skills.

While students were free to research other communities for their ethnography assignment, many students selected organizations on campus related to engineering, such as the Formula Society of Automatic Engineers and Society of Hispanic Professional Engineers. In their projects, students discussed how engineering projects, concepts, and challenges engage both engineering and nonengineering students in both local and global communities. Students then applied this working knowledge of discourse practices to their analysis of a scientific accommodation, in which they reflected critically on how the writing style, language, and content of a scientific article and its accompanying popular report revealed the rhetorical situation and audience for each. Jeanne Fahnestock's (1986) "Accommodating Science: The Rhetorical Life of Scientific Facts" was especially useful in helping students identify the writing practices for a specialist versus a nonspecialist audience.

To supplement the last two engineering-focused assignments, Mary also arranged to have an engineering librarian visit her class to talk to the students about engineering scholarship and research. Mary had previously met with one of the engineering librarians—who also teaches one of the introductory engineering courses—to discuss how to build students' research skills and increase their awareness of the engineering research resources available to them. The librarian visited the class twice—once to talk about how to conduct primary research when the students were writing their ethnography essays and another time to highlight different engineering

databases like Compendex and INSPEC and popular science resources from which students could cull articles for their science accommodation article. Because the librarian mentioned that students' research skills tend to improve over multiple, shorter class visits instead of a single longer visit, Mary scheduled two 20-minute sessions during the second half of the semester. In the reflections to their science accommodation project, students noted the usefulness of the class visits and agreed that the introduction to engineering-specific academic databases would be useful for their future coursework and research.

Mary also invited a construction engineering faculty member to come for one class period to discuss the importance of clear, effective communication within engineering professions. Although the readings for the last two projects focused on the relationship between engineering and writing, Mary also knew that having an expert in the field affirm these same points would give credence to the material. Moreover, such a visit also aligned with the WaW syllabus' objectives of introducing students to the contextualized, rhetorical writing practices of their specific academic discourse community. During his 50-minute presentation, the faculty member addressed strategies for delivering polished, professional presentations and stressed the value of producing concise, well-organized memos and emails to both clients and management. Because this guest lecturer was also the management director of internships for the engineering program, students recognized the importance of establishing a professional relationship with this important contact.

Sequenced Writing Assignment Syllabus Approach

Matthew and Gracemarie each taught one section of FYC for international students. The basic sequence of assignments for this section consists of a writer's autobiography, a personal narrative, an interview report, a literature review, and an argumentative essay. Apart from the writer's autobiography—in which students explore their development as writers—these assignments all center on a research topic of the student's choosing. In the personal narrative, students write about their personal interest in and experiences with their topic. Students then research their topic. For the interview report, students find and interview an "expert" in their research area—often a professor or graduate student. For the literature review, they find scholarly and nonscholarly sources relating to their research topic, summarizing these sources and providing a critical framework that analyzes the sources in relation to each other. Finally, students write an argumentative essay in which they support a claim about some aspect of their research topic.

In designing our curriculum for the GELC, we wanted to adapt this basic sequenced structure in order to make it more relevant to students' academic focus on engineering, to provide increased opportunities for extended collaboration, and to give students the opportunity to practice composition in a digital space. The most significant revision was to constrain students' topic selection. We asked students to consider issues in global engineering they would be interested in studying for the entire semester. Then, through a series of collaborative activities, including ice breakers, online forum posts, and "speed-dating"—where pairs of students spent a few minutes talking about their interests—students selected groups of classmates with similar interests, and together these groups chose a single problem in global engineering which they wanted to study in depth.

Before students began working on their global engineering problem, they first wrote a personal narrative. We combined the writer's autobiography and personal narrative assignments into a new assignment—the engineer's autobiography. In this assignment, students described their motivation for pursuing a major in engineering at Purdue. Though this shift in focus from the writer's autobiography to the engineer's autobiography eliminated the opportunity for students to write explicitly about their backgrounds as writers, it opened up a space for them to use writing as a tool to think critically about the motivations of choosing their career paths. Most often, students' work on this assignment focused on the impact of particular relationships on students' lives or problems in students' home countries that they wanted to solve through engineering. This increased attention to students' surroundings and especially the people in their lives promoted an outward-reaching mindset that is critical to successful professional communication in a global context.

Because students worked in groups on the same general topic, we were able to adapt the remaining assignments in the curriculum sequence to be more collaborative in nature. For the literature review, students worked together to select a set of articles and online sources that would be helpful for understanding their topics. Then, students divided these sources among themselves and each student wrote an individual literature review. By taking this approach—as group members' annotations served as brief summaries and analyses of these sources—students were able to access more information about their topics without having an excessive reading burden placed on them. In group conferences, we helped each group to find ways to work together well by, for instance, collaborating on introductory paragraphs and dividing their research into subtopics of their area of inquiry. We also

introduced students to research tools to help them work more efficiently, including library databases and reference management tools such as Zotero.

For the second assignment in the sequenc—the interview report—students worked together to select an expert on their topic. In class and in conferences, Matthew and Gracemarie assisted students to develop strong interview questions based on students' work in the literature review. As a group, students conducted a single interview with their selected expert, after which each student wrote his or her own report on the interview. The main benefits of this revised approach to the interview were the need for fewer interview subjects—translating to fewer logistical problems and demands on faculty time—and students' recognition that the same artifact—in this case, an interview—can be viewed from multiple, divergent perspectives. For instance, one group member might write about the entire interview through a descriptive narrative, while another group member might focus on the background of the interviewee and only a few important points from the interview.

Since the first two assignments were primarily individualistic in terms of products, we also wanted to allow students to participate in fully collaborative writing projects. Thus, we asked students to write the next paper in the sequence—the research paper—as a group. In most cases, students approached this task by dividing their papers into sections based on each student's particular area of interest or research within their broader topic. However, students faced the task of working together to create a cohesive organizational framework—including an introduction, a logic order for sections, smooth transitions between sections, and a conclusion. Additionally, through group conferences with the instructor and a variety of class activities, students learned about the challenges of maintaining

a consistent voice, consistency in editing, and the logistical aspects of collaboration—file-sharing—as well as team dynamics through this process. For instance, we implemented various forms of peer review and used several class periods as collaborative writing workshops in which students wrote together in their group on a single computer, with the instructor moving among groups to provide feedback as needed.

We also wanted to give students the chance to both practice their digital composition skills and present all their research to a global audience. To achieve these goals, we asked students to build a website about their research that would convey their expertise on their topic to a diverse, international audience. To account for a range of technology experience and designed skills, we asked students to develop their websites through Wix, a customizable, user-friendly platform. We also used the last several weeks of the semester to talk about visual and web design from a rhetorical perspective, which helped to emphasize the audience-based focus of the entire course.

Cocurricular Activities

To complement our course designs, we worked in conjunction with the engineering instructor and the student assistant to plan activities that would be engaging for students both academically and socially. Each instructor was provided with an activity budget by the LC program, which we chose to pool together to fund activities outside of class in addition to in-class activities. On a weekly basis, the instructors hosted "study tables" at an on-campus location—a reserved conference room in a dormitory. Students who attended these sessions had the chance to work individually or collaboratively on course projects and homework assignments and seek assistance from

instructors. Weekly study tables also became a place where students engaged in social and cultural activities.[2]

We also facilitated several one-time academic and social activities to help students gain social and professional experience. On the social side, we hosted a bowling night and a trivia night. In terms of career-related activities, we held two presentations by engineers. Following the logic of the presentation in Mary's class by an engineering faculty member, Gracemarie planned a panel on writing in engineering for members of her class. During one of her class periods, four graduate students in engineering (two international and two domestic students) briefly discussed their experiences with writing in both graduate school and industry. Students then asked questions about the panelists' backgrounds, experiences, and beliefs about writing. This panel provided a comfortable setting for students to discuss their concerns about writing with near-peers, and they later indicated that they were grateful for the chance to gain an inside perspective about real-world communication.

Another successful activity was a field trip to a local wind farm, which was made possible by funding from Purdue's Common Reading Program[3]. During this trip, students attended a presentation on wind farms, which focused on the Indiana community in which the farms were constructed, and observed windmills up close. Overall, this trip gave students a greater understanding of the interactions among engineers and the local communities in which they work, as well as an opportunity for building camaraderie.

The final cocurricular activity served as the capstone of our courses: the end-of-semester student showcase. For several months, we coordinated this culminating event with the engineering instructor and the student assistant. Our goal was to give students a chance to display their FYC work

in a context that would allow them to publicly present their work to and interact with a diverse audience. At the showcase—which was set up like a conference poster session in a large classroom)—students displayed their websites on laptops and talked with visitors about their semester projects. During the showcase, we displayed a Prezi on a large screen; this multimedia presentation—created by the instructors and some student volunteers—included video-recorded student reflections about what they had learned through the semester, pictures from activities, and other information that provided an overview of the GELC.

To provide an audience beyond the classroom, we invited instructors in the ICaP program, faculty members in the English and Engineering departments, and administrators in the Learning Community program. Thus, students had a large, diverse, and very real audience to whom they could present their research: in addition to the 50 or so members of the learning community in attendance, around two dozen visitors had the opportunity to vote on the best student projects in a number of categories. The extracurricular context of these presentations provided additional motivation for students during the semester as they worked on their projects, and perhaps more importantly, it served as a low-risk, high-reward opportunity to gain professional communication experience[4].

Learning from the Global Engineering Learning Community

Teaching first-year composition through a global engineering perspective was highly rewarding for us as writing instructors because it challenged our assumptions about how we conceive of and teach FYC. We believe that both FYC approaches were successfully adapted to the needs of the GELC and its students, and we received encouraging feedback from students and other

stakeholders. One of the things we learned through our collaboration is that each approach had its own strengths and weaknesses. We thus conclude with a comparative reflection of the two approaches, followed by a discussion of some of our programmatic concerns.

A primary strength of Mary's Writing about Writing course was its theoretical approach centered in rhetoric and composition scholarship, which provided a powerful means for familiarizing students with the engineering discourse practices of their own discipline. Moreover, this course introduced students to core rhetorical concepts like genre, discourse community, and rhetorical situation. With its focus on discourse, the WaW approach enabled students to examine language in specific contexts. However, because Mary allowed students broad latitude in their choice of discourse communities, not all students worked on issues related to global engineering. Additionally, because students worked individually on their projects, they had limited opportunities for collaboration.

By contrast, in their sequenced assignment approach, Matthew and Gracemarie had students work only on engineer-related topics, and students worked in groups throughout the semester. Thus, students had continual opportunities to collaborate as they explored their global engineering issues in depth. However, because the sequenced approach focused on the process of writing multiple drafts, the course did not prioritize theoretical concepts from rhetoric and composition. Instead, such issues were usually addressed in student-teacher conferences as they came up. While this flexibility had its advantages, the course could be strengthened by incorporating readings and discussions of some of the core rhetorical concepts from the WaW approach. Mary's WaW course would, in turn, be strengthened by relating more

projects (e.g., the ethnography assignment) directly to global engineering and by incorporating more collaboration among students.

One of the clearest lessons we learned as instructors was the value of collaboration. As writing teachers, it was immeasurably beneficial to share ideas and resources for planning, instruction, and assessment. Teaching is a notoriously isolating profession, but we found that our collaborations with other writing instructors and with an engineering instructor led us to rethink how we taught and pushed us to innovate (Leydens & Schneider, 2009). Ultimately, we feel that it was our commitment to collaborative teaching that led to the learning community experience being much more than the sum of its parts. Whether our students were aware of it, we were modeling the same types of collaboration and professional communication that we hoped to inculcate in them.

The collaborative structure of the learning community also meant that students had additional social and academic support as they faced the usual challenges of an FYC course. For instance, when choosing a topic and finding an expert to interview, students consulted with their writing and their engineering instructors, and in most cases, with other students in the learning community. A great deal of support came through the social networks that students developed by living together, attending classes together, and participating in activities together. This type of support network is one of the primary benefits of a learning community (Shapiro & Levine, 1999), and we sought to incorporate it directly into our writing assignments. By finding people in the classroom and on campus who shared their interests, students could engage with their interests through their writing. Indeed, writing in such a context is not an isolated or mere "academic" activity, but a method of investigation and problem solving, a

form of communication and community building. We believe that students benefited from extended engagement with each other and with their topics. By focusing on their chosen topic or discourse community—researching and writing about it from multiple perspectives, in multiple genres, both individually and collaboratively—they developed both their knowledge in an area of their professional or personal interest and their ability to more effectively communicate this new knowledge.

Despite the successes in the GELC, we do have some concerns about the future success of this course, especially as an interdisciplinary partnership between engineering and composition programs. We were supported with additional funding and resources to make our collaborations possible, but such support may be difficult to attain when many programs and instructors are being told to "do more with less." We also recognize the difficulty of getting students to participate in extracurricular activities. Most such activities were optional during the semester, but we always took attendance and students received extra credit toward one of their engineering courses. The student showcase was incorporated into the curriculum, as we made it clear to students from the outset that they would be presenting their work in this public forum. More importantly, students worked hard to prepare for the showcase and they enjoyed participating in it[5]. We consider the activities to have been successful by most measures, but we found— through our experience and from talking with colleagues in other learning communities—that it is crucial to plan interesting activities and to find ways to motivate students to attend these activities.

Finally, on a programmatic level, one of the challenges for this type of course is its long-term sustainability. The writing courses stand on solid theoretical and pedagogical ground, but it can be difficult to secure

sufficient institutional and financial support. Even at our own institution, other successful interdisciplinary composition courses have come and gone[6]. Clearly, our GELC writing courses were only possible because of the involvement of numerous stakeholders. This interdisciplinary collaboration was key to the course's success (Paretti, 2011); if such a FYC course is to have real value in the engineering curriculum and any chance of success, it needs to be supported by an engineering program, learning community, or another program with similar goals and values—or ideally, a combination of programs, as in our case. The benefits to all involved—and most especially to the students—make this type of global engineering FYC course well worth the efforts. ■

Notes

[1] As of 2012, Purdue currently enrolled more than 8,500 international students and had more than 1,000 international faculty and staff (ISS, 2012).

[2] For example, we provided pumpkins for student to carve at one of the October study tables and brought several boxes of cookies from a local bakery on another night.

[3] The common reading book for the year, William Kamkwamba's *The Boy Who Captured the Wind*, is an account of how a young man in a poor African village built his own windmill to generate electricity. The book dovetailed nicely with our focus on global engineering and served as a model for writing about engineering in the genre of a nonfiction narrative.

[4] Students' rhetorical and communication skills were challenged, as they had to repeatedly and concisely discuss their projects over the course of an hour and to tailor their presentation to different audiences. In addition, preparing for the showcase allowed us to talk with our students about cultural norms that may be hidden to some students, such as how to dress and comport oneself in a professional context in the US. We also emphasized the importance of this type of event for their professional development, emphasizing the weight that it would carry on their résumé and in interviews for internships, research positions, and jobs. In addition, we created a certificate of participation for each student, and to provide further recognition, we created a number of categories for the audience to vote

on. These were Best Overall Project (Group & Individual), Best Visual Display (Group & Individual), Most Original Project (Individual), and Most Potential for Impact (Group).

5   In fact, several students from the learning community also entered their projects into the ICaP Showcase, held at the end of the following semester.

6   See Matsuda & Silva (1999), for a description of a now-defunct cross-cultural FYC course involving the business school and enrolling a mix of international and domestic students.

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DESIGNING COMMUNICATION FOR COLLABORATION ACROSS ENGINEERING CULTURES

A teaching case

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This pedagogical case aims to better prepare engineering students for communication tasks in international collaborations. Its origin is an interview with a young female engineer in the United States who, when asked what might have improved her technical communication classes, answered by listing her current difficulties with intercultural and international collaboration on design projects. Her interview established a frame for the short case on international collaboration that follows. Included are materials suitable for students and resources to guide teachers.

Keywords. International collaboration, Intercultural communication, Project management, Gender, Web conferencing.
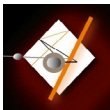
In an interview about her day-to-day writing and communication tasks, a new engineer noted that she would be better prepared for her current work if her communication classes had discussed the challenges intercultural and international projects would pose, and also if they had addressed how young engineers might construct or tweak the lines of communication in international work. Such pedagogy would help her now as she routinely works across cultures, across disciplines, and across engineering goals. Yu (2012) reports that our informant's interest in intercultural communication is shared by 86% of the U.S. engineering students she surveyed. Yu concludes that instruction in intercultural communication needs to address students' attitudes that favor their own cultural approaches. This case pursues a somewhat different, but still a complementary tactic: it does not confront students' preconceptions as much as it focuses their attention on redesigning how communication circulates around a project. In addition to relationships among the participants, the case that follows examines the structures and routing of communication in an international collaboration. The case was built on the real example provide by our informant, but tailored to address a broad set of intercultural communication issues.

A number of dimensions are highlighted by the case:

- The engineers are located at different sites—making face-to-face meetings too costly and at the same time complicating interpersonal communication.

- The new lead designer is a woman while all others participating are men.

- Disciplinary prestige affects discussions because the clients have doctorates while the designer has a BS degree, although she is

the only one involved who has in-depth knowledge of materials properties.

- Project investment also is frequently questioned because a new hire has been assigned to "fix" a strained collaboration.

The rest of this document is divided into three parts: 1) the case narrative suitable for distribution to students in a technical communication course as a basis for analysis and discussion, 2) theories and research from various disciplines that can be used by teachers to support and supplement the case, and 3) discussion questions, activities, and deliverables to extend use of the case.

Case Narrative

Marisol Hidalgo, a new design engineer at Dynamic Engineering, Ltd., works at the Cumberland office located in North Carolina. As one of her first job tasks, she is assigned to work with a team of engineers at the company's research center in Bangalore, India. Cumberland is designing a series of parts that the Bangalore engineers are using in their research on a new jet engine. Her boss, Kevin Smith, tells her the assignment is hers because of her materials knowledge—her degree is in metallurgy, not mechanical design—and because other engineers assigned to the project have not "meshed" with the Bangalore team. He suggests that Marisol can bring "new eyes" to the team and asks that she begin by observing and suggesting ways in which the collaboration can be improved.

Marisol suspects some thorny problems may underlie Mr. Smith's "not meshed" comment, so she not only attends one of their conference calls, she also investigates the background of how the two sites work together and communicate at times when they are not meeting. She finds:

- The Bangalore team functions exclusively as a research team—all have PhDs—and the Cumberland site is charged with designing parts to enable the researchers to test their theories about improving power output and efficiency in a jet engine the larger company will produce in the future.

- Weekly meetings are held using WebEx, a web conferencing computer application that allows live voice communication and screen sharing, but they choose not to include the video communication function. Interestingly, in the meeting, she notices the screen sharing does not seem to be interactive or collaborative—they might as well have emailed PowerPoint slides or Excel charts.

- These meetings usually run 2 hours and seem to just end abruptly. They do not close with any written or verbal statements about the coming week's work.

- Weekly meetings typically start at 9:30 a.m. U.S. Eastern Time—7:00 p.m. in Bangalore.

- The day after the meeting, the Bangalore team sends a memo with their updated requests—written when they arrive at their offices in the morning, which is nighttime in the US.

Jon Merrell, the previous lead in North Carolina, tells Marisol that those memos she'll receive after the meetings are wildly different from what happened in the meetings, and that they often reintroduce demands for design features that were ruled out during the previous meeting. But, as Marisol digs further, she discovers that many previous emails were cc'd to

an Indian engineer at the Cumberland office, Dr. Kumar, who others know, but who is not part of the project team. It seems that the Bangalore team doesn't send her group all the memos; for every memo her team receives, Dr. Kumar has received—and answered—emails that he does not share. So, if the Bangalore engineers assume Dr. Kumar shares those memorandums, they may well think they have negotiated with Cumberland by talking with Dr. Kumar. Thus, the Bangalore team may think Marisol's team is uncooperative or ignorant at the same time as her team thinks the Bangalore researchers are either unable to understand the limits on part design or unwilling to abide by decisions made in the meetings.

The more she digs, the more complex and entrenched the communication problems seem to be. The Bangalore team is codirected by Dr. Soudha, who has a PhD in physics, and Dr. Gowda, who has a PhD in applied mathematics. When she finally talks with Dr. Kumar at Cumberland, she confirms that Dr. Kumar often receives many memos from the Bangalore scientists for every message they send to her department. He further offers that the Bangalore team may have internal conflicts of interest that he would trace to theoretical differences: Dr. Soudha does not think they should disrupt their theoretical work to specify designs for prototype engine parts, and Dr. Gowda is more concerned about testing their ideas in order to keep their funding secure. Dr. Soudha also likes to think at night when others have left the center, and this meeting interrupts his mental work. So the leaders of the Bangalore team have issues with each other over whether they should spend time with the Americans who ask such mundane questions as "what temperature should this part withstand and for how long?"

Marisol has begun this investigation with the expectation that she will be in daily contact with the Bangalore team, but she also finds out that

messages relevant to her design of parts for their research project circulate differently than she anticipated. For example, every memo received from the Bangalore team has been so "worked over"—in part by sending drafts to Dr. Kumar for comment—that memos are typically very formal—and sometimes introduce topics not discussed in the web meeting—when they reach the North Carolina team. Meanwhile, Marisol realizes that memos from the North Carolina team probably seem too informal for the Bangalore team's preferences and may seem out of date because of the negotiation they have conducted with Dr. Kumar. She sees this back-channel talk between the Bangalore team and Dr. Kumar as potentially dangerous to successful collaboration, but she also finds him approachable and helpful. It may be the case that he has kept the formal collaboration from collapsing in the past.

Although the same meeting time has been used consistently, it occurs to Marisol that time differences between the sites—9.5 hours—increase the possibility of misremembering as the Bangalore team is at the end of a long workday when weekly meetings are held, and conclusions are not documented. Interactive white board screens are often not written down and conclusions about next steps are not penned in the meeting. No documentation is begun until the next day—if at all. Since the meetings have been conducted this way for several years, their patterns are entrenched and likely to be difficult to change. Further, she doesn't know if others would accept a new employee disrupting their routines; it might draw attention to her gender and youth.

Manager Kevin Smith has asked Marisol to make suggestions that he can champion, so she needs to draft a report to him about the communication problems. She is mindful that he will likely copy the text of any ideas he likes into a memo of his own—so she tries to write as she thinks he would.

Supporting Theories and Research

This case can be used in several different ways and types of courses. It might be used as a single-class-session discussion activity by sophomore-level engineering students who have not experienced professional internships. In such an early course use, the case can help students understand that: disciplinary differences can spark clashes, as can divergent work goals; cultural differences can impact communication etiquette and style; communication can circulate in ways that aid and hinder collaboration; and communication infrastructures sometimes need to be changed.

With junior and senior students the case might be expanded in scope and depth to include consideration of theories and research relevant to cultural, organizational, and disciplinary communication. The next section provides research on intercultural communication that might be supplied to students before a discussion activity, and can also lend theoretical support to situated learning activities including the writing of deliverables related to the case. These "learn-by-doing" activities are described in the third section.

Research on Intercultural Communication

Teachers who have not used intercultural cases before may want to introduce this case with some statements about the importance of intercultural communication in engineering.

Intercultural communication often begins with Edward T. Hall who coined the term to collect the work he and others were doing in the U.S. Foreign Service Institute in the 1950s to cover the (mis)understandings generated through body language, speech, and writing (Hall, 1959). Widely held distinctions grew out of this work that investigated differences in values

and behavior across individuals, groups, and even nations. Hall contended that two important dimensions of difference (i.e., ones that may lead to powerful misunderstandings) could be revealed by identifying high context versus low context cultures and by identifying proxemics—or the physical dimensions of communication difference. High context cultures, for Hall and his many followers, refer to cultures that spell out few details in writing because it is expected that the receivers know much of the context. His example of high-low problems was France to Germany versus Germany to US. The French and Germans have more trouble communicating in writing than do Germans and Americans because France is a high context culture, while Germany and the US both are low context cultures.

Hall's classic example of proximal distance compared Arabic speakers and U.S. English speakers, with the Arabic speakers expecting a truthful speaker to stand close to them, speak up, and maintain eye contact while the Americans would back away, speak more softly, and sometimes look away when they were made uncomfortable by close contact (Hall, 1966). While this work has been problematized, high and low context and proximal distance principles still are used often in intercultural discussions.

Geert Hofstede in the 1970s and 1980s developed dimensions of difference across cultures into the Hofstede model. These identified six nation characteristics—four of which became widely used in cross-cultural research in psychology: power/distance, uncertainty/avoidance, individualism/collectivism, masculinity/femininity, long/short term orientation, and indulgence/restraint. In a recent article, Hofstede (2007) pulled together results from a number of studies to contrast what is most and least important

Table 1

Priorities Revealed through Interviews of Managers

India managers	US managers
MOST important: family interests, continuity of business, personal wealth, patriotism, power	**MOST important**: growth of business, personal wealth, this year's profits, power, staying within the law
LEAST important: staying within the law, creating something new, responsibility to employees, respecting ethics, game and gambling spirit	**LEAST important**: profits 10 years from now, responsibility to employees, family interests, continuity of business, creating something new

Source: derived from Hofstede (2007)

to managers. As depicted in Table 1, the managers he surveyed from India and the US clash on: importance of family, long term orientation, and staying within the law (for a good discussion starter have students check The Hofstede Centre website at http://geert-hofstede.com/countries.html).

Shalom Schwartz developed two different value theories, one about individuals—in the 1970s and 1980s—and one about cultures. From the 10 individual motivations, he developed a mapping of individual value regions based on two dimensions: openness to change versus conservation and self-enhancement versus self-transcendence. When he transferred this work to cultures, he used his Schwartz Values Survey to assess intercultural values and applied that work to intercultural communication. Working with a number of psychologists interested in human values across cultures, Schwartz charted universal value constructs found in cultures including: harmony, embeddedness, hierarchy, mastery, affective autonomy, intellectual autonomy, and egalitarianism (Schwartz, 2008; the further reading provides a link to this report with good visuals for use in class). Intercultural business research began to use Schwartz's work—along with the European Social

Survey—quite widely in the 1990s and Schwartz's scale became popular in intercultural business research as a way to understand differences (see Schwartz, 2006).

Relevant to this case, Schwartz's work maps India as a hierarchy culture that values social power and authority. It also accepts uneven wealth, which leads to valuing humbleness. The United States maps as a mastery culture that values daring, independence, social recognition, choosing its own goals, and being capable, successful, and ambitious. In many ways the cultures should be compatible as workmates.

A wrinkle found in this case plays on a primary incompatibility as the disciplinary—and real—power is in the control of the Bangalore scientists. According to Schwartz's thinking, the Indians will expect that hierarchy will trump in discussions and that hierarchy is on their side: they are the scientists at a research center, the Americans are engineers who are so lowly they must design prototype engine parts. At the same time, though, the Americans will seek to make designs—and parts—work, to do so efficiently, and to stay on the task of solving whatever problems arise. They are unlikely to defer to their Bangalore colleagues on what matters to them, i.e., that the parts work.

Implementing the Case: Questions, Activities, and Deliverables

As stated in the introduction, this case is loosely based on information we were given during an interview with a young, female, American design engineer. It started with her response to the question: "What would have better prepared you for the communication challenges of your day-to-day work?" She responded by talking about her collaborative project with a research design team in India. A new engineering graduate, she made the

remark that her undergraduate communication classes had not anticipated, or prepared her for, how often she would work on international teams. "It would have helped me to practice thinking about how messages move around, and also to try out electronic meeting software. Probably cultural awareness stuff, too. Although I don't know how that fits with classes."

The case is written so that it is scalable. Students can read the case narrative by itself to prompt a single-session discussion activity in an engineering course. The case can also be implemented more widely in a variety of courses that address professional ethics, communication, and teamwork. As a multi-week project, students can use the case as a vehicle for practicing a variety of communication analysis activities and writing assignments.

In this section, we offer discussion questions, activities, and deliverables—realistic communication products—that might be produced by students who assume the role of the central figure in the case. We first describe these as assignments and then provide further detail of situated learning activities within the context of the case.

Discussion Questions

- Should Marisol directly address the Bangalore team's special relationship with an Indian engineer at the North Carolina site? If so, how?

- Which is more likely to be problematic for Marisol—her age, her gender, her education (only a BS dealing with PhDs)—and how does she position her ideas to separate them from these possible centers of discrimination?

- What actions of the North Carolina team are most likely to be seen by the Bangalore team as marking the Carolinians as "silly" Americans?

- What actions of the Bangalore team are most likely to be seen by the North Carolina team as marking them as playing to stereotypes of Indians or foreigners?

- Should she share what she has discovered about back-channel communication with others in her group?

- What technical adjustments might be considered, such as having participants in the web conference use the video as well as audio functions?

- If the web conferencing software allows recording of electronic meetings and sharing a link to the recording, what are the technical, legal, and cultural issues?

- What "little bet"—the smallest action that can affect the situation—might Marisol try first?

Activities

Communication path tracing. In her investigation, Marisol focused on how communication moved—and did not move—around in the collaborative project. As she found out about back-channel discussions, she began to consider whether to include it on her map. Would such disclosure be seen as policing discussion? Would leaving it out make the Bangalore group think she does not know that they use other channels? Or is it possible that they do

not recognize their conversations with Dr. Kumar constitute a back channel? Using the narrative above, map a communication path (see Figure 1, p. 141, for sample path). If you cannot trace all parts of the path, note the need to find out more in this area.

Role-relationship mapping. Another visualization technique that can clarify the collaboration process is to draw a map of the project roles and workplace relationships of the various parties involved.

Deliverables

Case analysis report. Directed to Kevin Smith, this short report analyzes the project communication process. It may include a visual that maps or charts the flow of information.

Recommendation report. Directed to Kevin Smith, this short report would follow the analysis and a discussion of the analysis. It would recommend changes to the work communication patterns.

Internal memos. Mr. Smith, Marisol's supervisor, will send several memos to various stakeholders in the project. He may, for example, send a memo to the Bangalore team leaders to introduce Marisol as the Cumberland team's new primary contact and make a few modest suggestions for improving team collaboration and communication.

Extended Case Implementation

Additional Discussion Dimensions

In her discussion of the communication challenges, Marisol noted a variety of issues that included: time zone differences, cultural diversity across the workforce sites, disciplinary complexity caused by both differences in area and in level of education, communication barriers, and communication path differences. These differences get displayed in written, oral, and computer-mediated communication, and sometimes they "stop down" the work. Of particular note is a difference in work focus: the Bangalore team is at a research site, which leads them to focus on theory and invention; and the U.S. team is a typical design team with a variety of projects and clients, which leads them to focus on tasks. Also, there are gender differences to take into account, as revealed when Dr. Soudha told Mr. Smith that he was sure the U.S. branch was making their project less of a priority by assigning it to a woman.

Interestingly, the intercultural dimensions that are stressed in this narrative are discipline and power, which may be hidden by the more obvious culture and communication aspects. The research engineers in Bangalore are more scientists than engineers, with one of the leaders having a BS in mechanical engineering but also a PhD in physics. They tend to view the Cumberland engineers as hopelessly applied. In direct contrast, the mechanical designers in North Carolina take pride in making machines work. Marisol is more applied than the research scientists but generally more scientific than the design engineers because of her specialization's theoretical use of chemistry.

Advanced Case Activities: Paths and Maps

A number of activities are supported by this case. In addition to traditional discussion questions intended to help students tease out issues lurking behind the narrative, this case suggests activities drawn from sociological research practices that often trace the circulation of actions or map relationships among people—or roles. Bruno Latour and Steve Woolgar, for example, used the tracing of mundane activities as a way to study work in scientific laboratories in *Laboratory Life* (1979). Their work merged with the work of others interested in the study of science and technology to form actor-network theory that features tracing as a way to reveal the ways ideas and actions circulate through laboratories during the process of science. Figure 1

Figure 1

Sample Communication Path Trace for Two Days
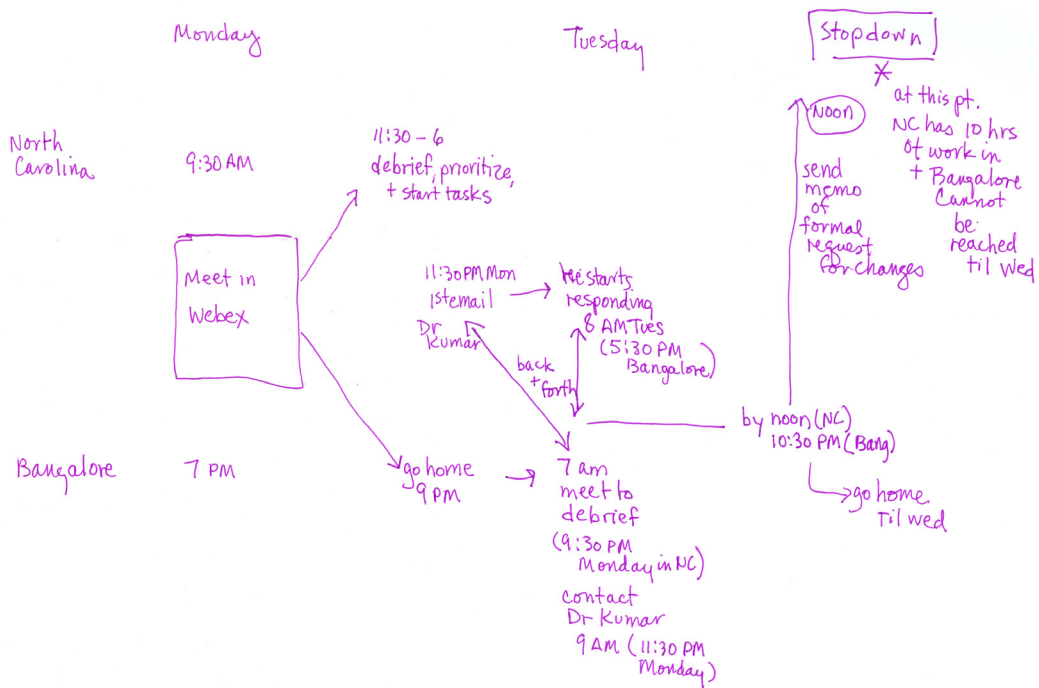
shows a sample communication path tracing that we drew during our informant interview. This tracing details how time-of-day differences between the two sites compound the impact of their miscommunications. By the time the Bangalore team can deliver their thoughts on the meeting—which they send after working late into the night—the Cumberland team has invested 10 hours of design work into what they thought were the priority tasks coming out of the WebEx meeting. Communication path tracing, in this instance, clarifies how quickly differences can spiral into dysfunction.

The mapping of relationships has been used widely in sociology. Pierre Bourdieu made them prominent in his work, and in *Homo Academicus* (1988) he focused on building multiple maps that aimed to picture complex cultural relationships that helped explain political and philosophical disagreements among professors in French universities. In that book, his research argued for the relative power of certain professors and disciplines through maps he made of their relationships via education, home background, political affiliation, and disciplinary allegiances. While Marisol, and others encountering this collaboration, are not going to invest the time to map the relationships among the various teams, it may be useful for a person encountering this project as a newbie to sketch the relationships based on the information that is easily available.

We adapt these sociological methods of tracing and mapping to case work, asking students to map out how communication moves around the collaborative group. By using tracing to identify dysfunctions—and there are several possible ones in this case—Marisol can address problems in teamwork that can be offloaded to "poor infrastructure" without pointing out less comfortable problems that may be traceable to distrust across groups, disciplinary differences, and so on. Because engineers typically are

less comfortable with the latter discussions, showing an infrastructural solution might help all save face. The mapping of relationships, too, can assist Marisol, or any person new to an established collaborative group, to assess who might be inclined to trust the opinion of a newcomer because of the roles that person inhabits.

"Best Ball" Approach to Deliverables

The case can be constructed to operate in one class as a discussion prompt, but it is most effective if it is distributed over several classes and includes several deliverables. We have had success with a best ball sequence in which each student produces a deliverable and receives individual feedback, and then the instructor discusses the deliverable using examples from students' submissions. This brings the group back to a common point from which they individually generate the next deliverable. Typically, the first deliverable is a case analysis report based on reading the case.

Case analysis. The case analysis should be written to the U.S. manager, Kevin Smith, to describe the communication patterns at work in the international team but not provide any recommendations or solutions. The case analysis may include communication path tracing (see Figure 1, p. 149) and role-relationship mapping and should be in an appropriate business report format. The teacher can provide feedback to students on the formatting and content of their case analyses, and then use examples from students' case analyses to generate in-class discussion intended to produce a consensus analysis. Students then write individual recommendation reports based on the group discussion of the case, providing the teacher with a second report grading and feedback opportunity.

Recommendation report. The recommendation report should describe potential solutions in terms of why, how, and by whom the solutions would be implemented. The report should provide priorities and a proposed sequence for implementing potential solutions. The primary focus should be on actions that can be taken quickly and that are expected to produce observable benefits, i.e., the "low hanging fruit."

Internal memos. The writing of internal communication memos provides students with practice in a very different type of writing. Within the constraints of the case, Marisol does not write the memos directly but rather writes the text of memos that she will provide to her supervisor, Mr. Smith, so that he can compose and send memos to key stakeholders. Ghost memos may be written to Drs. Soudha and Gowda of the Bangalore team and potentially to Dr. Kumar, the North Carolina-based engineer who maintains a back-channel relationship with the Bangalore group. These ghostwritten memos from Mr. Smith should introduce Ms. Hidalgo as the new lead engineer for the Cumberland group—stressing her credentials as a materials scientist—as well as suggesting a few minor changes to the structure of collaboration.

An obvious potential change the newly assigned engineer Marisol can propose is a change in meeting time. Current WebEx meetings require the Bangalore group to stay at work as late as 10:30 p.m. A less obvious response is to tackle logistics for building—and reinforcing and remembering—consensus. There are a number of ways of approaching such a change. A technological change that may help might be to record meetings—built into the web meeting software—and to add an agenda window that will sit on the WebEx desktop so that the group can update that agenda with the work they agree upon during the meeting and have a record of the meeting. Many

other project management ideas can be viable solutions, but aim for ones that nudge what is done already—wholesale changes are not likely to be successful in a project that already has years of semidysfunction.

Of particular importance in the follow-up memos is maintaining a respectful tone—a bossy or rude tone would be a failing response.

This case reveals numerous cultural sensitivity issues that may offer fruitful discussion. These include differences in: formality between the groups, directness of communication, level of education, disciplinary foci, team missions, and—in this case—age and gender.

Resources

News and culture online. Bangalore has a number of newspapers that have online editions:

- Mid-day: http://www.mid-day.com (compact daily newspaper)

- Bangalore Mirror: http://www.bangaloremirror.com/

- Deccan Herald: http://www.deccanherald.com/ (a main English-speaking newspaper for the districts of Kamataka, which includes Bangalore)

- The Hindu: http://www.thehindu.com/ (3rd largest English language newspaper in India)

- Times of India: http://timesofindia.indiatimes.com/ (largest English language newspaper in India)

Conferencing software. If students are interested in considering other conferencing software, Wikipedia lists a comparison of features for web conferencing software, complete with links to the products' websites: http://en.wikipedia.org/wiki/Comparison_of_web_conferencing_software

Videos. It also may be helpful, particularly for the introductory courses, to locate short videos that demonstrate particular cross-cultural ideas and encounters.

- Integration training's "Cross-Cultural Communication" (6:22) introductory discussion of practical differences across variables: power-distance—how much hierarchy is valued—individualism/collectivism, masculinity, and long-term orientation. It also brings up food and time. While the narrator presents Hofstede's framework and does not mention Hall or Schwartz, his discussion is consonant with their research as well. http://www.youtube.com/watch?v=at7srdUiRfM

- "Cultural Training: Americans and Indians Communicating Across Cultures" (2:30): two women workers—one in the US and one in India—talking about a common project. This shows problems that arise on a call between the U.S. worker's focus on the task and the Indian worker's focus on establishing a connection before turning to the task. The Schwartz differences between India and the US are emphasized. http://www.youtube.com/watch?v=UimqMmMq9C0

- "Managing Cultural Differences: High and Low Context" (4:45): Prof. Robert Moran for Thunderbird School of Global

Management explains high context and low context and how these differences work in business. http://www.youtube.com/watch?v=T3iYmZGome4

Surveys

If the class might profit from taking a survey, a shorter values survey called the Portrait Values Survey developed by Schwartz and his colleagues—plus a coding key—can be found at http://wiki.mgto.org/portrait_value_questionnaire_pvq This survey shortens Schwartz's full values survey (Schwartz et al., 2001) and is a grosser measure, but it takes only a few minutes of class time.

If the class focuses on values, or morals, the students can participate in a wide-ranging study of morals at http://www.yourmorals.org Run by social psychologists at University of Virginia, University of California (Irvine), and University of Southern California, the Schwartz Values Survey can be completed if they make an account—and they will receive feedback.

Additional reading for students

Gunia, B., Brett, J., & Nandkeolyar, A. (2012, December). In global negotiations, it's all about trust. *Harvard Business Review*, p. 26. http://hbr.org/2012/12/in-global-negotiations-its-all-about-trust/ar/1

Additional reading for teachers

Andrews, D., & Starke-Meyerring, D. (2005). Making connections: An intercultural virtual team project in professional communication. *Proceedings of the International Professional Communication Conference, 2005*, pp. 26–31. http://dx.doi.org/10.1109/IPCC.2005.1494156
Examines potential challenges and fixes possible in-collaborative teams that work across cultures.

Bargiela-Chiappini, F., & Kadar, D. Z. (Eds.). (2011). *Politeness across cultures*. Basingstoke, Hampshire, UK: Palgrave Macmillan.

> Their introductory essay traces politeness research since Lakoff's early work, focusing on business implications.

Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online Readings in Psychology and Culture*, *2*(1). http://dx.doi.org/10.9707/2307-0919.1014

> Introduces Hofstede's model in the context of intercultural psychology.

McNair, L. D., & Paretti, M. C. (2010). Activity theory, speech acts, and the "Doctrine of Infelicity": Connecting language and technology in globally networked learning environments. *Journal of Business and Technical Communication*, *24*(3), 323–357. http://dx.doi.org/10.1177/1050651910363275

> Looks specifically at complexities of technology in global teams.

Ralston, D. A. et al., (2011). A twenty-first century assessment of values across the global workforce. *Journal of Business Ethics*, *104*(1), 1–31. http://dx.doi.org/10.1007/s10551-011-0835-8

> A recent updating of Schwartz's survey taken in 50 countries worldwide. For the most part, confirms Schwartz's conclusions but is useful if students challenge the data as incommensurate or out-of-date.

Schwartz, S. H. (2008). *Cultural value orientations: Nature and implications of national differences*. Israel Science Foundation Grant 921/02. Moscow: Publishing house of SU HSE.

> This report includes visuals at the end of the report that can be used to show his models to students.

Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online Readings in Psychology and Culture*, *2*(1). http://dx.doi.org/10.9707/2307-0919.1116

> Introduces Schwartz's model in the context of intercultural psychology.

Verdugo, R., Nussbaum, M., Claro, M., Sepúlveda, M., Escobar, B., Rendich, R., & Riveros, F. (2013). Preparing undergraduate computer science students to face intercultural and multidisciplinary scenarios. *IEEE Transactions on Professional Communication*, *56*(1), 67–80. http://dx.doi.org/10.1109/TPC.2012.2237254

Winsor, D. A. (2003). *Writing power: Communication in an engineering center*. Albany, NY: State University of New York Press.

> Looks at ways communication acts to structure power relationships in an engineering center.

Volkema, R. J., Fleck, D., & Hofmeister, A. (2011). Getting off on the right foot: The effects of initial email messages on negotiation process and outcome. *IEEE Transactions on Professional Communication*, *54*(3), 299–313. http://dx.doi.org/10.1109/TPC.2011.2161804 ◼

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Bourdieu, P. (1988). *Homo academicus*. P. Collier (trans.). Stanford: Stanford University Press.

Hall, E. T. (1959). *The silent language*. New York: Anchor Books.

Hall, E. T. (1966). *The hidden dimension*. New York: Doubleday.

Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online Readings in Psychology and Culture*, *2*(1). http://dx.doi.org/10.9707/2307-0919.1014

Hofstede, G. (2007). Asian management in the 21st century. *Asia Pacific Journal of Management*, *24*(4), 411–420. http://dx.doi.org/10.1007/s10490-007-9049-0

Latour, B., & Woolgar, S. (1979). *Laboratory life: The social construction of scientific facts*. Princeton: Princeton University Press.

Schwartz, S. H. (2006). A theory of cultural value orientations: Explication and applications. *Comparative Sociology*, *5*(2-3), 137–182. http://dx.doi.org/10.1163/156913306778667357

Schwartz, S. H., Melech, G., Lehrnami, A., Burgess, S., Harris, M., & Owens, V. (2001). Extending the cross-cultural validity of the theory of basic human values with a different method of measurement. *Journal of Cross-Cultural Psychology*, *32*, 519–542. http://dx.doi.org/10.1177/0022022101032005001

Yu, H. (2012). A study of engineering students' intercultural competence and its implications for teaching. *IEEE Transactions on Professional Communication*, *55*(2), 185–201. http://dx.doi.org/10.1109/TPC.2012.2186657

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LINKING ENGINEERING STUDENTS IN SPAIN AND TECHNICAL WRITING STUDENTS IN THE US AS COAUTHORS

The challenges and outcomes of subject-matter experts and language specialists collaborating internationally

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In a first-of-its-kind international collaboration, technical writing classes in Spain and the US matched engineering students with international technical writing students to coauthor procedural instructions. These were then tested for usability by students in Finland and the US, and subsequently translated and localized by students in Belgium, France, and Italy. The coauthors faced challenges in gaining expertise, communicating clearly in a lingua franca, handling differing cultures, testing for usability, and
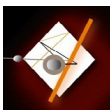
managing differing semester schedules and time zones. Insights from these experiences yield recommendations for instructors who wish to replicate such collaborations.

Introduction

For over 13 years, the Trans-Atlantic Project (TAP) has frequently paired technical writing classes—many filled with engineering majors—in the US with translation classes in Europe to collaborate in localizing procedural documents for both a source-language market and one or more target-language markets (Humbley, Maylath, Mousten, Vandepitte, & Veisblat, 2005; Maylath, Vandepitte, & Mousten, 2008; Mousten, Maylath, Vandepitte, & Humbley, 2010; Mousten, Humbley, Maylath, & Vandepitte, 2012; Maylath, Vandepitte, Minacori, Isohella, Mousten, & Humbley (2013). Not until autumn 2012, however, did the TAP link a technical writing class taught in English for engineering students in Spain with an international technical writing class in the United States.

The course in Spain aims to develop students' English language proficiency and writing competence in international engineering contexts. It is adapted to the European Higher Education Area (EHEA)[1], arising out of the Bologna process, a university reform seeking the harmonization of degrees across Europe and the adoption of a learning-processes-and-outcomes model specified as a series of competences to be acquired. This

course is offered as an elective in the engineering curriculum's last year at the Polytechnic University of Catalonia (Universitat Politècnica de Catalunya, UPC). With TAP integrated into the course, engineering students confront an authentic professional situation in which they must apply appropriate skills and strategies for effective technical communication, mirroring the challenges and processes found in real-life contexts.

The international technical writing course in the US aims to immerse students in globalization and localization processes that technical writers must know to handle cultures, languages, and rhetorical strategies in documents used in nations and language areas outside their own. Though open to engineering students and others at North Dakota State University (NDSU), based in Fargo, it typically draws senior undergraduate and graduate students almost entirely from the English Department. Previously in the TAP, technical writing students had always been their own subject-matter experts (SMEs), choosing topics for which they could be both author and authority simultaneously. In the 2012 project, however, students in this course served instead as English-language and technical documentation specialists, relying on the engineering students in Spain as SMEs. (See details below under "Design of the Project")

As procedural writing is the one of the most common types of technical writing, widely applicable to different audience levels (e.g., technicians, lay users), and lends itself to usability testing, it provides valuable authenticity for a technical writing assignment. The TAP thereby provided realistic challenges, as technical writing students at UPC took on the role of engineers while simultaneously the technical writing students at NDSU took on the role of language experts.

To a striking degree for the students in both classes, their collaboration led to deeply realistic challenges, namely the integration of specialist engineering knowledge into a collaborative communication task through a distance partnership of distributed work (cf. Paretti, McNair, & Holloway-Attaway, 2007). Within this context, students in both locations had to cope with challenges arising from

1. language and communication—English as a foreign language, processes and conventions in technical writing, student-student communication to develop the task, intercultural communication;

2. the use of technology;

3. task management—meeting deadlines, negotiating roles, as well as dealing with diverse views and expectations related to SME/language expertise within the project.

In this article, instructors from both sides of the Atlantic present a teaching case detailing their students' partnerships. After situating technical communication within an engineering degree and arguing for real interdisciplinary collaboration, we provide an account of the design of the project with its successive stages and goals, a narrative of what transpired, challenges along the way, and lessons drawn for use by others.

Literature Review

Although engineering students sometimes seem to come to class with an aversion to learning language skills, professional engineers recognize that much of their work relies on their ability to communicate clearly, often in more than one language. Among those calling for engineers competent in language are Downey et al. (2006); Swearingen, Barnes, Coe, Reinhardt,

and Subrahanian (2002); and Lohmann, Rollins, and Hoey (2006), who list "proficiency in a second language" as the first of five required competences (p. 128). Reflecting these dynamic multi-competence views of engineering, current curricula in the US and Europe include, as part of expected learning outcomes, the development of cross-curricular competences related to communication, collaboration and multidisciplinary work (cf. ABET [2012] for ABET descriptors in the US, and Joint Quality Initiative Informal Group [2004] for "Dublin" descriptors in Europe).

Along these lines, technical writing courses in English as a foreign language, such as UPC's for engineering students, can be aligned with the tradition of English for specific purposes (ESP) courses at European universities, which prepare students for academic and professional work in English (Räisänen & Fortanet, 2008; Gustafsson et al. 2011). ESP teaching focuses on specified learner needs, using the texts, activities, and practices that are characteristic of the students' discipline, with an emphasis on authentic materials and tasks, as well as interdisciplinary collaboration (e.g., Dudley-Evans & St. John, 1998; Belcher, 2004). Increasingly globalized academic and professional contexts where English is used as a lingua franca call for the need to prepare students for professional challenges requiring realistic communication and collaboration with authentic topics and tasks. In these internationalized academic settings, current trends move towards multidisciplinary approaches to the integration of content and language (ICL) in order to cater for discipline-specific academic literacies. Thus specific programs are being designed as a result of the close collaboration of content and communication specialists (e.g., Gustafsson et al. 2011).

Despite the allowances provided by technology to overcome geographical barriers, international coauthoring between engineering

students and professional communication students still remains rare. Wojahn et al. (2001) describe the benefits that they saw in placing engineering and technical communication students in collaborative teams; however, their teams were composed of students at a single university with English as the working language (also reported in Ford and Riley [2003]). Experimenting internationally, Paretti et al. (2007) teamed up engineering students in the US with communication students in Sweden to create Web sites and write white papers; however, the engineering students were not only SMEs but also native language authorities. In contrast, our project gave each team member singular expertise: the engineering students were SMEs while the international technical writing students were English-language experts in communication.

Design of the Project

While international language-project partnerships have grown numerous, virtually all have paired only two classes from two countries (Thompson & Carter, 1973; Jarvenpaa & Leidner, 1999; Moreno-Lopez, 2004; Du-Babcock & Varner, 2008; Flammia, 2005, 2012; Herrington, 2005, 2008; Humbley, Maylath Mousten, Vandepitte, & Veisblat, 2005; Gerritsen & Verckens, 2006; Herrington & Tretyakov, 2006; Stärke-Meyerring & Andrews, 2006; Goby, 2007; Stärke-Meyerring, Duin, & Palvetzian, 2007; Fitch, Kirby, & Greathouse Amador, 2008; Kennon, 2008; Maylath, Vandepitte, & Mousten, 2008; Mousten, Vandepitte, & Maylath, 2008; Anderson, Bergman, Bradley, Gustafsson, & Matzke, 2010; Flammia, Cleary, & Slattery, 2010; Mousten, Maylath, Humbley, Scarpa, Livesey, & Vandepitte, 2010a; Mousten, Maylath, Vandepitte, & Humbley, 2010b; Klein & La Berge, 2012; Mousten, Humbley, Maylath, & Vandepitte,

2012). However, in 2010, universities in five nations linked an international technical writing course in the US with a usability testing course in Finland and translation courses in Belgium, Denmark, and France. In this iteration of the TAP, described in Maylath et al. (2013), students in the U.S.-based course chose their own topics to write instructions. Working with students in a usability-testing course in Finland, they then tested their self-composed instructions, recruiting subjects in both the US and Finland. Using the test results to revise, they prepared their texts for translation, according to the guidelines in Maylath (1997). In the final phase, they partnered with students studying translation in Belgium and France to localize and translate accurately their texts into Dutch and French, respectively.

In its 2012 iteration, all arrangements were the same but with two important additions:

1. SMEs—the engineering students in Barcelona—would choose the topics, according to their interests and expertise, and then partner with the students in Fargo—all majoring in English—to coauthor the texts, and

2. a translation class in Italy would join the classes in Belgium and France so that each text would be translated into a third target language, Italian.

The first addition proved far more significant than the second. Although technical writers are rarely their own SMEs, when they took on both roles at once, they benefited from discovering what was opaque or ambiguous in their own writing as they, as SMEs, often took for granted how much they already knew and thereby left gaps or ambiguities in their instructions. When the roles were split, the benefit of discovering what

experts take for granted was transferred in large part to the SMEs at UPC. In turn, the English-language experts at NDSU gained the benefit of facing the far more realistic, though also more challenging, experience of depending on SMEs for content and accuracy. The trade-off seemed worthwhile going into the project and remains so in hindsight.

What Transpired

For the first time, the engineering students were faced with the complexity of communicating online to accomplish a professional task: producing an authentic technical text in English. As their course had led up to the project, they had worked on the concepts of audience, purpose, and situation; with the project underway, they found these concepts emerging in the flesh. Consequently, students were faced with a learning-by-doing context different from any previous learning situations they had been in. On one hand, the focus was no longer on language itself but rather on communication for the task; on the other hand, they were required to contribute their engineering knowledge to an interdisciplinary project involving the integration of different types of competences, in keeping with current ESP courses in engineering curricula. As SMEs, the engineering students chose the topics, some of which were highly specialized, in close relation to their studies, e.g., "How to conduct a Charpy impact test" and "How to use Ansys to make a water deposit," while others were addressed to a wider audience, e.g., "How to create effects with Photoshop" and "How to make a Wiki text."

Because the TAP required students to go through the different stages in the writing process, it aligned fully with the course syllabus, based on the notions of process and genre in specific socially-situated contexts (Hyland, 2003). The courses in both Spain and the US pivoted around the TAP as

the central course project, thus reflecting a typical ESP situation whereby students become the source of knowledge while the instructor acts as a language consultant willing to engage in interdisciplinary activity (Dudley-Evans & St. John, 1998; Freire, 2000; Belcher, 2009). In both courses, as the instructors taught procedure writing, they gradually revealed the project's stages and requirements. The engineering students found themselves doubly challenged: immediately they had to put into practice technical communication skills as they were studying them; in addition, the TAP required that they immediately apply sophisticated disciplinary skills, even if not adequately developed. This situation meant that students sometimes had not had the opportunity to work through the course materials thoroughly before each stage of the project, or gain as much practice as they would probably need before they were required to act as SMEs in a challenging, authentic communicative situation.

Challenges

Gaining Expertise

Given the above mentioned role of instructors as ESP language specialists, the engineering students had enormous responsibility and discretion as they did not have an expert engineering consultant to turn to. Thus, the whole project depended largely on them as SMEs. As such, they were required individually to choose suitable topics and to make sure that the instructions were testable (i.e., concrete enough and doable in terms of equipment needed). Through class discussion, the number of topics was refined to match the final number of teams coauthoring in the TAP. While engineering students were trusted as true experts in their field, they were provided thorough guidance in the

structure, organization, and language of technical instructions, often through questions that required them to clarify their meanings and reflect on what makes an appropriate instructive text. Without putting too fine a point on it, *the engineering students had to write in a foreign language*—English. Unlike the translation students in Belgium, France, and Italy, to whom they would later send their coauthored documents, the Spanish and Catalan engineering students were much more varied in their English language proficiency and in their degrees of self-confidence in expressing themselves in a foreign language. For many, it was the first time that they had to express themselves in English in a "real" situation, i.e., in which real people depended on the clarity and accuracy of their English communications; and for all of them it was the first time that they had to use technical English to convey ideas with which the reader was not familiar. Mastering English language and communication skills posed the chief challenge to engineering students in the TAP.

For the NDSU students, all of them majoring in English, most engineering topics and contents were foreign. Some of their UPC partners, whose proficiency in English was limited and who, to this point, lacked awareness of what is involved in collaborative writing, relied excessively on the NDSU students as language experts, thus relinquishing, to a certain extent, the SME role that they should have adopted. This situation meant that the U.S.-based writers had to learn key engineering concepts fast to cope with the demands of the project by interpreting and understanding texts on subjects of which they had little or no knowledge. Additionally, the translation students in Belgium, France, and Italy often sought answers to their questions from the U.S.-based technical writers, but because these writers were not SMEs, the NDSU students often had to reroute questions

to the engineering students at UPC. A change took place over time: initially, the Fargo students viewed their expertise in the instructions' topic as external to themselves and also far distant in Barcelona. However, as they conducted their own usability tests in laboratories in Fargo, they began to become aware that they had acquired knowledge about the procedure and were identifying possible quirks or flaws that the engineering students might have missed before receiving the test results. Gradually, the NDSU students began acknowledging that they too were becoming authorities, through the testing and authoring process.

Communication

Both classes grappled with communication appropriate to the task, which involved setting up the partnership: introducing themselves to each other and establishing the media to develop the TAP—e-mail, Dropbox, Google doc, etc.—then negotiating the approach and procedures for the task, writing and revising drafts, and setting intermediate deadlines. Communication thus took place at different levels and in different genres: engineering content in the procedural text, metacommunication about technical communication—structuring the text, language questions, etc.—as well as social interaction and task management.

From this experience, what came to the fore were the linguistic pragmatics of intercultural communication—negotiating their roles as coauthors—even as one was naturally the SME and the other the language expert (cf. Mousten et al. [2012]). Additionally, but naturally enough, the UPC students felt challenged in having to communicate in English with their U.S.-based partners. Conversely, the NDSU students frequently faced

the challenge of having to interpret engineering concepts and jargon in far-from-standard English.

Differing Cultures

Added to this were cultural differences. In one notable case, a NDSU student was surprised to receive a message from a UPC student signed off with the phrase "Good night kisses," which the recipient felt to be overly familiar. She mentioned it to her instructor, who passed the message on to the instructors in Barcelona, who then discussed the issue with the entire class. When the students were asked to suggest what might be wrong with the phrase as written, they immediately identified that there should, at least, be a comma after "Good night," but could see nothing else wrong. In fact, they were very surprised to hear that this phrase—a literal translation from a typical Spanish complimentary closing—could be considered inappropriate for some people. At first they expressed the feeling that this was just typical Anglo-Saxon "coldness"—unaware that the predominant culture in Fargo is Scandinavian—but, after some discussion and looking at other examples, they quickly came to understand and accept a need for cultural sensitivity and to be wary of literal translations, as in the example above. One of the instructors pointed out that such a closing could convey a dismissive tone, revealing something about assumed or expected roles, such as, "I'm the technical expert, and here it is up to you to manage the info and write the text"; in other words, remarks that could appear rather blunt in response to the American student's question.

The episode likewise was fodder for discussion during a subsequent class meeting at NDSU. On seeing the exchange, two of the students who had spent time in Spanish-speaking countries and who were double-majoring in

Spanish, as well as English, pointed out to their classmates that "Good night kisses" was indeed a direct translation of a common sign-off in Spanish. For both classes, this small *kerfuffle* proved a useful window into the ease with which interlingual and intercultural *faux pas* can be committed.

More generally, there was a tendency for some Spanish students to be more direct than would be usual for a native English speaker—and far more direct than is common in America's Scandinavian Upper Midwest—thereby running the risk of appearing rude. Also, a lack of high-level language skills could easily contribute to an appearance of bluntness, such as the message to which the "Good night kisses" closing was attached: "If you want to put it that way then do that." We are reminded of Paretti et al.'s (2007) observation of their engineering students collaborating internationally, who took

> a very narrow, task-oriented approach to communication . . . that, ultimately, hampers their ability to collaborate. The possibility that communication is a process of dynamic exchange or dialog did not come into play; instead their approach was highly task oriented ("do what you need to get it done"). (p. 343)

Although Paretti et al., referencing Downey et al. (2006), note that "U.S. citizens tend to minimize cultural differences; professionals and student alike tend to see others as more like than different from themselves culturally, and thus often miss key barriers to cross-cultural communication" (p. 334), in our project, the class in Fargo seemed to be more sensitive to cultural differences than the class in Barcelona. This could perhaps be a reflection of the students' major areas of study: the students in Fargo had included cultural studies in their coursework, many having already taken courses named Language Bias or Social and Regional Varieties of English. Four were enrolled in the PhD

program named Rhetoric, Writing, and Culture. Quite a few had already studied abroad or were preparing to do so. In addition, three had grown up abroad—two in Europe, one in Africa—and continually pointed out to their classmates differences that they saw between American culture and their own. In contrast, the students in Barcelona were enrolled in an engineering curriculum, which has little space for courses in the humanities and social sciences. For many engineering students, a technical writing course is one of their few contacts with instructors in the humanities, and they have even fewer opportunities to link with fellow students in the humanities.

Usability Testing

To fulfill one of their course assignments, the U.S.-based students conducted usability tests of their coauthored documents. To do so, they had to gain access to equipment in engineering laboratories on their own campus. Though many were able to do so, some difficulties arose, namely differences in equipment. The engineering students had been warned to choose topics for procedures that could be tested easily elsewhere and were simple enough for nonengineers to learn. Fortunately, the instructor in Fargo was able to secure enthusiastic cooperation from the university's College of Engineering and Architecture to have the international technical writing students conduct their usability tests in the local engineering laboratories with suitable test subjects.

However, on viewing the 18 topics chosen in Barcelona, the engineering faculty in Fargo reported that the labs lacked the necessary equipment to test eight of the procedures. Thus, close to half of the procedures went untested. Some of the topics were particularly machine specific, for example, "Programming a robot to solder a chip"; in other cases, confusion arose as

the machine used for the usability testing turned out to be a different model from that used in Barcelona. Thus, instructions that worked in Barcelona initially failed in Fargo. Also, some procedures required the use of additional machines not covered by the instructions. To gain experience at planning and conducting a usability test and in writing a usability test report, the NDSU students whose procedures could not be tested teamed up with those whose procedures could. Although the UPC students did not take part in the testing directly, those whose procedures could be tested were often consulted during testing when results indicated missing or unclear information. These students thereby benefited greatly as they became aware of what they had taken for granted or what they had not clearly communicated. In contrast, both in Barcelona and Fargo, the coauthors whose procedures could not be tested never had the opportunity to gain such benefits, other than obliquely from the results of classmates' tests.

When it became apparent that many of the procedures could not be tested in Fargo, hope emerged that some could be tested in Vaasa instead. However, when the Finnish class checked with their engineering labs, they discovered that they could test only six of the procedures—all ones being tested in Fargo as well. Hence, all eight that could not be tested in Fargo were also untestable in Vaasa. Moreover, two texts that were being tested in Fargo could not be retested in Vaasa. Thus, the six procedures that were tested in both Fargo and Vaasa yielded an embarrassment of riches for the coauthors who benefited from the results of testing at two sites, even as the coauthors for the completely untested procedures were left to revise nearly blind, with zero test results and only peer reviews from classmates to go by.

Time

Even as testing was taking place, the differing semester schedules and deadlines among the three European universities bringing translators to the project resulted in two of the translation classes' starting to translate the texts even before they could be revised with the benefit of test results. The class in Ghent required a draft first; the class in Paris, a week later. Because Italian universities start their autumn semester a month or more after those in Belgium and France, the class in Padua benefited from seeing much revised text, as the first set of procedures that they received arrived immediately following usability testing. Because translation agencies now compose technical documents in multiple languages simultaneously, not even labeling a source language or target languages (T. Thomson, personal communication, 1 May 2009), the experiences of the translation students in Ghent and Paris were actually more realistic and better preparation for what they would eventually face as practicing translators; however, they were also more frustrating, naturally enough, as the coauthors kept sending changes to the source text that the French and Dutch-language translators had already begun to translate.

Beyond the challenge of staggered starts to semesters, unshared holidays were sometimes a surprise when students *en masse* would inform their partners "I'll be out of contact the next few days for our Thanksgiving vacation," resulting in days of smooth progress falling victim to a pattern of fits and starts. In addition, the 7-hour difference in time zones proved difficult for some students, even as others were able to use it to their advantage as they "passed the baton" across their interlocking diurnal schedules—or, in the case of quite a few students, nocturnal schedules. Those who did not adjust in this way found it difficult to maintain a dialogue in real time, though some

eventually found some success by agreeing to use Skype during the project's latter phases. Interestingly, most of the students shied away from using real-time media early on. Indeed, on their own, they seemed to discover what Paretti et al. (2007) observed in their international collaborative project:

> Although rich media increase attention and motivation, they decrease participants' ability to process information; it is much harder, in other words, to come to a complex decision in a virtual chat or video conference than through an asynchronous e-mail discussion where each party has time to digest the information. (p. 333)

As iChat, Skype, Webex, etc. were largely ruled out, students came to rely on asynchronous communication such as e-mail, Dropbox, Google docs, and even Facebook, i.e., written communications that could be used as a record for reference later. This occasionally led to delays and may not have been as efficient as synchronous communication but was generally seen as an acceptable solution. As time went on and dialogue stretched out, more and more opted for the immediacy of real-time communications.

From the project's initial phase—selecting topics—to its final phase—translation and localization—having a long supply chain of skill centers stretching from Barcelona and Fargo through Vaasa and on to Ghent, Paris, and Padua meant that getting an answer to a question could take longer than anticipated, as the engineers usually did not respond directly or immediately to the translators, even when their e-mail address was included in queries. Instead, they tended to look to their coauthors in the US as the information hub, even when a translator's question could realistically be answered only by a SME. At times, Paretti et al.'s (2007) observation of their own students seemed to hold true:

ENGR students had far less incentive to collaborate; most of their work was related to the engineering design, in which the virtual collaboration played little role. The situation replicates many workplace collaborations between technical writers and product developers (p. 339).

With such a large number of people involved in the document's supply chain, any delay with one student often meant a knock-on effect at all the other skill centers, with the danger that information could be lost along the way. In one case early in the program, a student in Fargo failed to communicate for long enough that the project had to be abandoned, thus forcing her coauthor in Barcelona to join a classmate's project, but this also meant that the translators and testers originally assigned were left without a project, and they too had to be assigned to another.

As a project finale, the instructors arranged a real-time final videoconference connecting all parties simultaneously, i.e., coauthors, usability testers, and translators. However, with over 100 students participating among the six sites, only a portion of all the texts could be discussed during the two-session videoconference—starting at 2 p.m. in Finland, 1 p.m. in Western Europe, and 6 a.m. in North Dakota. Nevertheless, as had been the case in 2010, the students found the live connection both exciting and informative. For many, it was the first time that they had seen images of their partners beyond, perhaps, photos posted on Facebook. Afterward, many remarked that their partners had never seemed more real.

Conclusions

Though the project was far more challenging, and naturally frustrating, than students had ever experienced in any course they had taken, the vast majority reported, via postlearning reports, that they felt that they

had also learned more as a result of the TAP's realism, complexity, and learning-by-doing approach. As their instructors, we too are satisfied and pleased with the learning outcomes: the whole process, as revealed through prelearning and postlearning reports, proved valuable to raising students' awareness, prompting them to reflect on their writing, the challenges that they encountered through the process, and the finished products that they achieved by dint of effort.

For those who wish to replicate such a project, our experience leads us to offer the following advice:

1. *Start small, linking two classes internationally, then expand in increments.* As mentioned at top, the massive size of this undertaking, across seven nations in two simultaneous projects, began only after many years' practice on projects with much smaller dimensions. Except for the instructors newly added from Barcelona, instructors at all the other sites had gained practice over the years in bilateral projects. Recruiting partners at international conferences is relatively easy. Most of the TAP partners joined the network by that route. Whether international collaboration begins with coauthoring, with joint testing, or with translation/localization does not matter; choose a willing partner and gain practice. With success, you will be motivated to expand and will have gained the knowledge to manage additional partners.

2. *Make your best effort to align the courses with the project.* Learning works best when the course contents match the various stages of the project. That said, make peace with the things that cannot

be changed, especially universities' varied schedules and differing national holidays.

3. *Prepare the students for what is to come*. Engineering students need to be made aware of their critical role as technical communicators as well as their primary role as SMEs, if only to make the whole process easier and more effectual. As Paretti et al. (2007) put it,

> their assumptions about the degree to which workplace roles will be clearly defined a priori represent a significant learning opportunity. If they assume roles will be clear, then they will most likely lack the communication skills needed to identify or establish such roles in the absence of structure. (p. 347)

4. *The early stages are crucial*, especially the choice of appropriate topics. The whole project depends on the topics and procedures chosen. Once chosen, they cannot easily be changed. In our project, the instructors were all language experts, not engineering experts, so it was necessary to allow the students a great deal of freedom and integrity in the choice of subjects and the production of texts. In general, this worked extremely well. If the instructor understands her or his role as a monitor/facilitator, then the students stand to gain a great deal of experience and confidence from their work.

5. *Make sure that students are aware of potential communication problems*, including those arising from encountering a different culture. We have noticed that discussing problems that have arisen in the past is most effective at awaking students to what might go awry in their own communications. Obviously, the

accumulation of experiences is a help to teachers, so again we encourage readers to gain practice in increments. Also, at every class meeting throughout the project, it helps if instructors ask overtly how communication between partners is going so that misunderstandings can be cleared up and lessons drawn for the whole class to learn from. ■

Note

1 Information about the EHEA and the Bologna process of university reform in Europe can be found at http://www.ehea.info/

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