What Difference Do the Differences Make: Cultural Differences as Learning Resources in a Global Engineering Course

Yun Dai[a], Ang Liu[b], and Stephen C-Y Lu[a].
University of Southern California[a], University of New South Wales[b],

CONTEXT Over the past two decades, engineering educators and researchers in higher education have witnessed a growing emphasis on the intercultural competency for engineering graduates, due to the globalization in the market and workplace (Downey et. Al. 2006; Grandin & Hedderich, 2009; Valtaranta, 2013). In response to such reality, colleges and universities have initiated numerous technology-enabled intercultural programs and leveraged the task-based team activities to enhance intercultural exchange (e.g., Korhonen, 2002; Cajander, Daniels, & von Konsky, 2011). Nevertheless, the dominant discourses in this field tend to be framed by political, economic and organizational perspectives, with limited efforts devoted to understand educational experiences that students will go through in those courses and programs. Therefore, more attention should be paid to "the intercultural meetings and cultural content in education" and how to make that happen from a curriculum perspective.

PURPOSE By examining what and how students had constructed while engaging in an intercultural activity in a global technology-enabled engineering course, the research examines how the curriculum design supported or constrained opportunities of intercultural exploration in a global context.

APPROACH The study is situated in an ongoing four-year ethnographic project guided by Interactional Ethnography approach (Green, Skukauskaite and Baker, 2012; Castanheira, Crawford, Dixon, & Green, 2001). Data collected for the study include video records of classroom interaction, artifacts made by groups and instructors, filed-notes and interviews. The collected data was analyzed via ethnographic and discourse analysis.

RESULTS Firstly, it identifies that three groups of students, when provided a same task prompt, differed in multiple dimension in the group assignment, not only in contents and formats of presentations, but also ways of negotiating, making decisions and collaborating in preparing the assignments within the groups. Secondly, it finds that students extended and reformulated understandings of other cultures after contrasting the three presentations, and adapted effective ways of group working from other groups. Thirdly, it identifies that the transformations in student understandings and actions were made possible by the instructor's curriculum design, including designing of the tasks as well as the structure of the class activities.

CONCLUSIONS The research provides an evidence-based inquiry exploring how and in what ways the instructor's curriculum design created and shaped opportunities of intercultural learning in global engineering education practice. The learning evidence along with the identified transformation in student understandings shows that to support the intercultural learning in engineering education, it needs instructors to carefully and deliberately design the learning activities and opportunities.

KEYWORDS engineering education, cross-cultural communication, educational ethnography

Introduction

Nowadays, U.S. engineering programs are undergoing a shift from a traditional focus on "hard" technical skills, to an additional recognition of "soft" cultural skills, especially intercultural communication competency. Important initiatives have been made in the engineering curriculum, including the coursework requirements that students take foreign language and general education courses with an emphasis in international aspects and participate in study/work abroad programs. For example, Downey et.al. (2006) report a course titled *Engineering Cultures* as an effort to integrate global learning into classroom experience at Virginia Tech and the Colorado School of Mines, which was designed to engage larger numbers of engineering students to take the critical first step toward global competency. These studies, along with more recent ones (Van Maele, Vassilicos, & Spencer-Oatey, 2013; Hahn, & Sorenson, 2014; Deardroff & Deardorff, 2016), have provided practical guidance and suggestions for promoting intercultural competency among engineering students.

Literature review suggests some tensions within the intercultural initiatives. Ciftci (2016) in a literature review of computer-based intercultural learning suggests that the majority of current intercultural programs are fact-based, and sometimes superficial, in which students mainly exchange factual knowledge of different cultures and fails to maximize the opportunity to foster in-depth dialogues. Meanwhile, current research on intercultural education is usually outcome-oriented, focusing on the valuation and assessment of student development of intercultural competency. Guided by the orientation, a number of assessment models and frameworks have been developed, while limited research has been developed to focus on the enacted curriculum, examining the process how learning happens and students develop their intercultural understandings.

To bridge the research gap, this study presents a curriculum analysis of an intercultural learning task in a global technology-enabled engineering course that was jointly participated by three teams of students located in USA, Mainland China, and Taiwan (n=60). Focusing on the process of team tasks presented in the class, it explores how these three teams of students, when provided a common task statement, differed in ways of taking up the task, and how such differences in teamwork practice became resources for students to reformulate their understandings and actions in subsequent activities. Based on the empirical evidence, it examines how the curriculum design supported or constrained opportunities of intercultural exploration in a global context. Methodologically, the study is guided by an ethnographic perspective and adopts discourse analysis to trace the learning process. It provides an evidence-based inquiry exploring how and in what ways the instructor's curriculum design, including the task design and the course structure, created and shaped opportunities of exploring intercultural communication in global engineering education practice.

Research Design

Research setting

The study was conducted in an undergraduate engineering course Principles and Practices of Global Innovation in a global educational program called the iPodia Alliance (http://ipodia.USU.edu/) in 2016, which involved three globally distributed research universities in US, Mainland China, and Taiwan (USU, CHU, and TWU). To attend the course, students, who gathered in their local classrooms on their own campuses, were connected by the videoconferencing technology in a *World-Classroom* in which they attended lectures simultaneously. The lectures were delivered by the instructor who was physically located in the American classroom. The subject matter of the 14-week course was engineering design thinking from a socio-technical perspective. Its critical argument was that

designers must synthesize various social and technical factors to create functional artifacts (or service) that can satisfy customer needs (Jing & Lu, 2008) since social and cultural factors shaped customer needs while technical factors decided practical feasibilities. To help students understand how to explore the culture of a market, the instructor designed two intercultural activities along the quarter.

The present study focuses on the second intercultural activity titled *An Extraordinary Description of an Ordinary Day on Campus*. Guided by an ethnographic view of culture as socially and interactively constructed in everyday life, this task aimed to engage students in reflecting upon their everyday practice and exploring how the local culture was constructed in and through social interaction, as a preliminary step for future investigation on the culture in a foreign market. As requested by the task, three teams were formed by school and each team prepared 10-minute presentations for detailed and situated descriptions about their daily activities in a micro-level. On the day of presentation, the class section was structured into three parts. Firstly, each of the three teams took turned to have their team presentation. After that, the technical staff cut off the videoconferencing connection among classrooms for the 30-minute in-team discussion, in which they identified differences and similarities that were made visible about campus lives from the three previous presentations. Then, three classrooms were reconnected, and each team had a 10-minute response to present their findings.

Participants

The study (as well as the course) was participated by 60 lower-division undergraduate students from three universities in U.S., Mainland China, and Taiwan, with 20 from each university. As shown in Table 1, while USU students were exclusively from engineering and business backgrounds, CHU and TWU students were more diversified in academic backgrounds, including engineering, science, social science, humanity, and arts.

Table 1 Discipline Backgrounds of the Participant Students in the Study

	Engineering	Science	Social science	Humanity and arts	Total
USU	15	0	5	0	20
CHU	6	2	7	5	20
TWU	7	2	7	4	20

Research method

The research is guided by an international ethnographic (IE) approach (Green, Skukauskaite and Baker, 2012; Castanheira, Crawford, Dixon, & Green, 2001). This perspective focuses on artifacts and actions associated with language-in-use and provides a systematic and empirical way to record, analyse, interpret and report understandings constructed through social interaction within a social group. Unlike the quantitative methods verifying theories in a deductive way, it is an iterative, recursive and abductive reasoning process with an ultimate purpose to understand the insider's perspective. Guided by the IE approach, this research grounded the inquiry of curriculum on the task construction and social interaction in the class. Based on that, it explored what knowledge and understandings had been constructed and made visible.

Multiple methods were used to collect qualitative data, including field observation, class interaction videos, student interviews. The analysis followed a typical ethnographic research cycle, which consists of asking questions, collecting data, making a record, and analysing these data (Spradley, 1980). Generally speaking, the analysis starts with a summary description of activities happening within the context, then moves into more focused explorations of certain segments that might shed light on the research question, and finally to the more micro-level analysis of selected segments of observed interactions. To answer the research question, this research began at a general level of observation of the class interaction and gradually narrowed in how a particular activity (as well as a segment of the

assignment) was constructed (Spradley, 1980; Gumperz, 1982). Through the analytical approach, two kinds of data tables are created: an event map and a transcript. An event map represented phased and themed activities constructed by participants, while a transcript showed the moment-by-moment interactions among participants as they acted in a concerted way to achieve these activities. By using these two kinds of the data table, researchers were able to develop a comprehensive as well as in-depth understanding of students' task construction.

Findings and Discussion

Based on the analyses, the research findings are presented in the following two subsessions.

A same task, different take-ups

The field observation reveals that three teams of students, when provided a same task statement, delivered their own presentations that differed in multiple dimensions. In terms of the presentation format, USU students presented a PowerPoint slideshow, while the other two teams chose non-traditional formats: CHU students played a short movie to manifest their project, and TWU students presented a stage show in which students as actors acted out their project as if telling a story. The difference in format shows that each team had their own understanding of what counted as a presentation. While USU students held a regular view of a presentation as the business-style slideshow, CHU and TWU students appeared not to be constrained by the regular style, but creatively incorporating other media, format, and resources into the presentation. Beyond the presentation format, was in-depth difference reflected in presentation contents, including the content structures, their problem-solving strategy, and more importantly, the student learning.

Further analysis shows in-depth differences in the presentation contents. Table 2 summarizes the multi-level differences across the three presentations. In short, the NTU students presented a theatrical play supported by the linguistic, gesture, and spatial modes. In the play, they used narration to trace Ruby's, who was set as a typical NTU student, life routine across a day on campus. By unfolding Ruby's campus activities, it provided a detailed and situated description about the cultural practices on the NTU campus. As for the CHU students, they delivered an oral presentation and a movie as their assignment, which jointly used the linguistic, visual, and audio modes. In the movie, they created two characters as typical CHU students, Science Guy and Sunny Girl, and traced their experience across multiple settings on campus. By adopting the narration and comparison of rhetoric mode, they created situated description about their campus life as well as the problematical practices. Last but not least, the USU students did a PowerPoint presentation with linguistic, written, and visual modes. By organizing the content in a tree structure, they employed the division/classification rhetoric mode and exhausted student tools, options, and choices in the four dimensions of their lives, i.e., transportations, foods, academic life, and extracurricular life. Their description was oriented to a more comprehensive picture of student life by adding up the concrete options, while their view of student life went beyond the physical boundary of the university campus and included activities out of campus.

Table 2 Multifaceted differences of the Presentations across the three groups

	TWU	CHU	USU
Format	Theatric play	Remarks + movie	Slideshow
Mode	Language, gesture, spatial	Linguistic(oral), visual, audio	Linguistic, written, visual
Organization	Single tracing unit	Parallel contrast of two tracing units	Tree structure
Focus	Cultural practice	Customer needs	Tools, options, and choices
Rhetoric style	Narration	Narration, comparison/contrast	Division
What counted as extraordinary description	Detailed and situated description	Situated description with multiple manifestation and underlying reasons	Breadth and comprehensiveness, to exhaust possible options and add up
What counted as the ordinary campus life	A typical student's daily activity in typical settings on campus	Typical students' significant problems in living on campus	Student life in a daily basis, within and out of campus

What Difference Did the Differences make?

After the presentations, the instructor assigned the class for a 30-minute discussion section. For the discussion session, the videoconferencing connection across three classrooms was cut off, leaving each team to have discussion on their own. Each team had to identify some differences and similarities in campus activities from the three presentations. After that, three teams would be reconnected and present their team discussion outcomes and findings as a response. During the investigation of team discussion and responses, the differences made visible in previous presentations turned out to shape students' understanding and trigger two kinds of transformation.

The first transformation was evident in USU team's discussion. In addition to the differences and similarities, they also discussed how to present their findings. Table 3 is a transcript of an excerpt from the discussion:

Table 3 Transcript of A Segment of USU Team Discussion

Line	Speaker	Message Unit (Narrator)	Contextualizational Cues
334	Male	I say um we should make a 5-minute video right now	Class laughs
335	Female	iMovie!	High volume

Within this segment, a male student proposed to make a video, as CHU team did, for the incoming response and the class responded with laughter. The proposal to make a video reflects that USU students were aware of the difference, if not a gap, between their own presentation and the other two, and they appeared to want to learn from CHU team and present a video as well. Such self-awareness also can be seen in their following response as well, when a USU student opened their response by saying:

> *We noticed that apparently we, since we're all business majors, engineers in our team, that we aren't as creative (as our previous presenters). So we decided that we should add something to our slide show in our attempt to be more creative, as you guys.*

In this excerpt, USU team admitted that they were not as "creative" as other two teams, acknowledging a gap in ways of doing presentations. They further contributed the gap to their academic backgrounds of either engineering or business, which was believed to shape their particular ideas of presentations and constrain their creativity. To break the constraint and "be more creative", they changed their way of doing the response by incorporating a

short live show, which they learned from TWU team. It is clear that, by contrasting the presentation done by others and themselves, USU team reframed their understanding of what counted as a presentation and how to deliver a good presentation. That is, students' understanding of the presentation was greatly broadened by new ideas and best practices. Inspired by these models, they reformulated their mindset and adjusted their actions in the consequent response.

Another kind of transformation in understanding can be seen in three teams' response, which was caused by the differences in campus activities shown in the three presentations. TWU's response can be used as an example to demonstrate such a transformation. In explaining what differences and similarities they found among three presentations, the TWU presenter said as following:

> *We try to discuss the unconsciousness part that lies the little clip shot by the CHU students, and the slides of USU students. Like in little clip, there are some part like, Science Boy try to ask for the seat, and the sunny girl also ask for the seat, and other parts like, the Science Boy after he ordered meal, he also tried to find a place, and also like the sunny girl dancing on the platform of the metro, and these points are indicating that PKU students have needs and demands under their consciousness part of their brain, to seek for the space in their life, in their campus life. They're trying to find space, or the demand, or the X in the clip, are related to these kinds of wants in their daily life. We think about that's what we got for CHU students. And comparing to TWU students, we think that we also have this kind of situation on our campus. Since we have so many students also on our campus, we do have limited space, so we want for more space for our personal space. But compared to CHU we are freer, we do not have obligation or regulation, that we could not have activity in some building in some places, outside, inside the campus, or we do not have the regulation that we need to go to bed at 11. Without the regulation, we have more freedom, or the right to use the space on our campus. So compared to CHU students, although we also have this kind of problem, we have more flexible in this issue.*

In this excerpt, the presenter cited specific activities from presentations as evidence to support their observation that CHU students were "seek(ing) for the space in their life". These activities were carefully selected and reframed to fit into their central claim about the physical space problem. Based on the concrete evidence, he directly pointed out the inference and interpretation made by his team: CHU students had needs on space. The word choice, "under their consciousness part of their brain", indicated that the TWU team attempted to go beyond the surface of these activities and extract some essential understanding about CHU campus. The attempt was successfully achieved when he removed all these superficial differences in detailed activities between CHU and TWU and identified a shared problem in an abstract and essential level, the space issue. In addition to the similarities, he further identified differentiated reasons underlying the phenomenon. That was, even there was insufficient space in TWU campus, they did not have "obligation or regulation" that constrained students' usage of space as CHU did. By building connections across campus lives and reading beyond the surface, they advanced their understandings about cultural differences and developed in-depth understandings of essential reasons underlying these differences and similarities.

Similar advancement in understandings could also be found in CHU and USU teams' responses. For example, CHU figured out the growing awareness of privacy among this generation of college students as one of the essential reason for the space problem. As shown in the above analysis, the advancement in understandings was made possible by the previous presentations, in particular, the differences in presented activities. From this perspective, these presentations, like a collection of library references, provided rich resources for students to contrast and reflect upon, so they could go beyond the concrete activities and develop deeper understandings about the cultures and cultural differences.

The transformations presented above, make visible how the curriculum design and course structure with three phases of activities-- presentations, discussions, and responses, created the possibility for reformulation in understandings and actions. The presentations were not

only to present the final products of teamwork that happened before the class section but to also provide a starting point for engaging students in the practices and processes of exploring the similarities and differences in ways of doing presentations and campus-based activities across teams. From this perspective, as three teams unfolded their work in presentations, these presentations became public texts for interpretation, constituting new(er) contexts of the class. By observing what other teams were doing and where, when, and with whom, students (re)framed their discourses, adjusted their decisions, and (re)formulated their actions in consequent events, in order to match the changing context. In this sense, students in interaction became environments and contexts for each other, and they shaped and in turn were shaped by the context being constructed (Erickson & Shultz, 1981).

Discussion

This study presented a curriculum analysis of an intercultural learning activity in a global engineering course. By examining the assignment presented by the three teams, it identified different practices and understandings constructed by students in doing the task. Based on that, it further explored how the instructor turned the difference in taking up the given task into a new opportunity for learning. That is, the differences in doing the presentations and the different contents of campus activities presented in the presentations, were used by students as resources to reformulate their understandings and reframe their consequent actions. By uncovering the practice and process of student engagement in the designed activities, the study shows that the curriculum design supported student learning and exploration in intercultural communication.

Acknowledgement

The authors would like to thank the funding support from the James N Kirby Foundation.

References

Angelova, M., & Zhao, Y. (2016). Using an online collaborative project between American and Chinese students to develop ESL teaching skills, cross-cultural awareness and language skills. *Computer Assisted Language Learning*, *29*(1), 167-185.

Castanheira, M. L., Crawford, T., Dixon, C. N., & Green, J. L. (2001). Interactional ethnography: An approach to studying the social construction of literate practices. *Linguistics and Education*, *11*(4), 353-400.

Çiftçi, E. Y. (2016). A Review of Research on Intercultural Learning through Computer-Based Digital Technologies. *Educational Technology & Society*, *19*(2), 313-327.

Deardorff, D. K., & Deardorff, D. (2016). Assessing intercultural outcomes in engineering programs. *Teaching and Training for Global Engineering: Perspectives on Culture and Professional Communication Practices*, 239-258.

Green, J. L., Skukauskaite, A., & Baker, W. D. (2012). Ethnography as epistemology. *Research methods and methodologies in education*, 309.

Gumperz, J. (1982). *Discourse strategies.* Cambridge: Cambridge University Press.

Hahn, L., & Sorenson, L. (2014, October). Developing engineering students' language and cultural skills for academic and professional success. In*Frontiers in Education Conference (FIE), 2014 IEEE* (pp. 1-4). IEEE.

Jing, N., & Lu, S. C. Y. (2011). Modeling co-construction processes in a socio-technical framework to support collaborative engineering design. *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, *41*(3), 297-305.

Mayhew, M., Eljamal, M. B., Dey, E., & Pang, S. W. (2005). Outcomes assessment in international engineering education: creating a system to measure intercultural development. *age*, *10*, 1.

Schenker, T. (2012). Intercultural competence and cultural learning through telecollaboration. *CALICO Journal*, *29*(3), 449-470.

Spradley, J.P. (1980). Participant observation. New York: Holt, Rinehart, and Winston.

Van Maele, J., Vassilicos, B., & Spencer-Oatey, H. (2013, January). Global Engineers, global people? Integrating intercultural learning outcomes in the engineering curriculum. In *Proceeding of the 41th SEFI annual conference 2013: Engineering Education Fast Forward* (pp. 1-8). KU Leuven.