

## **Cultivating "global competency" in a divided world: A collaborative autoethnography of the cross-border curriculum design**

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## **Cultivating “global competency” in a divided world: A collaborative autoethnography of the cross-border, dialogue-based curriculum design**

### **INTRODUCTION**

#### **BACKGROUND**

Amid the pandemic and geopolitical conflicts, the world and local communities are facing supply chain disruptions, energy shortages, economic downturns, and various ecological and human crises. In this context, technological and scientific talent is not only considered a solution to these crises and disputes but also an asset. The National Academy of Engineering in the United States believes that future engineering students must possess cross-cultural communication skills, empathy, and an international perspective because they will face increasingly severe global disasters and market challenges, such as climate change, refugees, or network security, which require not only international competition but also cooperation. To address these challenges, there is an urgent need to cultivate interdisciplinary, cross-cultural analytical skills, and global perspectives among engineering talents to engage in responsible innovation and confront current crises while considering the possibilities for local and global sustainability.

Despite Taiwan and Korea’s positions at the core of the global industrial chain and geopolitical landscape, engineering and humanities education remains underdeveloped. To provide some context, in Taiwan, engineering accreditation system, IEET, was established in 2003 and became a member of the Washington Accord in 2005, working to promote, improve, and standardize engineering education to meet certain goals, engineering talent cultivation (“工程人才培养”) in particular. National Yang Ming Chiao Tung University is no exception, having to obtain IEET certificates in various engineering fields. Notwithstanding, the current general education curriculum in Taiwan still lacks engineering and humanities integrated courses specifically designed for the College of Engineering, such as courses related to engineering practice and corresponding cross-cultural socio-political systems. As a result, students’ learning experiences are like a hodgepodge, lacking effective interdisciplinary learning. Only a few engineering ethics courses are offered by professors from the School of Engineering and School of Electrical and Computer Engineering, but they face human resource, professional, and teaching bottlenecks.

Universities in Korea started offering engineering and humanities integrated courses as part of engineering curricula or liberal education around 2000. Like Taiwan there are not sufficient instructors who are trained and motivated. These inadequate course designs and systematic limitations lead to a lack of understanding of the relationship between technology and society and a lack of systematic thinking among science and engineering students. This situation limits students’ ability to think about their professional skills, future employment, ethical responsibilities, and other issues in a global context.

We also witnessed an educational reform in engineering education curriculum worldwide. In 2018, China began the New Engineering Education and Excellent Engineer Education and Training Plan as the cornerstone of its national engineering program. In May 2021, the United States passed the Innovation and Competition Act, which increased funding for STEM education. In other words, the development of engineering education is closely related to national expansion, industrial structure, and global political changes, and may become a key power field and colonial tool. Although Taiwan and South Korea play important roles in the global high-tech industry chain and geopolitics, their comprehensive thinking on engineering education is far from enough. As STS scholars and engineering educators in East Asia, we have a moral obligation to assume these responsibilities, and to examine the historical facts behind the impact of technology on geopolitics and society, in order to further analyze and reflect on what engineering education should teach, whom it should serve, and the ideology and value system behind it.

To achieve the goals, it is not enough to simply learn Western textbooks and knowledge. Instead, we should use non-Western experiences, research, and perspectives to re-understand the impact of the Cold War and neoliberalism on East Asian technological development, national governance, and labor structures. A dialogue-based classroom, as this paper argues, would be a possible pedagogical approach for teaching global engineering competency, especially in a non-Western context, and only then can we prevent engineering education in East Asia and globally from becoming a tool of capital and colonialism, and cultivate our engineer-to-be with critical thinking skills, global perspectives, and humanistic care.

## THE COURSE

This course is therefore an attempt to achieve the goals. Topics covered in this course include: Technology and Nation, Military-Industrial Complex, Science, technology and society during the cold war, Global Value Chain, Innovation Paradigms, Energy controversies in Taiwan and Korea, and Covid science and politics in Korea and Taiwan. We purposely selected these topics to provide students with an insight into the intricate connection between engineering and social and historical aspects. This course is co-instructed by Sharon Ku (National Yang Ming Chiao Tung University, NYCU) and Jongmin Lee (University of Science and Technology, UST) in Fall semester 2022. Shawn Sun (National Taiwan University, NTU) is the lead author and primary data collector and teaching coordinator. Sean Ferguson (California State University Channel Islands, CSUCI) has worked with all three members of the team in various capacities. As the syllabus suggests, this course aims to “*promote engineering humanities education across borders*” for the engineering students across the two universities. During the course period, for the purpose of fostering a dialogue-based classroom, each NYCU student will be paired with a UST partner to conduct interviews, homework assignments and a collaborative research project. Four teaching formats were used to facilitate the course progress:

1. **Synchronous Lectures:** Synchronous GC was hosted by two instructors from NYCU and UST. Comparative case studies and analyses were introduced with breakout room discussion to help students comprehend the interplay among science, technology and the

formation of world communities in various socio-political contexts.

2. **Prompt-based Interview:** Students conducted three sets of prompt-based interviews with their global partners through which to exchange learning outcomes and detect biases and stereotypes in cross-cultural communication.
3. **PECE Digital Infrastructure for collaborative homework and research data curation:** The digital archival platform PECE (Platform for Experimental Collaborative Ethnography) was implemented in this course to facilitate epistemic diversity and comparative insights in cross-cultural learning and research. Students used PECE to produce and curate their homework assignments and collaborative term projects. A tutorial section was offered for the methodological training.
4. **Collaborative term project:** Each pair conducted a research project to investigate science and technology across borders.

As for the student body, in this course, we had a total of 27 students, 12 students from NYCU and 15 students from UST. All of the NYCU students are undergraduates, while all of the UST students are either graduate or Ph.D. students because UST is a graduate institute. Their areas of expertise are in various fields of engineering, including civil, mechanical, chemical, systems, radiation, and computer science. Students from NYCU are mostly Taiwanese, with one Filipino, one Korean; comparatively, students from UST come from a wide range of countries, including India, Uzbekistan, Ecuador, China, Vietnam, Jamaica, Pakistan, Philippines and Indonesia. As for the classroom setting, NYCU students attend the course in-person at Chiao Tung campus, while UST students attend virtually and synchronously using Webex from their campus that spans the entire Korean peninsula.

The structure of this paper is as follows: Firstly, we examine relevant literature on global competencies in engineering and STEM education, as well as the teaching techniques and assessment tools used. Secondly, we provide context for the pedagogical approach we use in our project and course, which is based on critical pedagogy and dialogue-based teaching, and address critiques of this approach. The methodology section of the paper then outlines our teaching and research methods. The fourth section presents initial findings from the course, focusing on the different teaching methods we employed and evaluating each method, as well as discussing the transformation process by both instructors and students throughout the semester. Lastly, we conclude the paper by reflecting on lessons learned about this dialogue-based engineering humanity teaching methods in response to the increasing fragmentation of the global order.

## LITERATURE REVIEW / CHALLENGE / RESEARCH QUESTIONS

In the field of engineering education, research indicates that existing engineering education accreditation systems predominantly rely on outcome-based evaluation for assessing students’ abilities. This approach is teacher-centered and certification-oriented, whereby the content taught and the evaluation methods used are solely determined by instructors. This has led to a situation where many departments tend to allocate such courses to engineering or

adjunct professors in order to save on human resources. The former group often overly emphasizes micro-ethical issues at the personal level or simply regard ethical codes of engineering associations as the best practice and a dogmatic rule to be followed [1], [2], without providing students with broader knowledge and perspectives to explore organizational, socio-cultural, and international dimensions of engineering practice, as well as to engage in critical thinking about the moral, social, and political implications of engineering decisions in specific historical contexts [3]-[4]. The latter tendency marginalizes humanities education in engineering, resulting in a lack of interest and motivation among most students to take up elective engineering humanities courses [5].

As for developing global competencies, there are few clear guidelines on what are “best practices” in engineering and STEM education [6]-[7]. Choices tend to utilize generic criteria such as OECD’s PISA 2018 Global Competence assessment and IUPUI Civic Minded Graduate Rubric 2.0. The methodologies deployed to assess students against these metrics are then methodologically heterogeneous, with surveys predominating at the end of a class or project. A collaborative online international learning program (EPICS) developed at Purdue University has been operating for many years and situates international service learning within virtual environments—an innovation to augment or replace the short service projects common in engineering [8]. With the chaos of the COVID-19 pandemic more instructors have experimented with virtual STEM and engineering teaching. Ndubuisi et al. [9] designed a system for incorporating global competency training modules (GCMs) for students at a Canadian university to learn together and then apply the concepts to specific research projects. The course already existed in the curriculum and the GCMs were introduced before teams started working together. The emphasis on competency focused on self-reported intercultural communication skills development. Walter et al. [10] reported on an interesting mixture of synchronous and asynchronous resources that led undergraduate STEM students from four countries through a design based process to consider how to support health interventions in low resourced regions. Global engineering competency was collected from an ad hoc Likert scale survey focused on student attitudes to the collaboration experience.

Alternatively, one can choose to integrate validated, but also intensive, case study tools. For example, Mazzurco, Jesiek & Godwin [11] developed a 27 item self-reported measurement termed the Global Engineering Competency Scale (GECS) to assess students’ self-perceptions of global engineering competencies. These require pre/post surveys and can not be tailored to a given class else the question validity is lost. More recently, Jesiek’s research team developed a situational test for students to think through cross-cultural engineering practice scenarios and then rate the efficacy of presented resolutions to the multiple scenarios [12]. While useful in the scholarship on engineering education and global, cross-cultural competencies comparable empirical studies that can account for the rich context of international student cohorts working in virtual collaborative settings is critical. Many engineers do, or will, be navigating work life in these types of virtual, global environments particularly with a turn to industry 4.0 and ongoing interest in leveraging digital resources during a global pandemic [9], [10], [13].

Virtual global classrooms emerge as a response to our acknowledgement that more students need these cross-cultural experiences and the costs of providing these opportunities are high (e.g. [14]). More recently, travel to other countries has been strained due to geopolitical upheavals and concerns over a variety of risks. Our team steps into this space to offer our version of curricula innovation that provides the rich description of the individual and institutional context, procedural challenges, instructor perspectives, student generated data under analysis, and the researchers collaborative reflection spanning over a year of working together. We argue that deeply contextualizing how we theorize global competency, theoretically build and run our courses, and attend to the nuance of physical infrastructure and diverse cultures is a necessity for engineering educators to improve our capacity to facilitate effective global, cross-cultural learning.

## THEORETICAL FRAMEWORK

We ground our teaching methods in the literature of dialogue-based pedagogy. Firstly, Paulo Freire [15] argues that education, as a means of intellectual and practical liberation, should not involve shielding students within a protected and standardized evaluation system. Instead, education should be situated in the real world, and foster critical consciousness through dialogue rather than one-way lecturing by the teacher. Only through this process can students establish a genuine relationship between themselves and the world. Freire rejected traditional lecturing education, which he likened to a “banking model” where the teacher deposits knowledge into students who passively listen, accept, memorize, and repeat. According to Freire, human existence is not silent or passive; speaking is not a privilege of some or the well-off, but rather a *right* of all. Speaking as an act has the power to transform the world with the usage of expressing opinions. Here, he argues that dialogue-based teaching greatly promotes students’ thinking and exploration with teachers, in which students’ learning is no longer limited to passively receiving knowledge through the banking model, but is constantly stimulated to actively explore and discover through the back-and-forth dialogues they have with the instructors. In this process, students reflect on the inequalities imposed on individuals and society and raise their awareness. As a result, they acquire knowledge and power through the dialogue process. Notably, a genuine dialogue is not mere conversation but a two-way exchange in which both parties are subjects with agency. As a path to critical consciousness and liberation, this teaching approach then differs significantly from the traditional educational model, in which teachers impart knowledge and students receive it as a deposit.

However, dialogue-based pedagogy, as well as more broadly, critical pedagogy, has faced criticism from scholars such as Elizabeth Ellsworth and Alison Jones. Ellsworth [16] portrays pedagogy as a form of performative practices that can, far from what it vaunts, exclude certain perspectives and topics, leading to suppressed or changed objections. Critical pedagogy, according to her, is not as “empowering” as what it initially argues [17]. In the same vein, Jones [18] criticizes dialogue-based pedagogy practiced in multicultural classrooms, where it puts individuals from different backgrounds at asymmetric risk and self-disclosure. She challenges the assumption that cross-cultural understanding benefits both

dominant and nondominant groups equally and suggests that the desire for dialogue can be driven by a voyeuristic desire for redemption or forgiveness on behalf of the dominant group (“absolution”). In sum, while promoting dialogue is important in the critical process, we must reflect upon the form, tacit rules, and purposes of dialogue itself.

Another important element of this course is the use of co-teaching. Critical pedagogy also embraces co-teaching because the hidden curriculum can become foreground when two or more teachers are sharing their experiences in institutional context. Roland and Jones [19] note that there has been an increase in social justice teaching and co-teaching in higher education, but rarely are these practices combined in the extant literature. Co-teaching lends itself to the practice of undermining power in the classroom with each instructor operating between teacher, learner, and critical audience. In their particular case, their autoethnography informs the analysis on how co-teaching a politically challenging course as marginalized faculty informed their ability to retain the critical pedagogy praxis. Co-teaching is argued to be good for students and faculty, when “navigating the chaos of teaching”, particularly among instructors who are marginalized or integrate critical aspects into the teaching environment that invites tension between participants, what Banda and Reyes [20] describes as a comrade co-teaching essential for the instructors to support one another and protect their own well-being while also caring for students needs.

### **Research Questions**

- How to teach global engineering competency in a non-Western context? Is dialogue-based classroom an effective pedagogy?
- How is it possible to integrate co-teaching between different institutions, cultures, and pedagogical expectations?
- What essential competencies for cross-cultural, global engagement can we draw from the indicators that students and instructors exhibit in this classroom?

## **METHODS**

### **TEACHING METHOD**

To overcome the challenges of synchronous teaching and collecting research data, we assigned ourselves different roles: two instructor-researchers (Sharon and Jongmin) and two researcher-instructors (Sean and Shawn) who had main roles and supporting roles. Four members held weekly prep meetings where they constructed plans for the upcoming class and shared their interaction with students. Sharon and Jongmin took turns to serve as the main instructor for the weekly sessions while the other member was always present in the classroom to serve as the supporting instructor. For classroom setting, it is critical to understand the layout of this collective learning experience. We met every Thursday for two hours for sixteen weeks. As Korea and Taiwan had different fall semester schedules, we used fourteen overlapping weeks as our common learning time.

### **RESEARCH METHOD**

The data used for this study was obtained from a classroom fieldwork that took place from August 2022 to February 2023. The study utilized a variety of methods to gather data. First, the instructors were asked to write reflective notes about their teaching experiences, which were used as autoethnographic accounts for analysis. Second, a research assistant attended weekly instructor meetings and in-person classes at NYCU to observe the classroom dynamics between the instructors and the students. We are thus able to track how this course evolved during the semester. Third, the research assistant conducted qualitative interviews with the students after the semester ended to gain insight into their motivation for enrolling in the course and their thoughts on the most challenging/interesting aspects of the course. Qualitative interview was also conducted with the instructors by the research assistant. Note that prior to collecting interview data with students, we obtained approval from the Institutional Review Board (IRB) at the NYCU office. This was done in accordance with research ethics, particularly as students can be vulnerable to power dynamics in their relationships with instructors. Finally, a quantitative survey (course anticipation and evaluation) was distributed at the beginning and end of the semester to track the students’ learning progress numerically.

## **DATA PRESENTATION AND FINDINGS**

### **BEGINNING**

After the onboarding of every team member, we started to organize the global classroom for the Fall semester 2022. Our weekly meetings with instructors began in August 2022 to prepare for the course, where we covered topics such as course lexicons, course contents, IRB logistics, and platform to use for document-sharing and assignment upload. The duration of each meeting was about two hours via Webex. Throughout the instructors’ meetings, the topic of students and their needs have consistently remained at the forefront of our discussions, and we tried to align our different perspectives of how this course should run, and to what extent the course loading should be put onto the students. With Webex auto-transcription services, Shawn created word clouds after the meetings to present us with visual depictions of word frequencies. In effect, a quick text analysis coding for our review as an instructor team. Unsurprisingly, the conversations were student centric in most instances.

#### ***for the students***

The motives behind the enrollment of students in this course also deserve further scrutiny. For NYCU students, the motives can be categorized into several different reasons, including (1) the desire to earn a good grade without much effort, (2) the intention to improve their English skills, and (3) the aspiration to establish global connections. Firstly, Taiwanese students, especially those studying engineering, feel overburdened by an ill-designed curriculum, which drives them to search for courses that are regarded as “easy A’s.” These courses are those that require minimal effort and can quickly result in good grades. This particular course falls under the category of General Education (通識課程) and is also perceived in this way.



For example, a civil engineering student stated that he chose this course mainly because he believed it would be a simple and straightforward class, similar to other general education courses he had previously taken. “*At first glance of the syllabus, I thought that this is going to be an easy course as other ones that I had taken, and that is the only reason why I chose this one,*” he said, not expecting to devote much time and energy into this course. Some students, on the other hand, enrolled in this course with the intention of improving their English abilities. StudentY, recognizing his limited proficiency in English, selected this English-teaching course to develop his language skills. StudentA, who is planning to study abroad as an exchange student, also took advantage of this course. Overall, the success of a dialogue-based course is highly contingent on the students’ level of motivation and active participation in the course material; without students’ engagement, courses like this will be least likely to succeed, and this is what we experienced during the first few classes, which will be discussed later.

A comparable situation can also be observed from the perspective of UST students. Hung (student from NYCU) mentioned that her UST partner frequently expressed frustration about the amount of time they had to dedicate to this course, exclaiming that “*this course is irrelevant to my future! I’m only taking it to fulfill the course requirements.*” The UST student’s dissatisfaction may also be attributed to the fact that many of them are graduate or Ph.D. students, and some are with familial responsibilities, which makes it difficult for them to devote additional time to the course and its assignments. A few students from UST ends had also told us that such a course offered them an opportunity to “*have a slight deviation from my main capacity or major*”. However, some students from UST also expressed their interest in this course content, stating that “*I chose this class specifically to challenge myself to a topic more socially oriented*” or to seek for “*a diverse class environment*”.

## **PEDAGOGY**

As previously stated, the global classroom employs a range of teaching methods such as synchronous class, prompt-based interviews, the use of PECE Digital Infrastructure for photo essays, and collaborative term projects, all of which are designed to align with our dialogue-based teaching philosophy. In this section, we detail and evaluate each teaching method from instructors’ and students’ perspectives.

### ***Co-teaching hybrid classroom***

Collaborative teaching is a crucial aspect of this global classroom. It involves two instructors, in this case Jongmin from Korea and Sharon from Taiwan, with diverse cultural backgrounds, academic backgrounds, and teaching philosophies working together in the presence of students to facilitate a back-and-forth exchange, allowing students to observe in real-time how cross-cultural and cross-border dialogue and, in this course, cross-digital cooperation functions. On the instructor side, co-teaching required a great amount of time for coordination and collaboration. In addition to two hour class time, we had weekly instructors’ meetings. Two instructors, Sharon and Jongmin, also spent another few hours preparing for class. Sharon, Jongmin, and Shawn also met with students one-on-one or as a group. Occasionally, the atmosphere during instructors’ prep meetings would be a bit intense, as

those involved in the discussion were grappling with the challenge of deciding what to teach, how best to teach it, and which examples to use to effectively engage students in this diverse global classroom, according to fieldwork observations made by Shawn. We strived to exchange data and ideas in order to measure the level of student engagement and understanding to plan next pedagogical steps accordingly.

On the other side, during the class time, co-teaching with a virtual digital platform is also a craft, requiring effective communication and coordination between instructors, as well as the ability to adapt to the needs of the students and the constraints of the technology. At times, the two instructors might even fail to adhere to the allocated lecture time, leading to a reduction in the available time for discussions amongst the students. Below served as an example showing how co-teaching worked and the dyadic dynamics and dialogue in this hybrid classroom setting:

**Jongmin (via the Webex room, the main lecturer for today’s class):** I want to shift our focus to the intersection of technology and globalism. So when we talk about civilization...

**Sharon (in-person at NYCU classroom):** Hello, Jongmin.

**Jongmin:** ...Yes?

**Sharon:** Can I interrupt you for a moment?

**Jongmin:** Sure, go ahead. I’ll stop sharing my screen.

**Sharon:** Okay, just to recap, you were discussing nationalism and how it’s an imagined concept. Then you brought up the idea of techno-nationalism. Are you saying that scientists and others have imagined a nation as a space that needed to be constructed through technology, which is why countries like Taiwan and Korea have experienced an economic miracle? Is that what you’re trying to convey? Who imagines nations like Taiwan and Korea in a particular way? Who constructs this imagination?

**Jongmin:** It depends on the time period. In the 1950s, for example, only the elites were imagining something like a nation. ...

As for the students, one student highlights the challenge of understanding instructors and peers from different cultural backgrounds, stating that online teaching can be less effective than in-person teaching due to the need to pay attention to both the screen and the instructor in the classroom. Another two students emphasize the potential benefits of co-teaching in a global classroom, noting that it exposes students to diverse perspectives and opinions, leading to meaningful discussions.

### ***Assigned readings***

At first, we believe that to achieve an effective dialogue, one must have some prior knowledge. In this way, students are expected to complete the assigned readings before each class, and the instructors will facilitate discussions by connecting the readings to the week’s topic. The readings typically consist of 50 to 100 pages of English text per week. For the instructors, the readings assigned for a course are important for discussion. However, as we observe from this course, we found it equally important here to ponder over what to assign

for engineering students who are new to the humanities. It is worth questioning whether 30-page academic papers or book chapters are suitable as foundational knowledge or if videos and documentaries would be more effective, as some students suggested.

During his interviews with students, Shawn discovered that the majority of them failed to complete the weekly readings, and some even neglected to read them entirely throughout the semester. Several students made comments such as, “*I didn’t even read a single page, yet I still managed to understand what the instructor was discussing,*” and “*Why do the social scientists have so much to say and could not really trim it down?*” This poses an important problem regarding the use of course materials if instructors want to present an alternative perspective with the use of these academic readings as the prior knowledge. We argue that this might be an opportune moment for instructors to reflect on the syllabus-making process: what to assign, and what not to assign? What lays the foundation for the students to engage fully in class, especially when the goals are to cultivate a dialogue-based learning environment for global engineering competency? And what might hinder that process?

### ***Prompt interview***

To structure constructive and exploratory dialogue, we extracted several key concepts from important literature on each topic of the globalization course and designed a series of prompts as pre-class assignments for students. NYCU and UST students were paired as 1-1 learning partners and they used this series of prompts as a guideline for conducting weekly prompt-based interviews and exchanges. For each prompt, students recorded four aspects on the “prompt interview sheet”: their answers before the interview, what they think their partner would answer, their partner’s actual response from the interview, and their own reflections on the question after completing the interview. An unedited example driven from a student pair is depicted in Appendix 1.

These prompts and dialogue exchanges were designed to help students link classroom topics to their own experiences and values, allowing them to critically apply the theoretical concepts learned in class to similarities and differences in their cultural contexts using their own language and experiences. At the same time, this dialogue-based platform also enabled students to detect communication barriers, bottlenecks, and prejudices unconsciously imposed on each other during the exchange. We believe that reflection on cross-cultural communication would lead students to break free from the myth that communication skills and an international perspective are only about speaking fluent English, and must focus more on cultivating cross-cultural empathy. Questions for this course are listed in Appendix II.

StudentH from NYCU told us that the interview questions “*had forced her to think seriously.*” She explained that, unlike during her leisure time when she seldom discussed such questions with her peers or classmates, the course forced her to engage more deeply with the various topics alongside her global partners. Additionally, she noted that she “*had to search online for the information that she would like to introduce to the partner,*” which gradually gave her a sense of accomplishment as an engineering student who had not previously encountered such topics. It suggests that the use of prompt interview serves a dual purpose for Hung, facilitating both an external dialogue with her global peers and an internal dialogue with herself. Through this process, she gains a newfound understanding of herself through the knowledge and perspectives gained in the course.

### ***Final project***

In general, the final project was the most beloved aspect of the course by students. They are encouraged to work on a comparative project given that students came from different countries and were from diverse backgrounds. The topics they chose ranged from solar energy, gender and STEM education, AI, to hydrogen fuel and renewable energy policy. The whole preparation time for the students to do this project was about a month.

One student expressed that this was the first time they worked on a “*social science-themed*” project, and they learned a lot during the preparation and data collection process, as well as how to approach problems like a social scientist. He even told Shawn that “*I never thought that actually social scientists are quite meticulous when it comes to making solid arguments!*” This “social scientist” way of thinking, according to the student, is quite different from the training they received in their engineering department. Another student mentioned that it was actually during the final project collaboration, rather than the prompt-based interviews, that they finally understood how cultural differences work in reality, and how hard a successful conversation is to be achieved, having to overcome “*so many differences*”.

### **TRANSFORMATION**

A dialogue does not occur instantly, as the examples shown in this course, it requires time for dialogue to develop. In this section, we delve into a myriad array of transformations during the course, encompassing those that transpired within the purview of both students and

instructors. Moreover, we also highlight transformative moments that surfaced in the dynamic interplay between the students and instructors, or among the students or instructors.

***Students: from silenced students to students who speak***

Some students, especially those from NYCU end, seemed reluctant to engage in the course during the first few classes. This issue was a frequent topic of conversation between Sharon and Shawn as we were worried and tried to understand what might be the cause. We explored several potential factors that could have contributed to the issue, including the possibility of a language barrier, the prevalence of passive learning habits among Taiwanese students, and the perceived lack of relevance of the topics discussed to their interests and experiences.

Considering that this is an engineering humanities course centered around dialogue, “silence”, in this context, was unlikely to fulfill the original course objectives. In this type of course, active participation and dialogue are crucial for creating a collaborative and engaging learning environment. When students remain silent, it not only makes it difficult for instructors to gauge their understanding and level of engagement with the assigned materials and readings, but it also inhibits the co-learning experience with their peers. For instance, in the first few weeks of the course, Hsu exhibited reluctance to participate in class and was tardy in submitting assignments. This was not an exception, as during the fourth week of the course, students from NYCU remained conspicuously quiet throughout the class, in stark contrast to their UST counterparts, who were actively and enthusiastically engaging with Jongmin. After the class, the teaching team chatted a bit, where Sharon said: *“Yeah, we can gradually sense that dynamics, you know, in this global classroom, um, that, uh, your students seem to be more involved, engaged with the reading and then can connect this experience to, you know, the question they are interested in their countries and situation. And for my students, I feel like there is still a gap. I think the reasons are complicated, not just about their English ability. I think maybe it also reveals our students’, like, global literacy, or global competency.”* Following this was an email sent to NYCU students to ask them to have a one-on-one meeting with professors:

*...Being your professor, I care about your capacity to grow, as well as curiosity and confidence to embrace the world... Unfortunately, I am not seeing this happening, to the extent that I feel that we have failed each other...*

Jongmin and Sharon then conducted individual meetings with their students for a week, and as a result, the students gradually became aware that they needed to increase their efforts during class. During the meetings with some students, a few of them, especially those from UST, expressed gratitude and commented on how relevant the course was to their occupations and topics that were also relevant in their home countries. For StudentH, a student from NYCU, for example, the situation improved when he discovered that the topics covered in the course were closely related to their major and future career as an engineer. During the interview with Shawn when the semester ended, he said: *“I would say this course is quite useful in retrospect. I can easily connect the topics explored back to the real world and current geopolitics.”*

Clearly, NYCU students became more active after the instructors made it clear that classroom performance would also affect their final grade during the one-on-one sessions with each student. However, the disparity in classroom participation between students from NYCU and their UST peers was still a bit noticeable. In many instances, instructors had to prompt NYCU students to speak up or read some paragraphs from the assigned readings during class discussions. Interestingly, as the semester progressed, Shawn noticed that students prepared in advance by using their smartphones to translate the words they wanted to express into English. They then raised their hands and spoke the words on the screen. While this method may not be the best for real-time interaction, it could potentially improve the level of participation for students with a lower level of English proficiency.

The importance of student participation in determining the success of a class is widely acknowledged, and this dialogue-based classroom is no exception. However, it is pertinent to ask whether grades are being utilized as a tool by instructors to control classroom dynamics or as a means to incentivize greater student participation. This question is particularly relevant when striving to create a classroom environment aligned with a critical pedagogical approach. In hindsight, are we truly liberating the classroom or utilizing coercive measures that are only accessible to instructors? We believe that it deserves more discussion among the instructors and even with the students. Admittedly, it is possible that students in Taiwan are very grade-oriented and may take a course like this with the intention of earning a good grade, but it is also important to consider the potential drawbacks and reflect on the approach.

### ***Student-student***

In fact, in early August, the diverse composition of the student body, including those from NYCU and UST, emerged as a matter of concern, expressed by Jongmin, about how undergraduate and graduate student teams would work together. As it turned out, their partner experiences were more diverse than Sharon and Jongmin expected.

As the semester progressed, the majority of student teams worked without too much hassle. In a few groups, graduate students became mentors and undergraduate students became mentees and they interacted with revised expectations. StudentA had a particularly positive experience with StudentY during their prompt interviews, as Aprova taught StudentY a lot about the history of StudentA’s country. Despite StudentY’s challenges with English, her enthusiasm for learning and commitment to cross-border conversation impressed Aprova so much that she described StudentY as “*like my younger sister*” and felt recharged every time after their interview, amidst her hustling and bustling lab life as a graduate student. In other groups, graduate students dominated the group dynamics. The case of StudentG and StudentZ provides a good example of this dynamic. Despite both of them knowing Chinese, they struggled to find common topics to chat about during their meeting beyond the assigned interview questions. Additionally, StudentG, being a Ph.D. student with a disciplined schedule, took a dominant role in organizing the final project and topics chosen, dividing it into pieces and assigning tasks to StudentZ. StudentZ described feeling like StudentG was a big brother and felt that his role was simply to listen to StudentG’s commands.

### ***Instructor-student***

The (power) dynamics of the course, particularly the interaction between instructors and students, is also an interesting topic to explore. Students from UST, in comparison to the frequent silence that NYCU students had in class, were so eager to express their thoughts during the class, especially those students who are from Southeastern Asia and South America having unique backgrounds and experiences to contribute. They actively participated in dialogue with the instructors, and the discussions became quite lively afterwards. Two examples from the transcripts of classes are shown below:

**StudentS:** Can I ask something, Professor?

**Jongmin (the main lecturer):** Sure.

**StudentS:** Uh, I wanted to talk a little bit about Park. Although he had a military background, and in the end, he was more of an authoritarian ruler, people still loved him. So I’m wondering how he was able to maintain such popularity, despite his undemocratic rule. ...

**Jongmin:** Yeah, the first question is difficult, but thought-provoking. Some people disagreed with his policies, but others loved him because of his character and his way of promoting economic development. So perhaps we should also explore how he connected with the people. These are all helpful points for our discussion.

**StudentM:** Definitely. President Park connected nationalism and democracy, **which is something I didn’t know before this class. Previously, I had only heard about his dictatorship. However, learning about his impact on science and industry has given me conflicted feelings....**

For Shawn as an instructor and an observer, the transformative experience also occurred during his out-of-class interaction with the students. He admits that at times, the overwhelming coordination and logistics involved in running this course can feel suffocating for instructors. This is especially true when it appears that some students from NYCU are not fully invested in the course, which raises larger questions about our role as engineering educators in the Taiwanese and Korean contexts.

However, as mentioned earlier, we started conducting one-on-one meetings with students from both sides to better align expectations between instructors and students amid the semester. During one such meeting with StudentM, a Ph.D. student in material engineering from Ecuador, Shawn was struck by her gratitude and repeated expressions of thanks to both Dr. Lee and Shawn. It was a transformative moment for the latter, leading him to reflect more deeply on my role as an instructor and the purpose of the course, particularly when applied to a non-Western context. StudentM, during the very last class of this course, even shared her thoughts virtually in class:

*“Yeah, I just wanted to say, thank you, uh, to all the professors and for the... knowledge that you have important to ask, draw out the class, uh, for the experience to share together, like, with the aid of the technology,... to carry out this kind of class and get to know people around the world and, uh, to share our thoughts. And it’s all related to pursuing or on self development. So thank you so much for everything.”*

## EVALUATION

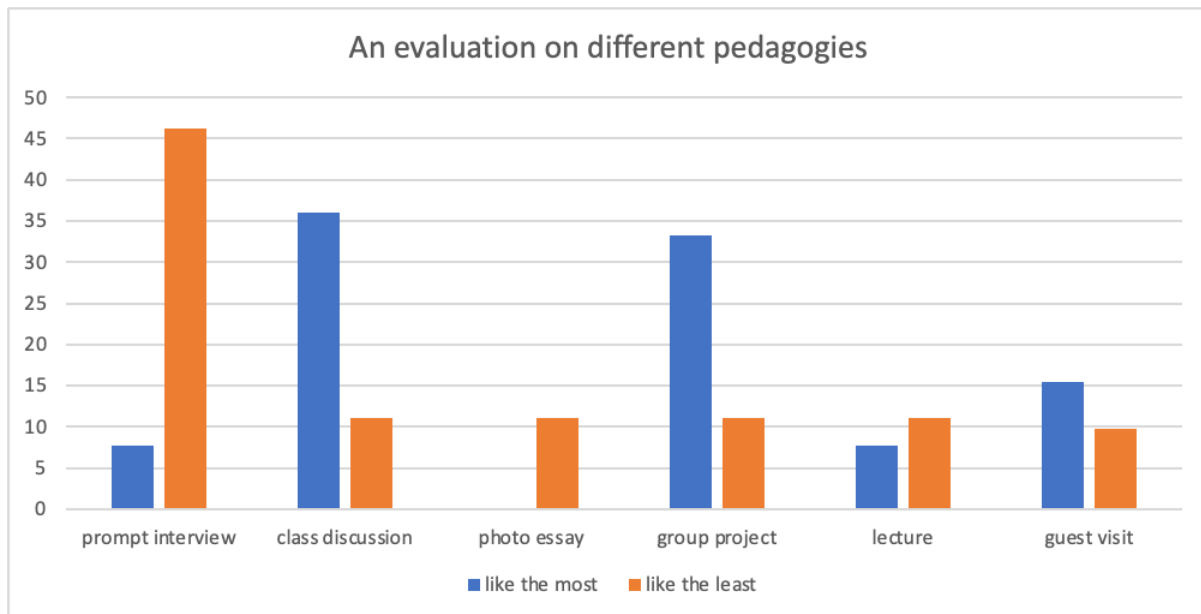
Within this section, we provide an overview of the course, drawing upon the results of both the course evaluation survey and students’ self-evaluation of their global engineering competency. We then proceed to expound upon the survey outcome in detail, examining potential factors that may have contributed to it.

### *On pedagogies*

Based on feedback gathered through the student course evaluation surveys from both NYCU and UST, it was found that classroom discussions and the final project were the two most favored methods, while prompt-based interviews the least.

Drawing on our past experience with virtual global classrooms, we began our course by gathering feedback from participants on different aspects of the course. The results of the survey (shown in figure below) revealed clear patterns among this group. One of the key components of our course, the prompt interview, which is fundamental to our dialogue-based teaching approach, received low ratings from students. We discussed this issue and developed several possible explanations: (1) students may perceive it as additional work; (2) scheduling conflicts may have been a challenge since everyone had different availability; (3) language barriers may have made the task difficult to complete; (4) students may have preferred to discuss daily life rather than course content; (5) there may have been confusion about whether the interview should be structured or free-flowing; (6) students may have found the outcomes of the interviews less clear than those of other course assignments; (7) logistical issues such as negotiating times and digital platforms may have tainted the experience. Overall, further discussions (as discussed in previous sections) with students provided insight into which of these hypotheses might explain why in-class and project-based experiences were more popular than interpersonal experiences outside of class among our learning community. We contend that a more comprehensive classroom activity, such as a group project in this case, has the potential to facilitate a more “engaging” dialogue compared to simply providing students with a set of interview questions and instructing them to interview their peers.





### ***On “global engineering competency”***

For students’ self-evaluation of the “global competency,” the following statements were presented to students at the beginning and end of the course, and students were asked to rate them on a scale of 1 (strongly disagree) to 7 (strongly agree) at the start and at the end of the course:

1. I can practice engineering in an international setting.
2. I can function effectively as a member of a multicultural technical team.
3. I am familiar with cross-national/cultural differences in engineering practice.
4. I understand how culture affects perceptions of the engineering profession throughout the world.

The following table presents a comparison of the survey results gathered from both the UST and NYCU ends. Based on the survey, it appears that the NYCU students had a more positive view overall. For instance, five out of the twelve NYCU students surveyed strongly agreed with the Q4 statement, whereas only two out of the fifteen UST students expressed such confidence in their understanding. In fact, one UST student even strongly disagreed with the statement, indicating a clear difference in perceptions between the two groups. In general, the survey results from the NYCU students appear to be more consistent, whereas the survey results from the UST students are more diverse. One UST student, who used to be a governmental officer, gave a rating of 7 out of 7 for all survey questions, indicating a high level of agreement with the statements. On the other hand, another UST student from Southeastern Asia rated all survey questions with a score of 1 out of 7. During the semester, the former individual frequently spoke up in class and shared his past experiences, while the latter mostly remained silent.

The meaning of “global” can be defined and applied in different ways and it was one positive outcome of this class to realize multiple definitions of the “global” from both students and

instructors input. Although the instruction team tried to problematize the mainstream or “Western” definition of modernity, development, and innovation, our examples were limited by our collective study and life experiences. It was through the various life and work experiences of students that these redefinitions can really manifest in the discussion. One UST student M who studied in Taiwan for his master’s gently contrasted Taiwan, Korea, and his home country to explain different work cultures in three countries. Another student Student K whose country experienced the Cold War from communist Soviet end expressed how his country persevered similarly and differently and new leaders used Korea as an example to follow after the Soviet Union collapsed. These lively examples helped both instructors and students to look beyond the settings of this class.

## CONCLUSION

Perhaps with this global classroom, our most important educational commitment is to foster dialogue and cross-cultural understanding as a response, if not remedy, to the world’s divisions. As such commitment is put into practice, it was both challenging and rewarding to engage with a diverse student body, although we argue that our pedagogical approach made an important step in dealing with the delicate topic of global competency in a cross-border classroom. Statistical analysis shows that the student course evaluations contain both positive and negative feedback. While some students found the course to be beneficial in terms of learning new concepts and improving their English speaking ability, others felt that there were too many assignments, particularly the prompt interview, and that they would have preferred more in-class discussion. As one student noted, *“I feel that I have met my expectations but I feel that the assignments given are too many, especially the prompt interview. I am more interested in discussing directly in class than making photo essays.”* Another student added, *“It met about 85%. As for the 15%, I expected more discussion sections.”* This preference for in-class discussion is consistent with survey results, which also showed that students are interested in classroom discussions.

However, students’ evaluation also showed how this course can be organized and implemented in an alternative way. Some students expressed concerns about the course’s chosen topics and perceived biases in the course material and during the class. As one student noted, there is *“too much focus on the semiconductor industry... and a narrative that was biased against the western world, particularly the USA, without considering equally exploitative events from other powerful countries.”* Another student from UST commented on the course’s limitations, stating, *“I feel that this class only discusses the surface from a global perspective. This class is good for starters, but it takes much more learning to make me a globally competent engineer.”* Overall, the feedback from the student evaluations underscores the importance of balancing assignments and fostering in-class discussion, while also being mindful of presenting a fair and nuanced perspective on global issues and what teaching methods are most useful when it comes to fostering a learning environment for global engineering competency.

After our reflection on the both challenges of and opportunities in teaching a cross-border synchronized course on global engineering competency, several questions emerge that demand further exploration. For instance, some may question the need for such a course type, while others may wonder about the most effective pedagogical approaches for co-teaching and facilitating cross-border dialogue. Additionally, the use of English as the primary teaching language raises important questions about access and equity for students, particularly those for whom English is not their first language. Despite these concerns, the experiences of both instructors and students in the course underscore the potential value of a cross-border synchronized classroom for cultivating different aspects of global engineering competency. While there were some difficulties in aligning expectations and ensuring effective co-teaching, the prompt interviews and collaborative final project allowed students from different countries and cultural backgrounds to work together, developing key skills for cross-cultural collaboration.

Secondly, in order to fully realize the potential of a cross-border synchronized classroom for global competency, it is necessary to address the challenges of co-teaching and dialogue-based learning. This requires careful consideration and course time management of how to balance lecture and group discussion, as well as a commitment to objective alignment among instructors with different backgrounds and responsibilities. Furthermore, the question of whether to teach in English or in Chinese is not simply a matter of practicality or convenience, but also raises important questions about the goals and values of the course. If the aim is to equip students with a global perspective and foster cross-border communication, then the use of English as a lingua franca may, in some sense, be essential. However, if the primary goal is to promote greater access and inclusivity for students, particularly those for whom English is not their first language, then teaching in Chinese may be more appropriate in NYCU’s context, and NYCU students might be able to better comprehend what the instructors teach and the course materials.

Overall, in this global classroom teaching experience, we observed that students typically need to spend a few weeks to adapt to English-language instruction, reading, and classroom discussions. It then took another few weeks to gradually develop English-language interviewing skills (especially for Taiwanese students) as well as critical thinking and analytical abilities on the subject matter. In other words, students need to wait after the midterm week, which is almost three-quarters into the semester, before they begin to have the confidence and basic ability to truly engage and enjoy the globalized classroom. Fortunately, as the above sections reveal, we find that students began to transform in the latter half of the course, with a willingness to speak up in class, improved English communication with global partners, and a growing awareness of how the knowledge gained in class can be linked to their own experiences and gaining a broader sense of this world and its geopolitics. They also began to critically examine the potential limitations in cultivating professional talents both in Taiwan and Korea, gradually developing their own skill set of critical thinking. In addition, the instructors also grew through teaching interactions in a diverse and cross-cultural classroom, and began to reflect on teaching methods that are inclusive of and suitable to multiple cultures. Despite the joy that comes with the accumulation of trust, dialogue, and

positive feedback between instructors and students, these efforts and changes are often cut short by the end of the semester.

Overall, based on our experience teaching for one semester, we argue that utilizing dialogue-based classrooms can be an effective approach to enhancing global engineering competency, and to engage students. Dialogue, as argued by critical pedagogists, is key to learning, and as this course shows, this is also crucial to learning global engineering competency, facilitating students’ ability to engage with diverse perspectives and develop intercultural communication skills. It also enables students to challenge and expand their own thinking by hearing and considering different viewpoints. Additionally, dialogue-based classrooms provide a platform for students to co-create knowledge with their peers and instructors, fostering a collaborative learning environment. This paper also acknowledges the limitations of this dialogue-based global classroom approach, which include: (1) The need for different classroom activities, such as in-class discussions or group projects, to cultivate an environment conducive to dialogue. Additionally, students tend to prefer non-structured interviews rather than following a structured prompt for interviews. (2) Do not crave for a “successful” transformation among students. Instructors should be aware that it may take longer for students to adapt to this dialogue-based environment, especially if the language used in the classroom is not their native language.

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## APPENDIX

I. Prompt interview: Unedited example of student prompt answers developed over the course of the semester with their partner, belonging to Question 5 (“Do you think the Cold War ideologies continue to shape engineering practice and engineers’ career paths? Why or why not?”)

UST/Your answer before class	UST/What you think partner students would answer	UST/Partner student's answer	UST/Your answer after class
<p>I think the cold war still continue to influence engineering practice and engineers’ career path. Even experts in the field of science and engineering hard to decide on what political ideology they will support in connection with their career. It also involves the kind of the ideology their country is supporting. In the case of the Philippines, many Filipinos wants to work in the US or work for the US. In general Filipinos view Americans as a friend and we want to develop and design a technology with the collaboration and help from a country that we consider as a friend because US is committed to always help and support Philippines if war will happen.</p>	<p>Cold war ideology still continues to shape engineering practice and engineers’ career with related to Taiwan because based on what we saw on the news, Taiwanese people like the idea of the capitalism and the US has its support in terms of economy and war.</p>	<p>Even though Cold War has been declared in public has ended, in my opinion it still exists and expands in many ways. Besides, the recent Ukraine -Russia War aggravates it as well. The world now is still separated to 2 parts: communist countries and capital ones. Between two kinds, they would race. Among capital ones, they have healthy competition and sometime do technical interchange to make both better.</p>	<p>Presently, Philippines tries to make friends with both US and China to avoid conflict but with what history tells us about the good relationship of US and the Philippines since form previous years, it is very obvious that Philippines will take the side of the US. Many times, shows that Philippines is dependent on the US not just in terms of economy but also in terms of territorial dispute. Speaking of innovation related to technology, China is using it against Philippines. China has the power to bully the Philippines using their weapons but the US assured us that if China will attack the Philippines, US is always ready to help.</p>

NYCU/Your answer before class	NYCU/What you think partner students would answer	NYCU/Partner student's answer	NYCU/Your answer after class
<p>Yes.</p> <p>Even though Cold War has been declared in public as ended, in my opinion it still exists and expands in many ways. Besides, the recent Ukraine-Russia War aggravates it as well. The world now is still separated to 2 parts: communist countries and capital ones. Between two kinds, they would have healthy competition and sometime do technical interchange to make both better.</p>	<p>Yes.</p> <p>In my opinion, looking at the Russian-Ukraine War, most people regard communist Russia as the bad guy, and the rest capital ones are the king guys, even expect US to do something to save Ukraine as a hero. The 2leading role in this war are the same as those in Cold War, and it’s therefore called new Cold War.</p> <p>Keeping this ideology in mind, it’s not like 100% but at least for all engineers with sympathy, they would deeply feel and realize what they can to stop this or to avoid being the complicity.</p>	<p>Yes.</p> <p>From the example of most of Filipino, they want to work in US or for US as they believe they are on the ally with US. Also, they believe once a war happens, US would help Philippines as a friend.</p>	<p>Yes.</p> <p>Ukraine-Russia War is kind of a reminder that the ideology from Cold War still exists and the antagonism even deepens. News of the war is so shocking that almost everyone near me talked about this when the war just began. Such an event seems to force people to take side, and lets them know that every decision they make shape the world.</p> <p>For me, I will never participate in any R&amp;D that might be beneficial to China and Russia.</p>

## II. Prompt interview questions

1. Who is your engineering role model? Why?
2. How do you prioritize engineers’ responsibility--individual, family, community, company, nation, human being, all living beings?
3. Where do you think engineers’ ultimate responsibility lies? Find an example of conflict and explain your answer.
4. Do you think engineers should participate in military related R&D? What are the benefits and limitations of participation or lack of participation?
5. Identify one of the cold war legacies you find most powerful in your country and explain its impact?
6. Do you think the cold war ideologies continue to shape engineering practice and engineers’ career paths? Why or why not?
7. Who should lead innovation? Government, private sector, users, innovators, others (specify “others”)
8. Do you consider “imitation” as innovation? Why or why not?
9. What is nuclear energy policy in your home country? What is your opinion toward sustainable energy choices?
10. How has the covid 19 impacted your life? How will you rank your trust in the solutions--vaccine, mask, personal tracking technology? How effective do you think your (home) country responded to COVID-19? What do you think we can do better?