

# WIP: Navigating Unfamiliar Waters: Enhancing Intercultural Understanding and Academic Self-Efficacy Among Computer Science Students in Japan

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**Abstract**—Global collaborations have expanded the importance of effective cross-cultural communication in engineering disciplines, with self-efficacy playing a crucial role in developing these skills. This work-in-progress innovative practice paper is a quantitative component of a mixed-method exploratory study investigating the experiences of fifteen computing students from the University of Florida who participated in a nine-week summer study abroad program at Kyoto University, Japan, in 2022. The research aimed to assess the enhancement of cross-cultural engineering self-efficacy and the evolution of students' intercultural understanding. Surveys were conducted at the program's inception and conclusion, allowing for a detailed analysis of students' self-perceived academic capabilities and intercultural awareness over time. Preliminary statistical analysis suggests an increase in students' self-efficacy in cross-cultural engineering by the end of the program, highlighting the impact of the study abroad experience on broadening students' perspectives and enhancing their adaptability in intercultural interactions.

**Keywords**—Study abroad programs, self-efficacy, computer science education, intercultural competence

## I. INTRODUCTION

The development of academic self-efficacy empowers students to approach their studies with confidence, resilience, and a proactive attitude, leading to improved academic performance and a greater willingness to tackle challenging tasks. [1]. Bandura's (1986) theory of social cognition expresses that these beliefs about self-efficacy are critical in influencing individuals' life choices, the extent of effort they exert, their resilience in overcoming obstacles, and the levels of stress or calmness they encounter while tackling the diverse challenges of life. In educational research, self-efficacy has garnered considerable attention [1]; it has been consistently linked to predicting students' academic success across various subjects and educational stages [1].

The concept of incorporating overseas travel into undergraduate education has rapidly evolved into a prevalent practice at many U.S. colleges and universities. Recent Institute of International Education data highlights this trend, showing a robust recovery and growth in study-abroad participation. As of the 2021/2022 academic year, students studying abroad

rebounded to more than half of pre-pandemic levels, with 188,753 students pursuing academic credits overseas [2]. Moreover, the 2022/2023 academic year projections suggest continued growth in study-abroad initiatives, reflecting an increasing acknowledgment of the value of international educational experiences. This significant increase in student participation underscores the resilience of international academic exchanges and aligns with broader educational goals of enhancing global awareness and competencies among students [3], [4].

Our primary research question is: “**How does participating in the cross-cultural engineering program influence students' academic self-efficacy?**” The program uniquely integrates technical learning with cultural immersion to challenge and broaden students' academic self-perceptions and cultural fluency. The “Cross-Cultural Engineering Design” (CCED) course is central to the program and a critical platform for experiential learning. This course highlights the interplay between cross-cultural communication and the engineering design process.

## II. LITERATURE REVIEW

Self-efficacy has emerged as a significant construct in understanding career development and academic achievement [5], [6], [7]. While international education has long emphasized fostering student growth towards independence or autonomy, incorporating self-efficacy as a construct remains relatively novel. The extensive literature on self-efficacy suggests that individuals with a strong sense of self-efficacy tend to perform better academically, exhibit greater confidence, and persist in facing challenges [1], [5], [8], [9]. Bandura's framework of human behavior posits that people's beliefs about their abilities are crucial for exercising control and demonstrating personal agency [10]. In essence, individuals act based on their judgment of their ability to perform an activity and the anticipated outcomes [10].

In studies focusing on language learners, researchers have explored the impact of self-efficacy on students' perceived ability to communicate in a foreign language, finding that higher self-efficacy correlates with increased confidence in

language proficiency [11]. For instance, Cubillos and Ilvento (2012) investigated the experiences of U.S. foreign language learners in short-term and semester-long programs in France and Spain [3]. Their pre- and post-test survey analysis revealed that studying abroad significantly boosted students' self-efficacy in various language skills, mainly through interactions with the host community and engagement with native speakers [3].

Scholars examining students' experiences during study abroad programs have introduced self-efficacy as a potential determinant of success [9], [12], [13]. Kehl investigated differences in global-mindedness and general self-efficacy among students who participated in semester-long study-abroad programs and those who intended to study abroad [12]. While no significant differences in general self-efficacy were found, variations based on gender and income were noted. However, the study's reliance on a general measure of self-efficacy may have limitations, as self-efficacy is best understood within specific domains [1], [12]. Despite these limitations, the study underscores the potential of study abroad experiences to enhance students' independence and autonomy, given the need to navigate unfamiliar environments without typical support systems [9], [12].

Several studies have linked students' study abroad experiences with heightened levels of self-efficacy [3], [9], [12], [14], [15], [16], [17]. However, reported alterations in self-efficacy often correlate with the program's duration. For instance, research by [18] Indicates significant shifts in study-abroad participants' perceptions of their abilities to undertake certain behaviors throughout their experience. This study examined both self-efficacy and self-esteem among study-abroad participants.

### III. METHODS

#### A. Participants

This study involved 15 University of Florida students who had taken prior computing coursework and enrolled in a study abroad program in Japan during the summer of 2022. This participant cohort uniquely consisted of students seeking to earn academic credits over the summer, providing a focused group to assess the educational impact of international experience on their academic and personal development. The program comprised two 3-credit hour courses: a general project-centric technical elective and the "Cross-Cultural Engineering Design" (CCED) course. The latter included a comprehensive examination of cross-cultural communication and human-centered design topics, supplemented by weekly excursions focused on practical aspects of cross-cultural engineering design to enhance the students' understanding of its role in the design process.

To investigate the impact of study abroad programs on academic self-efficacy, we employed a survey methodology that included multiple-choice and open-ended questions to elucidate participants' goals and motivations for joining the summer program. Surveys were distributed to the entire cohort, yielding 15 responses for the pre-, mid-, and end-program surveys. No incentives were offered for participation. The study

was conducted with the approval of the University of Florida Institutional Review Board (IRB).

#### B. Program Context

The University of Florida Summer C program, "University of Florida at Kyoto University – Cross-Cultural Engineering," is an eight-week course to immerse undergraduate students in the complexities of cross-cultural engineering and design practices. The program is intended to teach students about Japan's engineering prowess and rich cultural heritage. Students engage in theoretical coursework and practical site visits throughout the program. These visits include trips to locations where cross-cultural design was deployed and where students explore the intricacies of Japanese transportation systems, software, games, and manufacturing processes. Additionally, excursions are planned to showcase where and how cross-cultural engineering principles are applied in real-world scenarios. The program also focuses on cutting-edge research at local universities, providing students with opportunities to learn about the latest technological advancements and to connect with industry professionals. This program is intended to enhance their academic understanding and help build and foster professional international connections that could shape their future careers in engineering.

#### C. Survey instrument

The surveys utilized in this study consisted of five seven-point Likert scale questions shown in (Table 1). As shown in Table I, these questions were specifically formulated to support the program's overarching objectives, focusing on enhancing academic self-efficacy and intercultural competencies among computer science students through international educational experiences. The Likert questions were used to quantify the students' self-perceived growth in specific areas relevant to the study's objectives. Each item on the survey corresponds to a key competency area that the program aims to enhance. These areas are critical for developing intercultural competencies and academic self-efficacy among students. The survey used in this study was created for the sake of this particular program and was designed to measure self-efficacy in the five areas.

TABLE I. SURVEY INSTRUMENT

Q1	Describing the process of adjusting to a new culture
Q2	Identifying perspectives based on my cultural assumptions or those of others
Q3	Critically evaluating my cultural beliefs/norms and those of others.
Q4	Communicating across cultures
Q5	Applying universal and inclusive design principles

#### D. Data Analysis

This study explored the changes in students' self-efficacy and cultural adjustment abilities following participation in a study abroad program. We conducted five paired samples t-tests to quantitatively evaluate the program's impact on various competencies relevant to cultural adaptation. Each paired test

compared the self-reported abilities of the students at the beginning stage of the program and at the end of the program. The specific areas of interest included adjusting to new cultures, identifying cultural perspectives, critically evaluating cultural norms, communicating across cultures, and applying universal and inclusive design principles.

In this study, we employed paired samples t-tests to compare, the means of two related groups across the same participants at different times. Paired t-tests are well suited for designs where individuals are measured more than once under different conditions or over various periods, allowing for the control of inter-subject variability and enhancing the test's statistical power [27]. This method is effective in educational and psychological research, where behavior, attitudes, or skills changes are often assessed following an intervention or over an academic period [27]. In evaluating a study abroad program, where students' self-efficacy and adaptation abilities are expected to evolve, the paired t-test provides a rigorous means to determine if such changes are statistically significant beyond natural fluctuations in self-assessment.

We hypothesized that student self-efficacy would increase as a result of participating in the study abroad program (H1). We examined the paired sample's t-test results to identify changes between initial and subsequent assessments in our questions. These analyses were based on students' self-ratings of their abilities, captured at two different time points using a Likert scale. The responses on the Likert scale were converted into a numerical format, where 'Extremely Poor' was coded as 1 and 'Excellent' as 7 to enable quantitative analysis.

#### IV. RESULTS

TABLE II. PAIRED SAMPLE TEST

Item	End mean	Start mean	Mean diff	Std dev	t-value	p-value
Q1	6.17	4.50	1.667	1.231	4.690	<0.001
Q2	6.25	4.83	1.417	0.793	6.189	<0.001
Q3	6.33	4.83	1.500	0.798	6.514	<0.001
Q4	5.17	3.75	1.417	1.165	4.214	<0.001
Q5	5.83	4.00	1.833	1.337	4.750	<0.001

The first four items used indicators such as adjusting to a new culture, identifying cultural perspectives, evaluating cultural norms, and communicating across cultures to assess students' self-efficacy in the study abroad program. The results of these four items were analyzed correctly below and can be seen in Table II above.

- 1) *Adjusting to a New Culture*: The findings indicate a statistically significant increase in students' self-efficacy in adjusting to new cultures. The mean score improvement was 1.667 (SD = 1.231, SE = 0.355), with a 95% confidence interval ranging from 0.885 to 2.449. A t-value of 4.690 (df = 11,  $p < 0.001$ ) demonstrates a substantial enhancement, suggesting

that the program boosts students' confidence and capability in adapting to new cultural settings.

- 2) *Identifying Cultural Perspectives*: Students exhibited a noteworthy rise in their ability to discern cultural perspectives, reflected by a mean increase of 1.417 (SD = 0.793, SE = 0.229). The 95% confidence interval was 0.913 to 1.920, and the t-value was 6.189 (df = 11,  $p < 0.001$ ), showing improvement in their capacity to identify and understand cultural assumptions.
- 3) *Critically Evaluating Cultural Norms*: There was a marked growth in students' self-efficacy concerning the critical evaluation of cultural norms, with a mean difference of 1.500 (SD = 0.798, SE = 0.230). This increase is supported by a confidence interval of 0.993 to 2.007 and a t-value of 6.514 (df = 11,  $p < 0.001$ ), indicating enhanced analytical skills in evaluating diverse cultural beliefs.
- 4) *Communicating Across Cultures*: Improvement in the ability to communicate across cultural divides was also observed, with students achieving a mean difference of 1.417 (SD = 1.165, SE = 0.336). The confidence interval extended from 0.677 to 2.157, and a t-value of 4.214 (df = 11,  $p = 0.001$ ) underscores substantial progress in intercultural communication skills.

Overall, the results show that the cross-cultural engineering program supported students' self-efficacy across various dimensions of cultural competence. Meaningful improvements in each competency suggest that the program effectively enhances students' abilities to navigate and adapt to diverse cultural environments, positively impacting their academic and interpersonal skills. This analysis directly addresses the core of Research Question 1, illustrating the program's profound impact on students' self-efficacy in managing and thriving within cross-cultural contexts.

The fifth item on applying universal and inclusive design principles was used as an indicator to measure the self-efficacy of the students before the start of the program and at the end of the program. The data showed that after the program, students rated their ability in universal and inclusive design highly.

- 1) *Applying Universal and Inclusive Design Principles*: The largest improvement was observed in students' reflection on their ability to apply universal and inclusive design principles, where students reported a mean increase of 1.833 (SD = 1.337, SE = 0.386). The confidence interval ranged from 0.984 to 2.683, and a t-value of 4.750 (df = 11,  $p < 0.001$ ) strongly supports the program's effectiveness in cultivating these crucial skills.

While not qualitatively analyzed, the open-ended responses provide further insight into the personal motivations and experiences contributing to these outcomes, underscoring the holistic benefits of such international academic experiences.

## V. DISCUSSION

The marked increase in students' ability to adjust to new cultures suggests that the immersive experience provided by the program effectively prepared students to navigate and adapt to new environments. The results show a perceived increase in cultural understanding and self-efficacy among participants, as measured by research questions focused on these constructs. This means a study abroad program can enhance students' self-efficacy and ability to address complex and challenging tasks. The individual questions assessed comfort levels in interacting with people from different cultures, abilities to understand and respect cultural differences, confidence in navigating cultural norms, and perceived competence in completing academic tasks. The differentiation in these questions is crucial because it allows for a targeted assessment of specific competencies. Although related, cultural adjustment and academic self-efficacy are distinct constructs requiring separate measures to capture their development accurately.

In today's globalized world, professionals must often function across different cultural contexts [12], [19], [28], [20]. Improving this area likely contributes to broader academic self-efficacy, as students who feel comfortable in their environment are better positioned to focus on learning and applying new knowledge [15], [21]. When students feel comfortable, relaxed, and competent in new cultural environments, their stress levels decrease, allowing them to concentrate more effectively on their academic work [29]. This comfort translates into a greater willingness to participate in class, engage with peers and instructors, and tackle challenging coursework. Consequently, students with strong cultural adjustment skills are better equipped to thrive academically.

Based on the data gathered from paired samples t-tests, participation in the cross-cultural engineering program significantly impacts students' academic self-efficacy in computer science. The survey instrument targeted specific competencies related to academic self-efficacy. Improvements across various competencies relevant to interpersonal and technical skills indicate that the program boosts confidence in specific academic abilities and prepares students for a globalized workforce. The program included a variety of excursions and learning activities designed to deepen students' understanding of computer science and engineering practices in Japan. In the end-point survey, students assessed their learning outcomes, expressing significant benefits to their academic self-efficacy. Student self-evaluations showed increased perceptions of their abilities to identify and critically engage with cultural perspectives and norms. This skill is crucial in computer science and engineering, where design and problem-solving require understanding diverse user needs and contexts. Students' improved ability to critically evaluate these aspects suggests that they are developing into more thoughtful and effective problem-solvers and designers, benefiting their academic and professional futures [22], [25], [26].

Improving students' perceived ability to communicate across cultures is another finding, as effective communication is a cornerstone of successful team-based projects in computer science. The observed improvements indicate that students are gaining these essential skills. Language learning is another area

of study abroad that includes established measures for student learning, and several factors have been linked to successful language acquisition [3], [23], [24].

The outcomes of this study highlight the importance of incorporating academic self-efficacy, intercultural competence, and cultural adaptation into engineering education. By applying universal and inclusive design principles, curricula can address diverse cultural perspectives, making learning environments more accessible and engaging for all students. Integrating experiential learning and cultural immersion into engineering programs allows students to better understand global challenges and the perspectives needed to address them. Additionally, incorporating cross-cultural communication into the curriculum equips students with the skills to collaborate effectively in global teams, enhancing their academic and professional self-efficacy. Universities can adopt programs like the Cross-Cultural Engineering initiative in their study abroad efforts, which prepares graduates for an interconnected and multicultural workforce and supports institutional goals of promoting global awareness, equity, and inclusion, making engineering education more relevant and impactful in today's world.

## VI. LIMITATION AND FUTURE WORK

Our study was within an existing study abroad program, allowing us to collect data from authentic experience. This constrains the measurements of some factors, such as social persuasions, to allow us to focus on a genuine experience. In our future research, we will follow up this work with a qualitative evaluation of results from free-response prompts. In this research phase, we will also analyze the qualitative data rich with detailed personal narratives and contextual understanding. There is growing interest in studying abroad at the University of Florida. We expect the program to grow and enable us to conduct a larger study on students' academic self-efficacy in a study abroad program. The future gives us more opportunities to explore other sources of academic self-efficacy, e.g., social persuasions.

## VII. CONCLUSION

In our study, we explored the impacts of a cross-cultural engineering program on the self-efficacy of participating students, highlighting advancements in their perception of their abilities to navigate diverse cultural landscapes. It demonstrated individual improvements in competencies and provided evidence that study abroad programs improve students' academic self-efficacy, including adjusting to new cultures, identifying and evaluating cultural perspectives, and applying inclusive design principles. This research aligns with the goals of fostering global competence. It contributes to the existing body of knowledge, underscoring the importance of comprehensive educational strategies in our increasingly interconnected world. By highlighting the interplay between cross-cultural communication and the design process, this study shows how study-abroad programs can contribute to building self-efficacy among students in computer science and engineering students.

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