

PREPARING GRADUATES FOR THE 21st CENTURY WORKPLACE: A TRANSDISCIPLINARY APPROACH TO INFORMATION TECHNOLOGY-RELATED STUDY PROGRAMS

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Abstract

This paper discusses the importance of integrating global virtual team projects into Information Technology (IT) and Computer Science curricula to enhance students' cultural awareness and ability to collaborate across different time zones, as well as improve their skills in digital communication and virtual project management. In this study, students enrolled in an IT program at a university in Germany participated in a Collaborative Online International Learning (COIL) project involving peers from 17 different countries and various disciplines. A mixed-methods study was carried out over two semesters, and the results highlight the benefits of such transdisciplinary initiatives, demonstrating the value of incorporating COIL projects into IT curricula, and illuminate the challenges of COIL projects for both students and instructors. With this study, the author aims to encourage educators and administrators in Higher Education to support and implement interdisciplinary COIL projects, better preparing graduates for the challenges of the 21st-century global workforce.

Keywords: collaborative online international learning; transdisciplinary learning, 21st century skills; information technology; computer science curricula

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Graduates entering the workforce today are expected to bring a multitude of skills to meet the needs of industry. Much has been written on the so-called 21st century skills, which include information communication technology (ICT) competencies, virtual intelligence, creativity, and critical thinking, as well as collaborative and problem-solving abilities (van Laar et al., 2020). Due to the global nature of work, professionals are required to possess interpersonal communication and intercultural

competencies (Hollema, 2020). There is also a growing need for expertise related to an understanding of ethics, governance, and accountability (Cardon et al., 2023). This is particularly relevant for IT professionals, whose essential knowledge, skills, and abilities include project management skills that enable them to collaboratively seek solutions. They also require communication competencies and teamwork skills, which involve recognizing individual team members' strengths when delegating tasks (Chang et al., 2022; Hollema, 2020). The ability to communicate effectively through digital channels and to build rapport quickly, along with cross-cultural communication skills, is vital to their roles (Chang et al., 2022). Furthermore, understanding cultural differences and possessing intercultural sensitivity are crucial for mitigating bias, especially given the increasing reliance on algorithms and artificial intelligence (Cao et al., 2023; Smacchia et al., 2024).

In response to the evolving demands of the workplace, particularly since the COVID-19 pandemic, universities have started integrating virtual exchange into their curricula. This approach leverages access to expertise beyond local boundaries and fosters collaboration among colleagues and students on joint projects (Katre, 2020; Logemann et al., 2022). Through collaborative online international learning (COIL), students benefit from exposure to professors and peers from other countries. By participating in virtual team projects that utilize collaborative digital communication tools, students enhance their language skills, virtual intelligence, and intercultural competencies, effectively sharpening their 21st-century skills (Crawford et al., 2020; Swartz et al., 2019; Swartz & Shrivastava, 2021). This has been especially relevant for students unable to participate in study abroad programs due to financial, personal, or other restraints, allowing for a more inclusive educational experience (Barbosa et al., 2019).

Despite the advantages of virtual learning, COIL projects are frequently limited to those faculty members who are both interested and willing to invest the necessary time and energy, often forming partnerships through prior networking. A review of the literature on COIL projects shows a strong emphasis on initiatives within the social sciences and business fields (Swartz & Nayak, 2024). While there have been calls for increased digitalization across all academic disciplines, instructors in fields

such as law, medicine, as well as science, technology, engineering and mathematics (STEM), tend to be hesitant to change their educational approaches (Costigan, 2023; Singh, 2021). Traditional IT courses typically focus on technical subjects such as mathematics and software engineering, often overlooking essential soft skills like intercultural competence and teamwork. Several factors contribute to this reluctance, including resistance to change, time constraints, and lack of support from departmental administrators. Additionally, the highly specialized nature of course content can be a barrier (Costigan, 2023). There is also a tendency to underestimate the benefits of virtual exchanges, particularly in the context of transdisciplinary learning.

Educators need to consider the types of jobs that IT professionals will pursue and should therefore incorporate social and transdisciplinary skills alongside technical knowledge into their learning outcomes. One effective way to teach these skills is through experiential learning via COIL projects. Integrating virtual learning into university IT curricula can foster virtual intelligence, enhance students' resilience, improve their readiness for the workforce, and build skills such as frustration tolerance and empathy, ultimately preparing graduates for the challenges they will face in their careers (Crawford, 2021; Swartz & Nayak, 2024).

A review of relevant literature underlines the importance of developing intercultural and collaborative skills among IT professionals, as well as the relevance of ethical considerations and critical thinking for future developers. After making the argument for a transdisciplinary approach to educating future IT professionals, I will illustrate the potential of COIL projects for helping students develop these skills by describing two COIL projects with German students enrolled in an IT program. Finally, the results of a mixed-methods study and answers to the research questions will be discussed, emphasizing the value of incorporating COIL projects into IT study curricula. This study intended to encourage department heads and instructors, particularly those in the area of IT, to support COIL at their institutions.

Literature Review

Virtual team projects have become a common practice for professionals in the information technology sector, partly due to the offshoring of IT jobs to countries like India over the past decade (Sarkar, 2011). According to recent studies, there are an estimated 62 million ICT workers worldwide (Statista, 2021). The COVID-19 pandemic, along with global disruptions from war and climate change, has further accelerated the growth of remote and virtual team projects (Barrero et al., 2022).

However, working on projects with diverse teams across multiple time zones using digital communication tools poses various challenges. Team members must navigate language barriers, connectivity issues, and differing work schedules, all while building rapport and trust. They may be unfamiliar with the contexts of their teammates and may make assumptions based on intrinsic biases (Hollema, 2020). Cultural differences can also impact norms related to work and leisure, adherence to deadlines, task delegation, feedback processes, and decision-making (Hollema, 2020; Meyer, 2016). A lack of understanding of these cultural differences, as well as the skills to bridge them, can lead to unnecessary delays, team dysfunction, and, in the worst cases, project failure.

With the development of generative artificial intelligence (GenAI), the necessity for IT developers to possess intercultural competence and an understanding of cultural diversity has grown. GenAI involves computational techniques generating seemingly new content such as text, images, or audio from training data that is hardly distinguishable from human-generated content (Feuerriegel et al., 2023). Researchers point to how the norms, values, and attitudes of developers influence the design and function of GenAI systems, often unconsciously (Hedlund & Henriksson, 2023; Sam & Olbrich, 2023). Furthermore, the data from which AI draws is often biased or heavily influenced by western culture, excluding the variety of experiences and cultures throughout the world and thus skewing the results (Cao, et al., 2023; Christodoulou & Iordanou, 2021; Goffi, 2023; Han et al., 2022; Lier et al., 2024). This so-called ‘code bias’ can have a significant negative impact on areas where GenAI is utilized, including medicine and law enforcement and recruitment

(Liyanage & Ranaweera, 2023; Sam & Olbrich, 2023). It is therefore imperative that developers who write the code retain a critical mindset and a diversified approach to avoid biases and misinformation (Christodoulou & Iordanou, 2021; Dignum, 2019; Sam & Olbrich, 2023). Studies carried out on large language models (LLMs), a subset of GenAI that produces text that mirrors human writing, have pointed to the perpetuation and amplification of biases present in the training data of LLMs (Liyanage & Ranaweera, 2023). Therefore, developers should be aware of the potential biases in these models and be responsible for evaluating and mitigating them. “This includes ensuring that training data is diverse and representative, regularly auditing the models for biases, and involving domain experts to validate and interpret the model's outputs” (Liyanage & Ranaweera, 2023, p 21).

Studies have underlined the need for communication, training, and education to promote ethical self-reflection and critical mindsets among IT specialists (Hedlund & Henriksson, 2023). Nevertheless, there exists a persistent belief among STEM educators that a social skillset is the domain of the humanities, and therefore STEM coursework remains focused on technical knowledge, creating an academic silo (Costigan, 2023; McSharry, 2023). A survey conducted among students in the fields of IT or electrical and computer engineering substantiated the perception that innovation, technological robustness, and keeping the software and hardware running take precedence over ethical considerations such as fairness and avoiding biases (McSharry, 2023).

A partial explanation for the reluctance to adopt social content into IT curricula might lie in the difficulty STEM educators find teaching subject matter on culture and ethics. On the reverse side, educators in the social sciences may face a challenge teaching technical concepts outside their expertise. For this reason, researchers recommend a transdisciplinary approach (Walsh et al., 2023). According to Scarlat and Bārar (2023), a transdisciplinary approach to learning reflects the complex nature of IT projects today, which require a diverse set of experts from different disciplines, backgrounds, and experiences from different countries and cultures.

Embedding COIL projects into IT coursework offers one opportunity for students to experience firsthand the issues and potential conflicts that may arise in their later global work environment. Multiple studies have underlined the value of COIL projects for imparting important soft skills among students in IT programs (Ellingsen et al., 2021; Hastuti & Syafruddin, 2023; Horton et al., 2022).

This study examines COIL projects conducted in 2022 and 2023 involving 40 part-time computer science students enrolled in an information systems program at a university in Germany while also completing industrial apprenticeships. The study intended to encourage department heads and instructors, particularly those in the area of IT, to support COIL at their institutions. Over six weeks, these students collaborated in diverse teams with peers from various study programs at universities around the world. At the conclusion of each of the two projects, the students were asked to complete a survey which addressed the following research questions:

RQ1: What is the prevalence of previous experience with global virtual teams among students participating in two COIL projects at a university in Germany in 2022 and 2023?

RQ2: What challenges were experienced by students participating in two COIL projects at a university in Germany in 2022 and 2023?

RQ3: What benefits were experienced by students participating in two COIL projects at a university in Germany in 2022 and 2023?

RQ4: Should COIL projects be included in IT-study programs?

Materials and Methods

The COIL projects were conducted during the summer terms of 2022 and 2023 under the leadership of instructors from University of Southern California Marshall School of Business. These COIL projects involved 17 institutions across 10 countries—Colombia, China, Finland, France, Germany, India, Lithuania, Spain, Taiwan, and various states in the U.S., from New York to Hawaii. More than 500 students were randomly assigned to 90 heterogeneous teams. Participating students were enrolled in Business Communication courses led by participating instructors and studied a variety of fields, including Business Administration, International Business, Applied

Computer Sciences, Information Systems, Engineering, and Veterinary Medicine. Communication among team members took place entirely through digital platforms like SLACK, Teams, and Zoom, as well as via social media. Instructors shared a common understanding of the COIL project objectives, which included enhancing students' virtual project and time management skills, digital communication abilities, and intercultural competencies. The projects were integrated into the course curricula, and the grades on the collaborative project reports significantly contributed to the students' final grades.

This study specifically focused on Information Systems students enrolled in a part-time study-apprenticeship program at a German university of applied sciences. Over six weeks, the students analysed the online presence of an internationally operating company, evaluating aspects such as their commitment to the United Nations' (UN's) sustainable development goals (SDGs) (United Nations, n.d.) and diversity, equity, and inclusion (DEI) (Beach & Segars, 2022). Working with their teams, they gathered their findings and crafted recommendations in a final business report, which was assessed by an international panel of instructors. A strategic advisory and consultancy agency specializing in gender, race, workplace culture, and belonging selected the top three reports. Students who participated received microcredentials in the form of certificates and digital badges.

Upon completing the projects, 40 students completed a brief anonymous survey. Students were informed that participation was voluntary, and responses would not influence their grades. Out of 45 students, 40 responded to the survey, consisting of single and multi-select questions addressing their experiences with virtual team projects during their studies, as well as their perceptions of the challenges and benefits of engaging in the COIL project. In addition, they were asked if they believed virtual team projects should be a core component of their IT coursework. Finally, open, exploratory questions offered students the opportunity to explain their reasoning, as well as provide any additional feedback regarding the project. Their responses are summarized in the following section.

Results

Quantitative Results

The following results involve student responses to a post-project survey in which they were asked questions regarding their previous experience in virtual teams projects, their perceptions of the completed project, and their assessment of the challenges and benefits of taking part in a COIL project.

Of the 40 respondents, only 4 students had previously participated in a virtual teams project. Those students reported that the projects had taken place at work and not in a university setting.

The greatest challenges seen by 32 of the 40 students were working across different time zones and conflicting schedules. Also mentioned were difficulties communicating in English, working with peers from different cultures, and establishing communication with people they had never met in person. One student mentioned difficulties in delegating tasks and having to rely on others.

The greatest benefit of engaging in the COIL project was considered to be improving virtual teamwork skills, including the ability to communicate digitally (15 of 40). The second most important benefit mentioned was learning how to work with people from other cultures (9 of 40). Six students felt that the project had improved their language skills. Two students mentioned learning how to work on a collaborative paper and recognizing one's own weaknesses. However, 8 students reported seeing no benefit in the project.

Qualitative Results

Regarding the question whether COIL projects should be an integral part of IT-related study programs, 11 students answered in the affirmative. Their reasoning included the ever-increasing reliance on remote work and the international nature of IT work. One student stated, "I agree, because people who study computer science will most likely have to work with people from other countries regularly."

Having this project experience may also improve their employability. As one student explained, “Developing English skills and being comfortable working together with people from around the world is vital for a successful career.” Another student valued the opportunity to make firsthand experiences in what will later become their everyday working life:

I think having a first look into online project work with multiple people is really helpful since a lot of IT-based work later in life is connected to project work. Having that first experience gave us all a first impression which I think is great.

Furthermore, students agreed that COIL projects provide additional experiential learning to their study program. As one student added: “I think it was a very valuable experience and it broadens the horizon compared to the traditional IT syllabus.”

Nevertheless, 15 students remained neutral as to whether such projects should be a regular part of their curricula, and 14 students disagreed, 4 of them strongly. The reasons for their neutrality and/or disagreement lay largely in the difficulties with juggling their dual studies, which included an apprenticeship, and accommodating the differences in time zones and schedules. One student summed up their reservations as follows:

My stance is neutral to that topic, because while it does improve the teamworking and language skills, it's also a coinflip whether or not your team is good. Furthermore it is really hard to plan meetings because of the timezones and schedules and as a dual student it was especially hard because of the apprenticeship.

Additionally, some students said they would have appreciated the project more if the focus had been less on business and more on IT or computer science-related topics. An additional disagreement concerned the project organization itself, which was tightly structured and stringently managed. As one student remarked:

It should not be a must in my opinion since it is very challenging to work across different time zones in a very busy schedule, but I can see the benefits of it, either way this is some sort of experience you can get by

working in a group in your own will and in a less crammed schedule. The work was not difficult but in this sort of assignment it feels as if you are very limited due to the fact that you are told what to do in every step instead of finding your own way of doing things.

Students were given the opportunity to make any additional comments and provide feedback at the end of the survey. Many respondents expressed appreciation for the opportunity and found the project an enjoyable experience. Several students mentioned that their feelings towards the project would have been more positive had it been longer than six weeks, and they would have experienced fewer time constraints.

Discussion

The results of the post-project survey substantiate the first research question regarding the lack of virtual team project experience during IT-course programs. The fact that IT professionals will likely work in international, virtual teams and project-oriented work environments points to a discrepancy between the needs of industry and universities' commitment to imparting 21st century skills to their graduates. It should be mentioned here that this is not a phenomenon unique to German institutions of Higher Education. Reluctance to adopt COIL projects due to lack of resources, among other reasons, has been found at institutions in other countries (Swartz, 2021). Nevertheless, embedding COIL projects throughout university curricula offers a cost-effective and inclusive learning experience for students, especially those in part-time study programs who would ordinarily not gain intercultural exposure through a study-abroad program.

The challenges mentioned by students (see RQ2), such as difficulties working across multiple time zones and schedules and collaborating with peers from other cultures virtually, underline the importance of engaging students in COIL projects. Previous research on COIL projects has found that students generally overestimate their intercultural competencies beforehand (Swartz et al., 2019). By engaging in COIL projects, students confront some of their own pre-conceptions and intrinsic biases,

and at the same time are offered the opportunity to experience frustration, including failure, within the safe confines of the university before entering the workforce. As a result, students develop their own set of best practices with which they can successfully operate in their future profession.

Regarding the benefits of engaging in COIL projects (see RQ3), students recognized the positive impact on their language skills, as well as skills in virtual communication and project management. Particularly valuable was exposure to others' cultural norms regarding work, time management, and the importance of building rapport. Collaborating with cultures different from one's own through COIL projects develops students' intercultural understanding, an important aspect of critical thinking and questioning of societal biases (Kordzadeh & Ghasemaghaei, 2022; Liyanage & Ranaweera, 2023; Swartz et al., 2019). In turn, graduates are better prepared for their professional lives and are less likely to perpetuate such biases, for example when developing software including GenAI.

The final research question concerned whether COIL projects should be included in IT-study programs. Students' perceptions on the value of COIL projects for their study program varied. Although many students recognized the benefits of having engaged in the project, others emphasized the additional workload and stress of managing the project while completing the expected deliverables. This was particularly true for students enrolled in a dual education program, who were completing an apprenticeship while studying at university. Nevertheless, it should be noted that students may prefer the familiar forms of coursework such as studying and taking exams, over the time-intensive, international group work approach of COIL projects. Time constraints, scheduling conflicts, a high workload, and lack of resources are also reasons for instructors to avoid incorporating COIL projects into their syllabi (Swartz, 2021).

For both instructors and students to reap the benefits of experiential learning through COIL, recognition of the value of COIL projects on the part of university administration and department heads through changes in policy is necessary. University program accreditation needs to require Internationalization-at-Home

programs such as COIL (Barbosa et al., 2019). More support and recognition should be given to instructors for the additional workload involved in setting up and carrying out COIL projects. Student participation in COIL projects should receive greater acknowledgement through microcredentials, credit towards certification, and stipend applications. Specifically regarding STEM and IT-related areas of study, curriculum development must reflect changes in the 21st century workplace and the skills required of professionals today. The relevance of critical thinking and human agency, especially in light of GenAI and the growing pervasiveness of technology in all facets of human life, requires a more interdisciplinary approach to education than ever before (Fleischmann et al., 2024).

Limitations of the Study

Limitations of this study include the small sample size as well as the special nature of the respondents, who were enrolled in a rigorous dual study program involving an apprenticeship and undergraduate degree program and thus faced considerable time constraints compared to full-time students. Nevertheless, the responses to the survey reflect the majority of students participating in the COIL projects.

Implications of the Study

This mixed-methods study involved a small sample from one German university. Nevertheless, student responses emphasized the value of incorporating COIL projects into IT and computer science course curricula. At the same time, respondents confirmed that obstacles to embedding COIL projects, such as workload and lack of incentives, need to be addressed. Although previous studies involving similar projects substantiate these findings, additional research may potentially uncover different responses from participating students in other countries (Logemann et al., 2022; Swartz & Shrivastava, 2021). In addition, further research might focus on project content as well as evaluation criteria of COIL projects in terms of their value for learning outcomes (Carle et al., 2023).

Conclusion

As 21st-century technologies, including the rise of GenAI, continue to advance rapidly, Higher Education institutions can best prepare their graduates for future careers by adopting a transdisciplinary approach that integrates IT, law, management, social sciences, and humanities. One effective method is to engage students from diverse disciplines in collaborative virtual projects, such as the COIL projects highlighted in this study.

Students participating in COIL projects may enhance their virtual project management and digital communication skills while deepening their understanding of working across cultural differences. By fostering intercultural competencies, we can help mitigate bias in the development and application of technologies. Simultaneously, this approach promotes effective international collaboration, thereby increasing the potential for global progress.

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