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COLLABORATIVE LEARNING IN INTERNATIONAL INTERDISCIPLINARY TEAMS

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ABSTRACT
Teamwork, often distributed across continents and cultures has become a standard in the context of Industry 4.0. To enable students to look beyond their own space, time and culture while resolving specific problems in a specific context makes them more flexible and culturally sensitive and prepares them for collaborative work in their future design practice. The paper discusses key aspects of an online collaborative project developed by students from two design careers, interior design and industrial design, located in two Latin American countries, Mexico and Peru. The study draws upon socio-cultural approaches and deliberates the different dimensions of collaborative work – cognitive, socio-relational and affective. We analysed the individual and shared goals of the collaboration, the roles that each participant played, the specific methods and tools used by the two groups, how knowledge was shared, how problems were negotiated and resolved and how students felt about it. Our main objective is to evaluate how the collaboration impacted students' learning. Firstly, we focused on students' performance, the co-created knowledge and the competences developed in the course of collaboration. Secondly, we examine the quality of the design project and correlate it to the effectiveness of the communication in the teams. Research data were collected with student surveys and self-reflection writings carried out at the end of the semester, and comparative study on the intercultural collaborative project outcomes with the outcomes of a traditional in-house team project.
The advantages of collaborative learning and the values created are summarized in conclusion.

Keywords: Collaborative learning, interdisciplinary design, intercultural collaboration

1 INTRODUCTION
Teamwork, often distributed across continents and cultures has become a standard in the context of Industry 4.0. The digital transformation profoundly changed the dynamics of the production processes and business models which imposed a shift in the workforce competencies requirements. Along with cognitive abilities, systems skills and problem-solving skills, the new technological adoption entails capabilities of collaboration, communication and adaptability [1].
The complexity of the design tasks, the need for multiple expertise and the division of labour are recognized as driving factors for the increased necessity of collaboration in the design field [2] Moreover, the shift from the traditional human-centred design approach towards co-creative practices implies that the challenges we face today can be resolved only as a team effort where researchers, designers and users participate together in the design process [3]. Different projects have been exploring the participatory capacity across design processes around the world [4,5,6].
The role of universities is vital in preparing the new generations and equipping them with the knowledge and skills demanded by the companies. Design education responds to these realities through implementing team projects where small groups of students are exposed to a situation where they "learn or attempt to learn something together" [7]. Through communication, dialogue, argumentation, negotiation, conflict resolution they jointly take decisions and solve problems. In the collaborative process, all participants are dependent on each other, share responsibilities and work together to achieve the common objective in a more efficient way [8]. As a result, students acquire collaborative skills that will be crucial for their future success as design professionals.

1.1 Collaborative online international learning

Information and communication technologies expanded the channels of collaboration for design teams and generated new opportunities enriching the ways students learn. Collaborative Online International Learning (COIL) is one of the methodologies encouraging collaborative learning between students from different countries. It expands their horizons by providing the opportunity to get acquainted with new cultural realities, thus, broadening their knowledge. Though this innovative teaching and learning paradigm originated back in 2006 [9], virtual exchange gained its momentum with the covid-19 pandemic. The methodology allowed the internationalization of both students and teachers which would be otherwise impeded by the travel restrictions. Students could participate in a virtual journey enriching their cross-cultural experiences while teachers were allowed to teach a course in a foreign university without the need to be physically present. What differentiates COIL from a typical online course is that it is specifically designed to connect students with a different cultural background and different geo-physical perspectives. The planned activities focus on the creation of shared experience and understanding, while exploring the potential of various platforms for online collaboration [10]. Students are enabled to look beyond their own space, time and culture but at the same time they resolve specific problems in a specific context thus becoming more flexible and culturally sensitive. Hence, they are better prepared for such types of collaborations in their future design practice.

According to Dillenbourg, Järvela and Fischer [10], for many educators collaborative learning is one of the best ways to achieve changes in educational citizenship. Teamwork in virtuality, has the same objective as in face-to-face settings; therefore, it can be considered a joint work of people who are trying to achieve a common goal. Virtual learning environment has already established itself as a space where innovation is present, and when collaborative learning is added, the possibilities of developing enriching learning experience of the participating teams become optimal. This is particularly valid when two or more disciplines of the same profile are involved.

2 COIL IN THE LATIN AMERICAN CONTEXT

The project in consideration in this paper brought together two Latin American universities - Universidad de Monterrey (UDEM, Mexico) and the Pontificia Universidad Católica del Perú (PUCP, Peru). From the Mexican side there were 14 students led by one professor and from the Peruvian side 33 students and three professors participated. The Mexican students were in their seventh semester in the *Interior Design* programme in the Department of Architecture and Habitat Sciences. The class where COIL was implemented was *Studio Integral*. This is the last and most advanced studio in their course of study where they develop large-scale interior design projects drawing on the knowledge built in the previous studios. The general aim is to prepare them for the elaboration of their diploma thesis. The Peruvians were students of *Industrial Design* in their sixth semester, in the Industrial Design programme at the Arts and Design Faculty. The course where the project was implemented was *Design Project 2*. This is the second course of the third year of Industrial design studies. The Industrial Design Career takes five years, and the third year is their first in specialized design studies after two years of general courses. The main objectives of the class were to prepare students for collaborative work with partners from other design specialties and fields and to practice the development of a comprehensive design project.

2.1 Planning

After establishing initial contact between the professors from the two countries, several zoom meetings were organized to choose the topic of the project, to align the existing course syllabus and objectives of the two courses, to discuss and develop the specific activities.

The COIL project was integrated as a module within each of the courses with duration of five weeks. It took place in the second half of the autumn semester in 2021, so that students could be preliminarily acquainted with the theoretical aspects, conceptual and instrumental tools necessary to elaborate the project. Adaptive reuse of an industrial heritage building was selected as a topic for the collaboration. The general objective was formulated as follows: to explore the potential for adaptive reuse of the dilapidated Peña Blanca building in Monterrey (Mexico) through evaluating its cultural significance as an industrial heritage and reinventing its values as to enhance the building and to bring it to new life through the proposal of new functions relevant to the current context. The interior design students were in charge of analysing the historical, cultural, social, artistic and economic context of the site, to estimate the values of the historical building by gaining holistic understanding of the problem of preservation

and conservation of cultural heritage, to identify the potential for intervention and to generate design proposals. The industrial design students elaborated deeper the analysis of the user needs according to the proposed concept. They were expected to design the furniture and equipment, to specify the materials and manufacturing processes.
Moreover, the objectives of the COIL were formulated:

- To develop skills to work in multidisciplinary and international teams
- To encourage cross-cultural experiences and students' awareness of similarities and differences
- To strengthen the online learning mode imposed by the global quarantine through building a collaborative learning experience and establishing a cross-national dialogue
- To foster an international creative network in the field of design
- To develop skills on multiple visual platforms on and offline

2.2 The process

The first synchronous meeting included the project presentation, introduction of the students and designation of the teams. Each team was constituted of students from both countries as this is a prerequisite to achieve the goals of the collaboration. Four teams were formed consisting of 2-4 Mexican students and 6-9 Peruvian students. Since the industrial design students were a big group, they were split into three sections, each one guided by one teacher in charge. The Mexicans, who started working on the investigation phase two weeks earlier, presented the outcomes of their research to their peers and discussed the project brief, the user needs and the possible interventions in certain areas of the building. The Peruvians joined the discussion with further consideration of the human perspective in the problem solving process. Thus, the five-week experience began.
Students started to actively search connections between the user needs and values, and the current trends within the broad socioeconomic and technical context, to frame questions, discern opportunities and generate alternatives, to explore the advantages and disadvantages of the proposed ideas. The project advance was supervised by the teachers, but the group dynamics were not controlled as the students worked independently outside of the class time.
In such collaborative learning settings students not only acquire knowledge but are exposed to specific social situations where the interaction that takes place significantly impacts the learning process. Learning emerges as an interrelation of the cognitive, socio-relational and affective dimensions of the collaboration [11]. In our case, due to the different schedules of the two classes it was not possible to find a time slot to organize a synchronous meeting of the two groups, so students were expected to self-organize and work jointly on the given tasks without direct control of the process by the teachers. Thus, some of the teams that failed to take the initiative and timely meet their partners to advance on the project experienced a delay in the design process. This resulted in late submission of the deliverables, justified by the students from both countries as a fault of their partners. It is recognized that tensions often occur in collaborative work. However, these tensions are not considered as process disruptors, but rather as "a vital precursor to learning and development" [12]. When students encounter problems in the collaboration, they search for opportunities to resolve them in order to improve the situation and eventually to meet the learning goals. Considered from that perspective, collaborative teamwork significantly contributes to the development of students' social competences. After participating in an international collaborative learning experience, they acquire some generic skills related to social communication, interpersonal and social relationships, and construct interpersonal intelligence.
Collaborative work between students from different geo-locations (Peru - Mexico) allowed the creation of a space where differences in time, culture, competences, etc., took on great value, transforming all of this into competences with the capacity for mediation between equals [13].To be able to interact, different contexts or digital tools were used, and different cooperative learning techniques and communication tools were employed. Teamwork in virtual environments has in common the use of communication and interaction tools, used with pedagogical intent as elements that enrich the way of learning by doing. With these two lines and a constructive learning method, both students from the Peruvian university and students from the Mexican university went through an experience rich in values, ideas, customs and skills acquired during the semester in which the project lasted.

3 RESEARCH METHOD AND DATA COLLECTION

To evaluate how the international interdisciplinary online collaboration impacted students' learning we used a socio-cultural framework. It considers that individual learning is developed through social interactions which are dependent on the social and cultural context in which they occur [11,14].

A qualitative case study was carried out to investigate the cultural, individual and social factors that influenced the behaviour and the learning experience of the students in the specific intercultural context of the collaboration. Firstly, we focused on their performance, the co-created knowledge and the competences developed in the course of collaboration. Secondly, in order to go beyond the subjective experience of the students, we examined the quality of the design projects they delivered and correlated it to the effectiveness of the communication in the teams.

Research data were collected with student surveys and self-reflection writings carried out at the end of the collaboration. The surveys consisted of open-ended questions to encourage student's reflection on the collaborative process, including the personal and team challenges faced, the problems encountered, the behaviours adopted, and the choices made to overcome them, how the final outcome was impacted, and the most significant personal meaning of the COIL project. We consider this "reflection-in-action" as Schön [15] defines it to be of particular importance for the acquisition of knowledge. When students contemplate on the experience in a structured way, they learn how to control the process and hence improve their collaborative competences.

Furthermore, we performed comparative study on the intercultural collaborative project outcomes with the outcomes of a traditional in-house team project to confirm whether the COIL experience had a positive impact on the quality of the design.

4 DATA ANALYSIS AND DISCUSSION

The first question addressed in the research referred to the problems and challenges that the students encountered in the collaborative project development. The major problem mentioned by all participants was time-management and the delayed submission of the deliverables caused by the amount of work which had to be accomplished within tight deadlines and the big scale of the project. The students from both universities indicated the difficulties in communication and non-compliance with deadlines as the greatest challenges for teamwork. *"We had to work with two teams from Peru and not all of the team members answered our messages which made the communication very difficult,"* and *"It was difficult to work with students who did not respect due dates,"* shared the students from Mexico in the self-reflection writing. The perception of the Peruvians was similar: *"The biggest challenge we had to resolve was communicating with the students from UDEM because of our schedules. It wasn't easy, but we solved it by sending each other information through a chat on WhatsApp."*

Work in a big interdisciplinary team was also identified as a problem. This is evident from the following quote by a Peruvian student: *"I had never worked with a team with lots of members and it was difficult because there were a lot of opinions and ideas. The greatest team challenge we experienced was how to make decisions, because everyone had opinions, suggested different ideas and it was very difficult to choose a final one."* Indeed, we observed that the students were very enthusiastic in the beginning of the collaboration and proposed many ideas which were eventually rejected because the lack of time did not allow their full development. Another reason for the delayed delivery was the desire to improve the initially proposed concept: *"My group developed a new concept for the project, and that decision changed the guidelines we have been following, so that affected the schedule we have settled."*

The following two quotes describe how students tried to overcome the difficulties and to resolve the communication problems which occurred. *"We set rules to attend all team meetings, 100% honesty in our opinions, and an open mind to criticism,"* and also, *"We decided to divide the work according to the expertise of each member. This allowed us to move the work forward more quickly and to improve the quality of our proposal."*

However, despite the difficulties a general satisfaction of the final project outcomes was expressed: *"After much debate and several proposals made, we managed to resolve the problems in the best possible way, and this impacted the project outcome in a very positive way"* (student from Mexico). *"It was a great teamwork experience; everyone gave their best and really amazing proposals came out with potential to continue being developed"* (student from Peru).

When asked to describe their experience of the COIL project, among the positive comments that students wrote were that it was "a very productive collaboration," "an innovative educational experience," "an open minding experience," "a great opportunity to recognize the pros and cons of my own design

process." There were also some negative comments such as "it was very stressful," "it was difficult," and "the amount of work was huge."

Among the most personally meaningful aspects of the collaboration, all students mentioned the opportunity to work with students from a different design field and a different cultural background. *"It was a very interesting project where we got to test our skills in front of a new group of colleagues and share experience with each other. We met new realities and different approaches."* The intersection of the two knowledge domains gave the students the opportunity to learn and get inspired by each other: *"When we were sharing ideas for the concept, I felt really inspired by the ideas of my partners"*. The new skills that were obtained were also recognized as one of the advantages of the COIL. Among them were indicated: to take risks and not be afraid to experiment, to work under pressure and plan the time, to build mutual trust and appreciate the different points of view, to gain confidence in expressing and defending ideas, to be more responsible, organized and patient. Students shared that they not only learned how to distribute tasks in order to work more efficiently but also mastered a new design vocabulary to communicate their design ideas.

Besides the insights on students' perspective on the collaboration, for us as educators it was important to ascertain to what extent COIL has contributed to the knowledge acquisition and how the quality of the design project was affected. For this purpose, we compared the project delivered as a result of the interdisciplinary intercultural collaboration with a traditional in-house team project developed the previous semester. In the case of the interior design students, a more profound and comprehensive project was delivered with a greater attention to the details, a better stylistic conformity between the furniture and the other interior components, and a more careful specification of materials. In a traditional project students focus rather on the architectural programme of the space and use ready-made furniture usually selected from available 3d models in online libraries which do not always respond fully to the defined user needs. With the collaborative project development, the product design students contributed with their knowledge about ergonomics, structures, materials and processes, so a more conscious alignment between space and product was achieved. Product design students in turn could integrate their design proposals in the interior spaces rendered by their partners. Thus, they not only validated them but had the opportunity to reinforce the socio-environmental aspects of their projects.

5 CONCLUSIONS

In conclusion, we can summarize that with the COIL project students gained experience preparing them well for the challenges which might be encountered in intercultural interdisciplinary collaborations. The participants developed intercultural competences, i.e., the relevant knowledge, skills and attitudes to relate and communicate effectively and efficiently with individuals from other cultures. In this group effort, team members from each university came with their diverse perspectives and design approaches but when working together to achieve a common goal, they learned how to share knowledge and build mutual trust to find the solutions of the problems together. Despite the communication gap which was reported by the participants as a shortcoming we consider it beneficial for their training because by dealing with it they learned how to manage the tensions of collaborative work. To avoid the occurrence of such problems in future collaborations we plan to ensure a closer supervision of the collaborative process to aid the teams deal with them in a timely manner.

We were very satisfied to observe that all students showed willingness to overcome the problems and that during the process they built confidence in their own skills as designers, in regard to both generating and communicating ideas to the others. We consider reflection as an important element of learning that promotes conscious thinking and analysis of the educational experience, so we encouraged students to rationalize how the collaboration has contributed to their personal development. *"I didn't have experience working with people from other countries and other design fields, but now I know what I have to improve in order to work effectively with colleagues I haven't met before,"* shared one of the students. This opinion, together with the overall higher quality of the projects in comparison to the traditional in-house projects testifies the successful outcomes of COIL implementation in the educational process.

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