Insights Into Student Self-Assessment Within Interdisciplinary Project-Based Learning

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Abstract
The literature indicates that university programs often lack opportunities for interdisciplinary project-based learning, essential for developing new skills, including professional ones (Reverdy, 2013). Reflective practice has been proven to be a valuable method for enhancing learners' awareness of their abilities (Denami & Adinda, 2023), enabling them to regulate their own learning (Bandura, 1991). This study explores learners' learning experiences in a Hackathon, a project-based learning activity, within an interdisciplinary framework. Master students from two different study fields worked together on a real project. Our method involved providing a reflective form to help them identify various aspects of their learning, such as competencies and learning situations. Lexical analysis software was then used to analyze their answers. Results indicated that on the first day (T1), participants identified five main topics demonstrating their competencies: work values related to interdisciplinary settings, collaborative work, project management, public speaking, and debating skills. These same topics reappeared on the second day (T2), with more accurate use of vocabulary related to project management and the interdisciplinary context they experience. Decision-making skills also emerged as an additional topic. Despite the benefits of interdisciplinary collaboration, learners experienced stress due to limited understanding of their peers' academic cultures. However, their reflections revealed the value of such collaboration. Addressing these challenges and targeting successful crisis management skills requires indeed an innovative pedagogical approach. The findings of this study emphasized the necessity of transcending traditional lectures to more innovative pedagogical approaches fostering competencies needed by their prospective professional environments.

Keywords: Project-Based Learning, Interdisciplinary Setting, Hackathon, Professional Skills Acquisition

Introduction

Universities today undergo significant transformations in multiple dimensions, particularly pedagogy and organization. Since implementing the Bologna Process, higher education institutions have been increasingly tasked with aligning their curricula to meet the evolving demands of socio-economic partners. This alignment aims to enhance the professionalization of university students and better equip them with the competencies required by the labor market (European Commission, 2022). These changes are not merely administrative but touch upon the core of teaching practices, with a growing emphasis on fostering skills that bridge academic knowledge and professional application.

Our contribution focuses on exploring one such pedagogical approach: the "hackathon" method, implemented within interdisciplinary contexts. Hackathons are time-bound, collaborative events where students work together to solve real-world problems, combining skills from diverse fields such as technology, business, and design. This approach encourages creativity, problem-solving, and teamwork, essential competencies for the modern workforce Through this research, we aim to provide interdisciplinary learning environments that favor students' capacity to tackle complex, real-world problems while preparing them for careers that increasingly demand both specialized knowledge and broader, cross-disciplinary skills. Consequently, this study aims to identify the competencies that students develop in an interdisciplinary project-based learning activity, embodied in a hackathon, and to highlight whether the competencies present are those targeted by the activity and critical for both professional and academic success, such as communication, adaptability, and collaboration. To achieve its objective, the study first reviews the literature focusing on project-based learning, learners' professionalization through Hackathon, and interdisciplinarity in learning. Then, the data collection protocol, which emphasizes using reflective forms to help learners identify various aspects of their learning, was implemented. The article concludes with a presentation of the results and a discussion of the key conclusions drawn from the study.

Literature Review

Project-Based Learning and Learners' Professionalization Through Hakcathon

While hackathons are generally organized as corporate events designed to rethink work practices and situations, it is interesting to study their implementation in the academic context, as they provide an environment conducive to the acquisition of methodological and professional skills. The word hackathon combines two words: "hacker" and "marathon" (Komssi et al., 2015), and takes the notion of playful ingenuity and integrates it with a context of intense concentration and limited time (Brennan et al., 2014). A hackathon can be defined as a digital innovation competition taking place over a short period (Adinda et al., 2024). The effectiveness of this environment relies, in particular, on the motivation and involvement of participants and on the fact that the participants have something to share to bring out a dynamic of reflection around a problem posed (Gréselle-Zaïbet et al., 2018) to identify a solution or define a potential project to carry on in response. The hackathon format plans to bring together, for 12 to 48 hours, professionals from a variety of backgrounds (interdisciplinary dimension) in an attempt to "collaboratively and openly provide original and practical solutions, generally of a technological nature, to problems that then remained unresolved. Today, this approach even tends to extend to socio-technical or organizational solutions, such as the design of new processes (Dionne & Carlile, 2016).

French universities are constantly called to innovate to support research and learners' success, both at university and in their future professional lives. Indeed, professionalization has become a major issue for higher education (Rose, 2018). On this subject, the issue most often put forward is that of matching the demand of professional circles with training in professional, specialized, and disciplinary skills. Furthermore, over the past decade, the craze for transversal skills (Santelmann, 2019), essentially social skills or soft skills (Morlaix, 2015), has also broadened the scope of professionalization. Consequently, professional skills training schemes have been set up at universities since the first years of the bachelor's degree, with the most prevalent formats which include professional bachelor's programs and internships, which allow learners to be immersed in a professional context and undergo training during their academic year. However, it is the host organization that bears the responsibility for the development of learners' professional skills acquisition, while the university's role is to equip them with conceptual and theoretical knowledge (Coulon, 1997).

Project-based learning is an experiential learning approach (Kolb, 1984) based on a constructivist paradigm. Recently reintroduced to higher education, this approach allows learners to engage in active exploration of their environment, seek solutions to their problems, and carry out a project. Krajcik & Shin (2014) noted that this approach also enables learners to gain a deeper understanding of the subject learned when they actively construct their knowledge by understanding the needs of the projects and working on them. The socio-constructivist dimension of this method also allows individuals to benefit from support from their peer group through social interactions and the establishment of collective intelligence, thus facilitating both the realization of the project and the co-construction of knowledge. For those unaccustomed to this learning approach, notably, when implemented through a Hackathon, the experience enables them to progress in a zone of proximal development (ZPD), thereby facilitating the broadening of their skills.

Several studies have already demonstrated the effectiveness of this approach, which encourages greater participation in educational activities and improves various dimensions of learning. Kaldi et al. (2011) observed that learners who had engaged in project-based learning exhibited enhanced outcomes in both content knowledge and group work skills. This study also highlighted a significant aspect of learning: learners' intrinsic motivation and positive attitudes towards peers were also developed as a result of teaching project-based learning. Other studies (Boaler, 1998; Karaçalli & Korur, 2014) observed that project-based learning had significant effects on learners in terms of academic success and knowledge retention. Indeed, project-based learning is known to improve conceptual understanding, often requiring creative and in-depth thinking, in contrast to the procedural knowledge acquired by the traditional teaching group, which relies mainly on information recall. Stewart (2007) observed a positive influence of project-based learning on preparation for autonomous learning. His study highlighted that learners who experienced project-based learning developed high levels of self-direction skills and were able to achieve significant results in terms of learning scholarly knowledge. This phenomenon can be explained by the fact that project-based learning enables learners to identify the meaning of their learning activities, which are more akin to social activities, promoting a shift from pure knowledge to more meaningful, "global" and cross-disciplinary learning (Weber, 1982). To sum up, the current literature agrees that participatory learning enables the development of disciplinary and cross-disciplinary or transferable or soft skills and competencies and is in some way linked to the phenomenon of professionalization.

Interdisciplinarity and Learning

Interdisciplinary learning is an effective response to the challenge of training university students, the citizens of the future, to deal with various societal challenges. If we think, for example, of the challenges of climate change, health, and justice, we can only agree on the importance of approaching these issues imperatively from a holistic point of view that goes beyond "disciplinary" technicality if the solution envisaged is to be viable (Boix-Mansilla, 2017; Nikitina, 2005; Slakmon & Schwarz, 2019). Interdisciplinarity as a pedagogical approach, unlike the project-based learning approach, has not yet been sufficiently studied (Markaiskeite et al, 2024) due, among other things, to the difficulty of being able to design and create adequate learning spaces. The implementation of the approach is a considerable challenge, and consequently, research on this subject remains relatively underexplored.

Interdisciplinarity refers to any form of collaboration between disciplines in different spheres integrating research, academia, community, industrial, political, or private life contexts (Markaiskeite et al., 2024). As a pedagogical approach, like many others, interdisciplinary learning has its origins in ancient Greece (Klein, 1990, 2006). At that time, reference was made to a taxonomy of domains and knowledge to be found within science. Nevertheless, the concept of interdisciplinary learning took hold at the end of the 19th and beginning of the 20th centuries: when university research and education had become more specialized and compartmentalized, this approach proposed a posture of openness in contrast, therefore, to this compartmentalization, which was developing a "technicality" that was not functional to societal needs.

In 2002, Ivanitskaya et al. conducted a literature review highlighting the benefits of a particular educational approach based on various scientific studies. According to these authors, this approach promotes flexible thinking, helps individuals recognize the strengths and weaknesses of different disciplines, and enhances the ability to assess the value of acquired knowledge. The benefits also include improved reflective capacity, cognitive skills, content retention, and proactive thinking. Consequently, it also fosters creativity, critical thinking, and the ability to connect disparate ideas. Additionally, this approach helps individuals develop greater tolerance for ambiguity, increase sensitivity to ethical issues, have a balance between subjective and objective thinking, and enhance awareness of biases (Field, Lee, & Field, 1994, cited in Ivanitskaya et al., 2002). While there have been a few pioneering empirical studies (Kidron & Kali, 2015, 2024; Shen et al., 2015; Tytler et al., 2021), research into interdisciplinary learning remains underdeveloped in the context of higher education.

The objective of this contribution is to conduct a study that identifies the types of competencies facilitated by and within this interdisciplinary learning approach. To achieve this objective this study aims to identify the competencies that students develop in an interdisciplinary project-based learning activity, embodied in a hackathon, and highlight whether the competencies present are those targeted by the activity and critical for both professional and academic success, such as communication, adaptability, and collaboration.

Methods

Participants of the Study

The study involved forty-three students from three different master's programs in two fields of study. Two groups of participants come from two music education programs at two higher education institutions in France are enrolled in the music education program, preparing them for the secondary school teaching exam in France (Group A; N:10), and are in the instrumental or vocal pedagogy program (Group B; N:10). As for group C (N:23), learners in this group are in an educational sciences program focusing on socio-educational actions, at a university in France.

To collect data on learners' experience of the hackathon, we designed a Reflective form that allowed students, individually and anonymously, to express themselves on the following dimensions:

- Competencies developed or used during the event
- learning experience in various learning situations
- Crisis or problem encountered
- How the crises or problems encountered were resolved

This work focused on the competencies developed or used during the event.

Instruments for Data Collection and Analysis Method

Given the total number of learners involved and the complexity of the subject, we adopted a qualitative approach, allowing the target audience to describe their experience and skills using an anonymous written reflective form in which open-ended questions are proposed to them on the first and second (and last) day of the Hackathon (Figure 1). Reflective practice has been proven to be a valuable method for enhancing learners' awareness of their abilities and learning (Denami & Adinda, 2023) enabling them to self-regulate their learning (Bandura, 1991). However, while it's true that the answers provided in the reflective form are self-declared, the anonymity of the questions helps to limit bias. To analyze the responses to the reflective forms longitudinally, we asked the students to choose a pseudonym to fill in on the form during the two data collection phases.

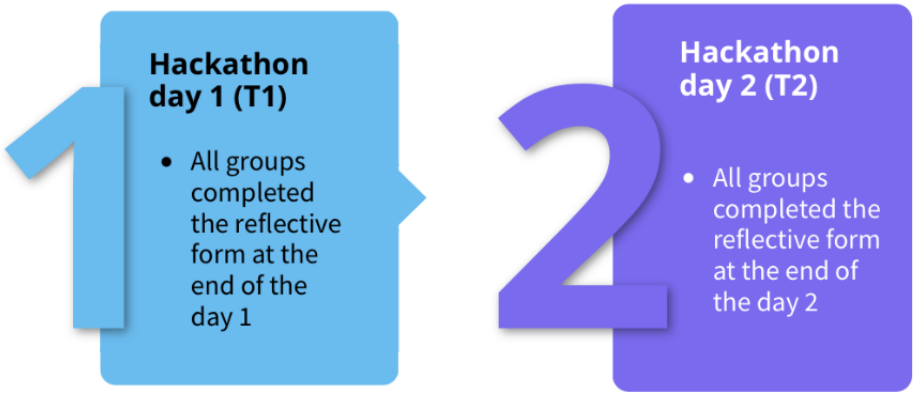

Figure 1: Study Protocol

To ensure the objectivity of the findings, while identifying competencies declared on the reflective form, a hierarchical top-down classification analysis administered in Iramuteq

software was carried out. Using the algorithm developed by Max Reinert (1987), this analysis identifies groups of words (lexicons) often found together in the data studied. The software provides a representation of the classification results in the form of a tree structure or dendrogram in which the most characteristic words of each class are identified. In this study, we also managed to do a correlation test between the competencies and participants' profiles using the software (Table 1).

Table 1: Data Analysis Method

Administered test in Iramuteq	**Variable studied**
Hierarchical top-down classification analysis	Competencies identified on the reflective form (T1 and T2)
Correlation test	Competencies and participants' profiles

Results

The results indicate that on the first day of the event (T1), participants highlighted different topics to describe competencies they used or developed during the day, which included their project management skills (class 3, class 10), collaborative working skills (class 2), communication skills (class 4, class 5, class 8), social relations (class 6, class 9) and their experience in discovering interdisciplinary setting of their team members, as well as their knowledge of the work values related to working in interdisciplinary setting (class 1, class 7).

If we focused on the most significant topics that represent at least 10% of the text, the dendrogram highlighted (Figure 2):

- Work value (class 1)
- Collaborative working skills (class 2)
- Project management skills (class 3)
- Public speaking (class 4)
- Debating skill (class 8)

According to the participants' profiles, the correlation test administered pointed out that group A perceived that on the first day of the hackathon, they developed and used project management skills and public speaking skills. Students in group B identified public speaking skills and debating skills as the competencies they developed and used during the first day of the event. Students in group C highlighted collaborative working skills as one of the competencies they will develop and use during the first day of the event. They also pointed out the topic of work values as important as they work in an interdisciplinary environment (Figure 3).

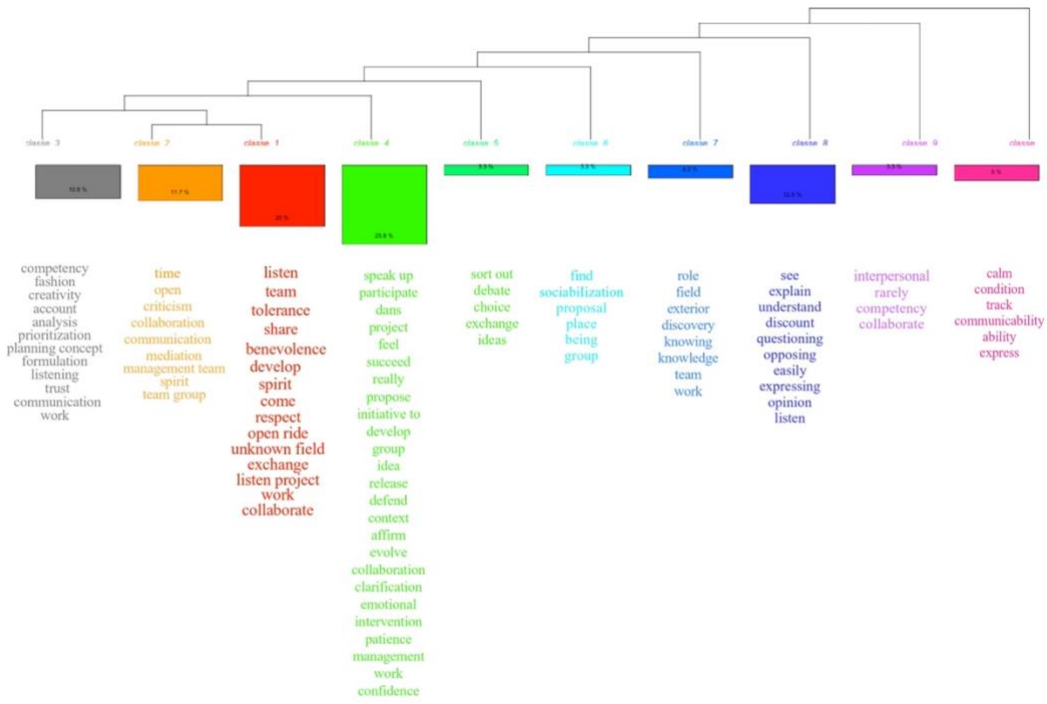

Figure 2: Competencies Identified on the Reflective Form (T1)

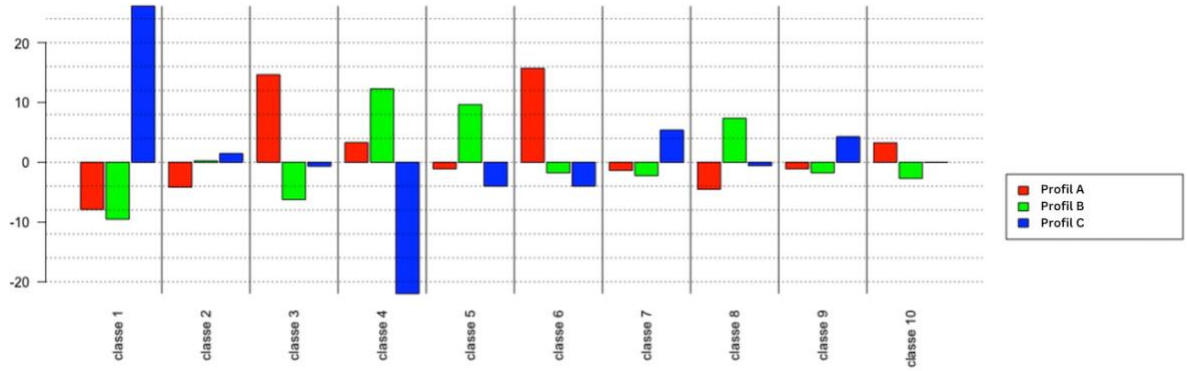

Figure 3: Competencies Identified on the Reflective Form (T1)

These similar topics were mentioned on the last day of the event (T2), with more accurate use of vocabulary related to project management and the interdisciplinary context they are in. If we focused on the most significant topics that represent at least 10% of the text, the dendrogram highlighted (Figure 4):

- Team and project management (class 6)
- Critical thinking and prioritization (class 7)
- Decision-making (class 9)
- Public speaking (class 4)

Those are the skills that specified the project management topic. The topics related to the interdisciplinary learning experience that students have, as well as their knowledge of the work values, are now split into various smaller classes:

- Work value (class 5)
- Communicate synthetically (class 8)
- Future discussion subject or project perspectives (class 10)

If in the beginning, when students highlighted their experience in an interdisciplinary setting, they described it as a discovery (class 7; T1), now on the last day of the hackathon, they are able to identify various discussion subjects or project perspectives (class 10; T2) and thus describe their broadened knowledge of interdisciplinary topics.

According to participants' profiles, the correlation test administered pointed out that group A perceived that on the last day of the hackathon, they developed and used public speaking and decision-making skills. For students in group B, their answers are more correlated to small classes, in which they talk more about role assignment, self-esteem, and work value when they are asked to identify the competencies used or developed. While for students in group C highlighted project management and critical thinking as well as prioritization, as competencies they developed and used during the event (Figure 5).

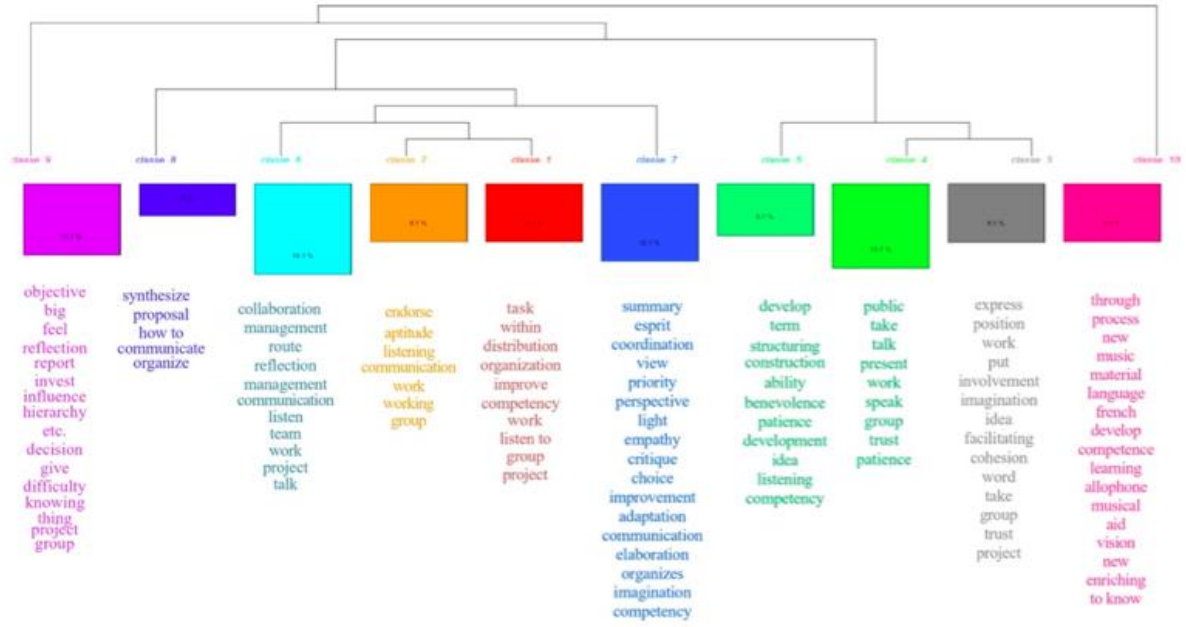

Figure 4: Competencies Identified on the Reflective Form (T2)

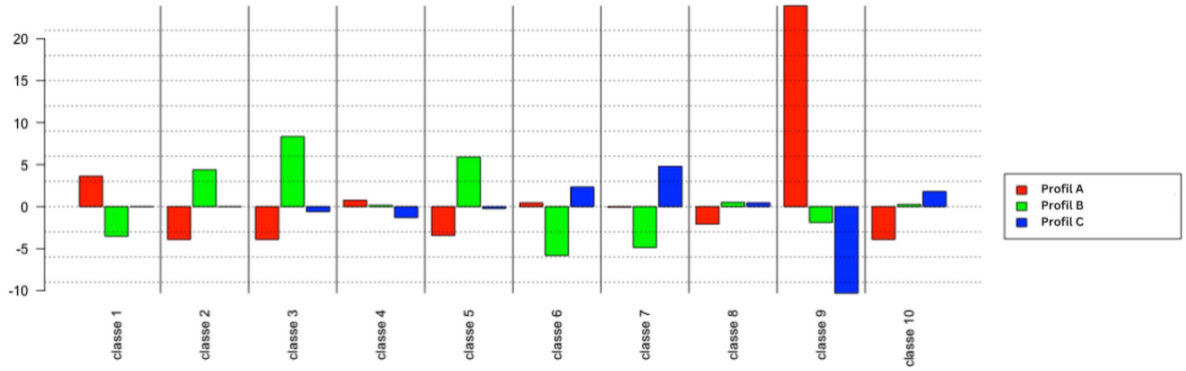

Figure 5: Competencies Identified on the Reflective Form (T2)

Conclusion

The results showed that each group of learners developed and used different competencies but tended to use and develop a more defined competence at the end of the event. These are indeed the competencies that the Hackathon was designed to target.

Table 2 below highlighted that group A perceived that on the first day of the Hackathon, they developed and used project management skills and public speaking skills. However, on the last day of the event, their answers add more precision to the project management skills by including decision-making skills in the list. As for learners in group B, they identified public speaking and debating skills as the competencies they developed and used during the first day of the event. On the last day of the event, the answers of group B are more related to small classes. They also talk more about role attribution, self-esteem, and working value when they are asked to identify the competencies used or developed. Finally, the learners of group C, at the beginning of the event, highlighted working on collaborative skills as one of the competencies they will develop and use. They also pointed out the topic of work values as important as they work in an interdisciplinary environment. Their answers on the last day of the event also provide more details about working on collaborative skills, stating that project management and critical thinking, as well as prioritization, are the competencies they will develop and use during the event.

Table 2: Comparison of Competencies Developed Between T1 and T2

Time 1	**Time 2**
Group A Project management skills (class 3) Public speaking (class 4)	Group A Public speaking (class 4) Decision-making (class 9)
Group B Public speaking (class 4) Debating skills (class 8)	Group B Role assignment (class 2) Self-esteem (class 3) Work value (class 5)
Group C Work in collaboration (class 2) Work values (class 1)	Group C Project management (class 6) Critical thinking and prioritization (class 7)

Interdisciplinary project-based learning is relatively rare in higher education Therefore, when we looked at the transcripts of the learners' answers to our reflection form, it was noticeable that they also faced crises related to project quality, misunderstandings in communication, and group work dynamics due to their lack of knowledge about the academic culture of students from different fields and their expectations within interdisciplinary teams. They were also stressed, not only by their project responsibilities but also by uncertainties about their role and expertise within the group. Overcoming these challenges requires clear communication. This involves public speaking skills, mutual respect that can be reached by knowing and having a shared working value, and a supportive environment. To better understand learners' experiences, Future studies will explore their learning experiences across various learning situations (formal, informal, semi-formal learning), focusing on the crises or challenges they encounter, and the strategies employed to resolve them.

Although the analysis of crises presented in this paper is very limited and not the primary objective of this study, the result of this work shows that interdisciplinarity encourages learners to develop attitudes of benevolence, open-mindedness, and readiness to collaborate,

and to work in a team. Those are also competencies targeted by the activity and useful for both professional and academic success. This study also shows that through structured activities designed to support these competencies, students gain the emotional resilience to face academic challenges, the communication skills to bridge diverse disciplinary perspectives, and their capability to constantly reassess their competencies and ensure their continuous improvement in relation to those of their teammates and the project. This process is fundamental in preparing students for answering the demands of their future professional environments. Consequently, this study, ensuring the alignment between university curricula and the demand of the labor market (European Commission, 2012), emphasized the necessity of transcending traditional lectures to more innovative pedagogical approaches fostering competencies needed by their prospective professional environments.

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