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(Eds.)

Miradas contemporáneas sobre la educación: investigaciones, experiencias y reflexiones

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Chapter 7. Learning through challenge-based innovation in a rural context: the students' perspective

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Abstract: This study explores an immersive Challenge-Based Innovation experience developed in Miranda do Douro, a rural municipality in Portugal. Through interdisciplinary and multicultural student teams, the initiative promoted co-creation with local stakeholders around real-world challenges. The qualitative methodology employed a combination of evocation, symbolic representation, audiovisual reflection, and peer evaluation to capture students' perceptions, engagement, and sense of ownership. Results revealed significant gains in autonomy, collaboration, creativity, and responsibility, particularly in culturally rooted projects such as those related to Mirandese language and music. The study also highlights the value of facilitation strategies and student appropriation in team dynamics, as well as the importance of preparatory support to improve outcomes. The UNESCO pillars of learning – learning to know, to do, to be, and to live together – provided a useful interpretive lens to assess the transformative potential of the experience. The findings support the broader adoption of challenge-based methodologies to promote innovation and engagement in higher education, particularly in rural and peripheral regions.

Keywords: challenge-based learning, co-creation in higher education, facilitation, student engagement, transformative pedagogy

1. INTRODUCTION

Higher education institutions face the growing challenge of preparing students for complex, real-world problems that require interdisciplinary collaboration, critical thinking, and a strong sense of social responsibility. In response to this demand, educational models that integrate experiential learning, challenge-based learning (CBL), and co-creation with communities are becoming increasingly relevant. This study is grounded in an immersive pedagogical experience

developed in the rural municipality of Miranda do Douro, Portugal, within the framework of the WE – Working & Envisioning: Challenge-Based Innovation initiative. The programme brought together students from diverse cultural and disciplinary backgrounds to co-create innovative solutions with local stakeholders, combining academic knowledge with contextual sensitivity. Rooted in the principles of challenge-based learning, this approach emphasises learning by doing, promoting problem-solving in authentic contexts and peer collaboration. The project also mobilised facilitation techniques to support students through moments of ideation, reflection, and prototyping, reinforcing the role of educators as enablers rather than providers of knowledge. In this context, the pedagogical experience addressed the four pillars of education proposed by UNESCO (Delors, 1998): *learning to know, to do, to be and to live together*. These pillars served as guiding values in the design and implementation of the activities, helping students engage not only cognitively but also emotionally and socially with the challenges at hand. The aim of this study is to understand, from a qualitative perspective, how students experienced immersive learning in a rural setting and to identify the dynamics of co-creation, collaboration, and the development of emerging competencies throughout the process.

Challenge-Based Learning (CBL) has emerged as a dynamic pedagogical model that aligns with 21st-century educational needs by promoting critical thinking, contextual engagement, and interdisciplinary problem-solving. According to Farizi, Umamah, and Soepeno (2023), CBL significantly enhances students' critical thinking skills and learning outcomes, particularly when challenges are designed to be authentic, relevant, and grounded in real-world contexts. Their quasi-experimental study demonstrated that CBL leads to deeper cognitive processing and higher academic performance than traditional approaches, emphasising the importance of active inquiry and the construction of new knowledge. Building on this, van den Beemt, van de Watering, and Bots (2023) argue that CBL is not a uniform method but a flexible, learner-centred educational strategy that encourages variety in implementation. Their proposed "CBL-Compass" framework highlights key dimensions such as stakeholder engagement, interdisciplinarity, and open-ended challenge design, framing CBL as a comprehensive ecosystem for educational innovation. Together, these perspectives position CBL as a transformative approach that redefines the student's role from passive recipient to active agent in the learning process.

Co-creation in higher education extends beyond conventional student engagement to include collaborative knowledge production among students, educators, and external stakeholders. As Dollinger et al. (2018) argue, co-creation entails both co-production, where students contribute to the design and delivery of learning experiences, and value-in-use, the personal and contextual meaning students derive from their participation. This dual framework supports a more participatory and responsive educational environment. Similarly, de Oliveira Gasi and Sanz (2025) emphasise that co-creation fosters mutual transformation and learning when diverse actors are included from the outset of the learning process, reinforcing the importance of shared purpose and context. Healey et al. (2016) further stress that authentic partnerships between students and staff require trust and reciprocity, enabling all parties to learn from one another. Importantly, co-creation becomes especially meaningful when situated in real-world settings, as shown by Tormey et al. (2020), who highlight how multi-actor collaboration with communities, institutions, and educators generates socially relevant and situated outcomes. Within challenge-based

initiatives, co-creation enables not only the joint development of solutions but also reinforces the learner's role as a co-designer of educational pathways, making it a core value in transformative, place-based pedagogy.

Effective facilitation techniques are essential for fostering collaborative learning, especially in educational environments that prioritise teamwork, critical thinking, and the co-construction of knowledge. According to Thomas and Thorpe (2018), facilitators play a dual role as process designers and relational mediators, requiring both technical expertise and interpersonal sensitivity. When facilitators are adequately trained, they are more capable of managing group dynamics, encouraging inclusive participation, and navigating interpersonal challenges, especially in blended or complex environments. Specifically, in team-based learning (TBL), facilitation is enhanced by structured formats that guide students through readiness assurance, problem-solving, and immediate feedback cycles. Burgess et al. (2020) highlight that successful TBL facilitation depends on creating diverse teams, delivering timely feedback, and supporting peer evaluation, all of which require an active facilitator role that stimulates engagement and accountability. Furthermore, Onrubia and Engel (2019) argue that practical facilitator training should include not only pedagogical strategies but also experiential reflection and modelling of group processes, ensuring facilitators can adapt responsively to evolving team needs. Altogether, these approaches underline the importance of facilitation as a skilful, intentional, and dynamic practice that significantly impacts learner outcomes in group-based educational settings.

The four pillars of education – learning to know, learning to do, learning to live together, and learning to be – first articulated by the Delors Commission in 1996, remain essential for guiding educational practice in the 21st century. These pillars provide a holistic framework that supports cognitive, practical, social, and personal development, especially in contexts requiring intercultural competence and lifelong learning. As Gauthier (2020) notes, these dimensions are interrelated and increasingly relevant in pedagogies that prioritise collaboration, community engagement, and learner autonomy. "Learning to know" goes beyond acquiring content knowledge to include learning how to learn, a key skill in project-based and challenge-based environments. "Learning to do" emphasises active participation and problem-solving, while "learning to live together" encourages empathy and communication across differences – both central to group work and co-creation in diverse teams. Finally, "learning to be" highlights self-awareness and personal responsibility, which are cultivated through reflective practices and immersive learning. This study's pedagogical approach draws directly from this integrated perspective, positioning the four pillars as both conceptual foundation and evaluative lens for the design and implementation of the challenge-based learning experience.

2. OBJECTIVES

This study aims to explore the students' experience of an immersive challenge-based learning initiative conducted in a rural setting, specifically within the municipality of Miranda do Douro, Portugal. The pedagogical programme was designed to foster interdisciplinary collaboration and co-creation with local stakeholders, grounded in real-world problem-solving.

The specific objectives of the study are to examine how students engaged with the principles of challenge-based learning, including the development of critical thinking, teamwork, and contextual sensitivity. It also aims to understand the role of co-creation in fostering meaningful collaboration between students, facilitators, and community stakeholders. Another objective is to analyse the facilitation techniques employed and their influence on group dynamics, peer learning, and project development. In addition, the study to assess how the learning experience addressed the four pillars of education proposed by UNESCO – learning to know, to do, to be, and to live together – as a multidimensional framework for educational innovation.

By addressing these objectives, the study seeks to contribute to the growing body of literature on transformative pedagogies in higher education and their potential to enhance student agency, intercultural competence, and regional engagement.

3. METHOD

The methodological approach adopted in this study followed a qualitative perspective, aiming to understand how students experienced Challenge-Based Innovation within a rural context. The research was conducted under the WE – Working & Envisioning: Challenge-Based Innovation project, which focuses on fostering connections between higher education, innovation, and regional development.

The methodology was designed to explore students' perspectives on the training process during an intensive week of immersive activities in Miranda do Douro, in north-eastern Portugal. Daily co-creation sessions were accompanied by moments of reflection and evaluation at the end of each day. This region is characterised by a strong cultural identity, including the preservation of the Mirandese language, traditional agricultural practices, and rich natural and cultural heritage – despite having a low population density. These contextual features provided a fertile ground for pedagogical experimentation through Challenge-Based Innovation, encouraging students to co-create solutions rooted in the local territory.

This approach enabled the capture not only of tangible outcomes but also of subjective and interpersonal transformations experienced by students throughout the process. A total of nineteen students participated, representing six nationalities (Portugal, Brazil, Guinea-Bissau, Angola, Cape Verde, and Nepal) and diverse academic backgrounds, including health, communication, tourism, education, and engineering. The students were organised into five multidisciplinary and multicultural teams, each addressing a specific challenge proposed by local associations in Miranda do Douro.

Data collection took place at four distinct and complementary moments, occurring at the end of each day during the intensive week. A combination of techniques was used: free evocation, symbolic representation, audiovisual reflection, and qualitative peer evaluation.

The first instrument was a word cloud generated from terms entered by students using collaborative software at the beginning of the week. This exercise captured initial perceptions and expectations, offering an interpretative lens on the most frequently evoked words.

In the second stage, students took part in an activity involving symbolic representation of team roles. Each student selected an image that reflected their perceived role and wrote a short justification.

The third methodological moment involved the creation of reflective videos by each team on the third day. These videos aimed to document progress, address challenges encountered and highlight learning and idea development. Analysis focused on indicators such as idea maturation, emotional investment, clarity of communication, and increasing student engagement with the challenge. Table 1 outlines the criteria and descriptions used to assess levels of idea development.

Finally, qualitative intra- and intergroup evaluations were conducted. Students assessed their peers using criteria such as collaboration, initiative, creativity, responsibility, and communication. These assessments enabled a comparison between self-perception (as expressed through image selection) and peer perception of individual contributions.

Data analysis followed a process of manual coding and inductive categorisation, grounded in principles of thematic and content analysis. The corpus included participants' freely chosen words within structured reflective activities, selected images and justifications, video transcripts, and peer assessment records. Categories emerged through repeated, reflective reading and were subsequently validated by two independent researchers. Cross-referencing across the different data sources strengthened the consistency of identified patterns and supported a robust triangulation of results.

Table 1. Criteria for assessing the degree of maturity of each challenge.

Criterion	Description High Level	Description Medium Level	Description Low Level
Clarity and structure of the solution	Well-defined solution, structured in clear steps or complementary components	Solution defined, but some parts remain vague or require consolidation	Vague, poorly structured or poorly articulated idea
Prototype development level	Prototype developed, tested, or visually represented	Prototype under development or partially built	Absence of a prototype or very generic mention
Feedback integration	Clearly integrated feedback for proposal improvement	Feedback mentioned, but not yet clearly integrated	No reference to feedback use
Articulating the challenge	Direct and contextualised response to the proposed challenge	Response to the challenge is present, but needs refinement	Solution not aligned with the presented problem
Feasibility and perceived impact	High applicability and potential for local impact	Application potential present, but with visible limitations	Low or uncertain applicability
Appropriation discourse	Constant use of expressions of possession and involvement ('we decide', 'our solution')	Expressions of involvement appear occasionally	Limited participatory engagement

4. RESULTS

The qualitative analysis of data collected during the intensive week of Challenge-Based Innovation in Miranda do Douro revealed meaningful student engagement, ownership, and skill development. The dataset comprised four main sources: a word cloud created on the first day, symbolic role representations within teams, reflective videos recorded mid-week, and intra- and intergroup evaluations completed at the end.

The triangulation of these instruments enabled the identification of consistent patterns and meaningful overlaps. The initial word cloud captured first impressions and expectations, with frequently mentioned terms such as culture, collaboration, innovation, learning, enjoyment, and success. These reflected a positive initial mindset and informed the first analytical categories, later reinforced through the other data sources.

In the symbolic representation activity, students selected images to represent their role within the team and explained their choices. Common roles included creative thinker, leader, organiser, communicator, and technical support. This exercise offered insight into group dynamics and how students perceived their own contributions. Peer evaluations later confirmed these self-assessments, suggesting a shared understanding of team roles and responsibilities.

The reflective videos recorded on the third day illustrated the development of ideas and increasing emotional investment. Statements such as "we want people to apply our idea in the real world" and "our next step is to refine the feedback and improve our prototype" indicated growing ownership and motivation. A clearer, more structured discourse was noticeable, pointing to enhanced critical thinking and understanding of project aims.

Although students were generally engaged, some expressed early challenges. Comments like "we struggled to organise our ideas at first" and "I wish we had started prototyping earlier" highlighted the need for stronger methodological support at the outset. Clearer initial guidance helped reduce uncertainty and improve group focus and productivity.

The co-created solutions reflected creativity, feasibility, and alignment with the local context. Projects included: repurposing residual sheep wool for insulation; integrated management of Mirandese cattle in collaboration with local butchers; digital tools for promoting the Mirandese language; immersive events centred on traditional music; and educational and therapeutic activities involving the Mirandese donkey. These proposals were considered viable and received positive feedback from local stakeholders.

Cross-analysis confirmed the coherence of emerging categories, including creativity, territorial engagement, idea development, and collaboration. The convergence of data supported the validity of the findings and demonstrated the impact of the Challenge-Based Innovation approach. Students developed interpersonal skills, critical reflection, and a sense of belonging–key components of meaningful, experience-based learning.

Table 2. Results of the assessment of the degree of maturity of the challenges.

Group	Initial situation	Intermediate stages	Current solution	Degree of maturation	Observations
Mirandese music	Identifying the causes of loss of interest	Root cause analysis + brainstorming	Cultural festival with multiple components	High	Strong cultural connection and planning
Mirandese language	Creating a website with resources	Inclusion of influencers and additional tools	Digital platform with Mirandese identity	High	Clarity of target audience and purpose
Mirandese sheep	Understanding the problem	Selection of ideas based on feedback	Acoustic prototyping + pitch	Medium	Focus on the process, clear structure
Mirandese donkey	Creative ideation using humour	Reception of feedback and redesign	Prototyping in progress	Medium	High expressiveness, solution under development
Mirandese cow	Initial market ideas (butchers, restaurants)	Tourism exploration and innovation	Structure yet to be defined	Medium	Creativity, but it needs to be consolidated

5. DISCUSSION

This study aimed to understand how a challenge-based learning (CBL) experience implemented in a rural setting – Miranda do Douro – supported student engagement, co-creation, group facilitation, and the development of transversal competencies. The results reveal that the immersive nature of the challenge and its relevance to real-world issues created a fertile environment for both academic learning and personal growth.

In relation to engagement with CBL and interdisciplinary collaboration, students demonstrated active involvement in all phases of the CBL cycle – from problem framing to solution prototyping. This engagement confirms prior research suggesting that CBL enhances critical thinking, autonomy, and contextual awareness (Farizi et al., 2023; van den Beemt et al., 2023). Importantly, the interdisciplinary team composition fostered exposure to multiple perspectives, reinforcing the relevance of collaborative approaches to complex challenges. However, the novelty of the approach also introduced some initial uncertainty, highlighting the need for structured scaffolding during the early stages.

Overall, the outputs from the intensive Challenge-Based Innovation week in Miranda do Douro revealed significant dynamics of engagement, ownership, and skills development among students, between students and facilitators, and also between students and local challenge partners. Terms such as “culture,” “collaboration,” “innovation,” “learning,” “fun,” and “success” appeared frequently in student responses, indicating a positive perception and a strong willingness to engage from the outset. These perceptions can also be explained by the cultural and

disciplinary diversity of the teams, which enabled the co-creation of innovative solutions with local stakeholders, blending academic knowledge with contextual sensitivity.

The appropriation process linked to Project-Based and Challenge-Based Learning also became evident. As noted by DGE (n.d.), these methodologies encourage students to collaborate while supporting autonomous learning. They often lead learners to explain or defend their ideas within project groups – making their learning more likely to be appropriated, that is, internalized, personalized, and valued. This process was clear in mid-project reflections, where the maturity level varied across teams. Higher maturity was observed in projects focused on Mirandese music and language, while other groups exhibited a medium degree of maturity. Students frequently used expressions such as "our project," "our solution," and "together we aim to ensure its preservation," revealing not only a sense of ownership but also a growing connection to the local territory.

The experience also revealed important engagement and ownership dynamics across roles such as creative, leader, organiser, and communicator, allowing a deeper qualitative understanding of how students positioned themselves within team processes. These findings align with Oliveira Gasi and Sanz (2025), who emphasize that co-creation fosters mutual transformation and learning when diverse actors are engaged from the outset and work toward shared goals within a common context.

Furthermore, the active involvement of external stakeholders played a crucial role in enriching the learning experience and deepening students' understanding of the region's sociocultural and economic context. As highlighted by Dollinger et al. (2018) and Gasi and Sanz (2025), co-creation in higher education redistributes agency among students, instructors, and community partners. This supports Jacoski's (2024) claim that higher education institutions must remain open to external challenges, allowing students to apply scientific knowledge to real-world problems. In this case, authentic engagement with stakeholders enabled the development of context-sensitive solutions and prompted critical reflection on their implementation. However, variations in the degree of stakeholder involvement across teams indicate the continuous need for clear and consistent guidelines for collaboration.

Facilitation also proved essential in shaping the learning environment and group dynamics. Facilitators supported team functioning by helping manage time, resolve interpersonal tensions, and focus on learning objectives. These roles align with the frameworks presented by Onrubia and Engel (2019) and Thomas and Thorpe (2018), which underscore the facilitator's importance in navigating collaborative learning. This study also echoes the findings of Barkley, Major, and Cross (2014), who identify collaborative learning as a highly effective strategy to foster student autonomy, active construction of knowledge, and interpersonal interaction. Similarly, Kleine and Vosgerau's (2018) review of 147 higher education studies confirms the pedagogical value of collaboration, particularly in promoting student agency and responsibility for learning.

Notably, facilitators also functioned as emotional anchors, especially in moments of tension or uncertainty, by helping teams strike a balance between autonomy and structure. Students recommended stronger methodological support before the immersive week, suggesting that reinforcing preparatory strategies could improve the process and outcomes by building confidence, clarifying expectations, and improving group performance.

Finally, using UNESCO's Four Pillars of Education – learning to know, to do, to be, and to live together (Delors, 1998; Gauthier, 2020) – as an interpretative lens allowed for a multidimensional understanding of the students' learning experience. While these pillars are not ends in themselves, they offer meaningful trajectories for learner development.

The project contributed to "learning to know" through research and local immersion; "learning to do" through prototyping and collaboration; "learning to live together" through intercultural teamwork and conflict negotiation; and "learning to be" through reflection and enhanced self-awareness. The challenge-based methodology thus proved to be a strategic pedagogical approach for making these pillars relevant and visible in higher education. Student feedback reinforces this perspective, with several highlighting increased emotional literacy, adaptability, and a deeper awareness of future professional roles.

6. CONCLUSION

The Challenge-Based Innovation experience in Miranda do Douro demonstrated that pedagogical processes grounded in co-creation and challenge-based learning can be transformative within higher education. By engaging students in interdisciplinary, real-world contexts that are culturally situated, these approaches foster not only cognitive and technical competencies, but also emotional, social, and relational skills – dimensions increasingly critical in contemporary education and society.

This study offers a comprehensive understanding of local co-creation processes, incorporating both student and partner perspectives. The findings reveal that co-creation is not a linear task, but rather a dynamic and relational process in which interaction among diverse actors significantly enhances the relevance and value of outcomes. Moreover, the alignment between students' perceptions, tangible results of the challenges, and UNESCO's Four Pillars of Education underscores the pedagogical strength of active methodologies that cultivate student agency and meaningful engagement with local territories.

While such approaches are not entirely new, they offer renewed relevance in the face of complex societal challenges. Their potential lies not only in fostering academic learning but also in promoting reflective, responsible, and collaborative citizenship. Therefore, it is recommended that the adoption and dissemination of these methodologies extend beyond isolated curricular initiatives and become integral to institutional strategies for innovation in higher education, particularly in rural territories.

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