

# INNOVATIVE TECH CHALLENGES AS CATALYSTS OF STUDENT CREATIVITY: CROSS-NATIONAL EVIDENCE FROM THE ERASMUS+ SMART SOLUTIONS PROJECT

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## Abstract

**Purpose:** This paper presents findings from the *Innovative Tech Challenges* (IO2) of the Erasmus+ *Smart Solutions* project (2024–2026), which aims to enhance digital literacy and creativity through scenario-based learning activities in secondary education across Europe. **Method:** Seventy digital challenges integrating problem-based learning, design thinking, and visual-based learning were co-created by partners from Ireland, Turkey, Latvia, Portugal, Italy, Romania, and Poland. The 2025 piloting phase involved 312 students and 68 teachers who completed selected tasks and provided feedback through post-piloting questionnaires and follow-up interviews. **Results:** Self-reported data indicate significant perceived improvement in digital creativity and problem-solving competences, particularly within DigComp areas 4 and 5. Students emphasized increased motivation, collaboration, and confidence in using digital tools, while teachers noted improved facilitation skills and readiness to apply open-ended, technology-supported methods. **Conclusions:** The results suggest that narrative-driven, challenge-based learning effectively promotes creativity and transversal competences in diverse classrooms. The paper outlines key pedagogical insights and practical guidelines for integrating such digital challenges into curricula and sustaining innovation through European cooperation.

**Keywords:** *Digital competences, creativity, problem-based learning, design thinking, Erasmus+, secondary education.*

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## 1. Introduction

The digital transformation of education has increased demands for pedagogical approaches that move beyond functional ICT skills toward creativity, problem-solving, ethical awareness, and learner agency (OECD, 2019; Voogt et al., 2015). This shift is reflected in policy frameworks emphasising transversal and transformative competences for participation in digitally mediated societies. In Europe, DigCompEdu identifies creativity, digital content creation, and reflective practice as core dimensions of effective digital teaching (Redecker, 2017), while the OECD Learning Compass 2030 places creativity and responsibility at the core of future-oriented education (OECD, 2019).

Despite this policy consensus, translating competence frameworks into classroom-ready practice remains challenging. Digital learning often remains tool-oriented, offering limited opportunities for open-ended, creative, and socially meaningful engagement (Tondeur et al., 2017). This gap underscores the need for structured yet flexible instructional designs applicable across diverse contexts.

The Erasmus+ *Smart Solutions* project (2024–2026) addresses this need through *Innovative Tech Challenges*—narrative-driven, scenario-based learning activities designed to foster creativity and digital competence. By embedding digital tool use within authentic problem situations and creative production tasks, the challenges aim to operationalise competence-based goals in pedagogically coherent ways.

Although project-based learning, problem-based learning, digital storytelling, and design thinking are well documented as effective for developing digital competence and engagement (Hmelo-Silver, 2004; Krajcik & Blumenfeld, 2006; Robin, 2016), integrated scenario-based resources remain scarce. Moreover, alignment between competence frameworks and classroom tasks is often weak (Redecker & Punie, 2017), and creativity, ethics, sustainability, and career readiness are still frequently treated as separate priorities despite their interdependence in contemporary digital societies (OECD, 2019; UNESCO, 2018).

The present study positions the *Innovative Tech Challenges* as a response to these gaps by examining their pedagogical design and perceived impact in authentic school settings. The purpose of this paper is to examine the *Innovative Tech Challenges* developed within the Erasmus+ *Smart Solutions* project (2024–2026) as a structured, scenario-based pedagogical response to the gap between competence-oriented

policy frameworks and classroom practice. The study explores how narrative-driven digital challenges, grounded in active learning pedagogies, function as catalysts for student creativity and digital competence development across diverse European secondary education contexts. To achieve this aim, the study addresses the following research questions:

1. How do the scenario-based *Innovative Tech Challenges* integrate established active learning methodologies such as project-based learning, problem-based learning, design thinking, and digital storytelling?
2. What pedagogical functions do these scenario-based challenges serve in fostering student creativity and digital competence?
3. How do students and teachers perceive the impact of the *Innovative Tech Challenges* on learning processes, engagement, and teaching practice?
4. How do the scenario-based challenges complement existing international digital competence frameworks and policy initiatives?

## 2. Conceptual and theoretical framework

The conceptual framework of this study draws on contemporary theories of creativity, digital competence, and active learning. It integrates sociocultural perspectives on creativity with competence-oriented models of digital education and pedagogical approaches that emphasise authentic, collaborative, and design-oriented learning, providing the analytical lens for examining the *Innovative Tech Challenges*.

Creativity is conceptualised not as an individual disposition, but as a situated and socially mediated competence emerging through problem-solving, design, and meaning-making activities supported by cultural tools, including digital technologies (Glăveanu, 2014; Sawyer, 2012). This perspective aligns with contemporary digital competence frameworks that position creativity and digital content creation as core dimensions of participation in digital societies. DigComp identifies creative digital production and responsible content use as central competence areas (Vuorikari et al., 2022), while DigCompEdu emphasises learning designs that enable learners to create, reflect, and engage critically with digital media (Redecker, 2017). Empirical research further indicates that creative digital tasks—such as multimedia production, storytelling, and prototyping—support deeper cognitive engagement, particularly when learners are positioned as designers or problem-solvers (Henriksen et al., 2016; Robin, 2016).

The *Innovative Tech Challenges* are grounded in a convergence of learner-centred pedagogies. Problem-based and project-based learning support authentic inquiry and transferable skills (Hmelo-Silver, 2004; Krajcik & Blumenfeld, 2006), while design thinking contributes an iterative, user-centred problem-solving process (Razzouk & Shute, 2012). Digital storytelling and visual-based learning support multimodal meaning-making (Kress, 2010; Robin, 2016), and collaborative learning frames knowledge construction as a social process (Dillenbourg, 1999). Rather than applying these approaches in isolation, the challenges combine them into cohesive, scenario-based designs, responding to calls for pedagogical hybridity in competence-oriented digital education (Henriksen et al., 2016; Voogt et al., 2015).

The study is situated within key international frameworks, including DigComp and DigCompEdu (Redecker, 2017; Vuorikari et al., 2022), the OECD Learning Compass 2030 (OECD, 2019), and the UNESCO ICT Competency Framework for Teachers (UNESCO, 2018). While these frameworks articulate *what* competences should be developed, they offer limited guidance on pedagogical enactment (Tondeur et al., 2017). The *Innovative Tech Challenges* address this gap by translating framework-level competences into scenario-based learning designs that specify roles, tasks, tools, and reflective elements, thereby mediating between policy and classroom practice.

## 3. The *Innovative Tech Challenges*: Design and structure

The *Innovative Tech Challenges* form the core pedagogical intervention of the Erasmus+ *Smart Solutions* project and are designed as flexible, modular, scenario-based learning activities that translate competence-oriented policy frameworks into classroom-ready practice in secondary education. Grounded in research calling for pedagogically robust yet feasible instructional models (Bell, 2010; Tondeur et al., 2017), the challenges are underpinned by three interconnected design principles: narrative framing, which situates learners in authentic roles and real-world problems to enhance engagement (Barab et al., 2010; Robin, 2016); creative digital production, through which learners construct knowledge by creating shareable digital artefacts such as stories, prototypes, or interactive designs, consistent with constructionist and design-oriented learning theories (Papert & Harel, 1991; Kafai & Peppler, 2011); and reflective closure, which supports metacognitive awareness and competence development via structured reflection, peer feedback, and self-assessment (Zimmerman, 2002).

The scenario collection comprises 70 digital challenges, organised into seven thematic scenario families, each targeting a distinct dimension of digital competence, creativity, and transversal skills:

1. *Digital equity envoys* – accessibility, inclusive design, digital rights, and advocacy.
2. *Sustainable tech solutions hub* – sustainability, climate awareness, and eco-innovation.
3. *Adaptive learning apps workshop* – design thinking, prototyping, and data literacy.
4. *Digital narratives lab* – interdisciplinary storytelling and multimodal literacy.
5. *Global tech diplomacy* – intercultural communication, civic literacy, and European cooperation.
6. *CareerTech navigator workshop* – employability, digital identity, and ethical workplace practice.
7. *EduPlay innovators* – game-based learning and edutainment design.

Rather than constituting a linear curriculum, the scenario families form a pedagogical ecosystem. Teachers can select, adapt, and combine challenges according to curricular goals, learner characteristics, and local contexts, supporting both scalability and contextualisation. This modular structure aligns with research advocating flexible, competence-oriented learning designs capable of addressing complex educational aims in digitally mediated environments (OECD, 2019; Voogt et al., 2015).

#### 4. Methodology

The study employs a mixed-methods exploratory design suitable for examining innovative pedagogical interventions in authentic educational settings (Creswell & Plano Clark, 2018). Reflecting the developmental and practice-oriented nature of the Erasmus+ *Smart Solutions* project, the research focuses on participants' perceptions of learning processes, pedagogical value, and feasibility rather than on experimental measurement of learning outcomes. Quantitative and qualitative data were collected concurrently during the piloting phase and analysed complementarily.

Data were collected during the 2025 piloting of the *Innovative Tech Challenges* in secondary schools across seven European countries (Ireland, Turkey, Latvia, Portugal, Italy, Romania, and Poland). Participants included 312 students and 68 teachers from diverse subject areas. Schools were selected to reflect varied socio-educational contexts, with voluntary participation and ethical standards, including informed consent and anonymisation, fully observed.

Teachers implemented selected challenges within regular teaching practice, with flexibility to adapt scenarios to curricular goals and available time. Implementation typically involved collaborative work, digital artefact creation, and structured reflection. Teachers received initial guidance but retained autonomy to ensure contextual responsiveness, consistent with prior research (Tondeur et al., 2017).

Data sources included post-implementation student and teacher questionnaires and semi-structured teacher interviews. Questionnaire items were descriptive and reflective, aligned with competence-oriented evaluation approaches (Redecker, 2017). Quantitative data were analysed descriptively, while qualitative data were examined using thematic analysis combining deductive and inductive coding (Braun & Clarke, 2006). Triangulation enhanced credibility. The reliance on self-reported data, lack of a control group, and contextual variability limit causal claims and cross-context comparability; however, these constraints are typical of large-scale pedagogical innovation research and are addressed through transparent reporting and triangulation (Creswell & Plano Clark, 2018).

#### 5. Results

Across participating countries, students reported perceived improvement in competences related to creative digital content creation, including the ability to design, adapt, and combine digital materials for specific purposes. Students frequently referred to producing multimedia artefacts such as digital stories, visual campaigns, prototypes, and interactive designs, describing these tasks as more open-ended and engaging than typical ICT activities. Students emphasised increased confidence in experimenting with digital tools and making design decisions independently or collaboratively. Rather than focusing on mastering specific software functions, students described learning in terms of using tools creatively to communicate ideas or solve problems. Teachers corroborated these perceptions, noting that the challenges supported creative problem-solving and encouraged students to move beyond procedural tool use. Teachers also reported that scenario-based tasks facilitated formative assessment of digital content creation processes, including ideation, iteration, and refinement, which they found difficult to observe in more traditional digital assignments.

Competences related to responsible and ethical digital participation were most evident in scenario families addressing digital equity, sustainability, global citizenship, and career readiness. Students reported increased awareness of issues such as accessibility, digital inclusion, ethical communication, and the social impact of technology use. Teachers noted that scenario-based discussions prompted students to articulate ethical considerations explicitly, particularly in relation to inclusive design, environmental responsibility,

and professional digital identity. These competences were described as emerging through dialogue, reflection, and decision-making rather than through direct instruction. While students did not always label these outcomes in technical DigComp terms, both student and teacher responses indicated engagement with values and behaviours associated with safe, responsible, and socially conscious technology use.

In addition to DigComp Areas 4 and 5, participants consistently reported development of transversal competences that supported digital competence acquisition. This included collaboration, communication, and problem-solving, particularly through group-based scenario work. Students described collaborative work as central to generating ideas, distributing tasks, and resolving challenges. Teachers observed that the scenario format supported learner autonomy and peer learning, with students assuming active roles in planning and decision-making.

Teachers perceived the *Innovative Tech Challenges* as pedagogically valuable and adaptable, enabling integration of DigComp-oriented learning outcomes into existing curricula. Many teachers reported a shift toward a facilitative role, focusing on guiding inquiry and reflection rather than providing step-by-step instruction. Implementation varied across contexts in terms of duration, subject focus, and digital tools used. Common challenges included limited instructional time and heterogeneous student digital skills; however, teachers generally reported that the modular design of the challenges allowed for contextual adaptation without compromising core learning objectives. Reflective components were identified as particularly important for supporting competence awareness, though teachers noted that these required deliberate scaffolding to be effective.

## 6. Discussion

This study examined the *Innovative Tech Challenges* as a scenario-based response to the gap between competence-oriented digital education frameworks and classroom practice, addressing the research questions through the lens of the DigComp framework, with particular attention to Area 4 (Digital content creation) and Area 5 (Safety and responsible use).

The findings indicate that the *Innovative Tech Challenges* integrate project-based learning, problem-based learning, design thinking, digital storytelling, and collaborative learning in a coherent and mutually reinforcing way. The scenario format functions as an integrative pedagogical structure, enabling these approaches to operate synergistically rather than in isolation, in line with research advocating pedagogical hybridity in digital education (Henriksen et al., 2016; Voogt et al., 2015). Results further suggest that the challenges effectively support competences associated with DigComp Area 4, particularly creative digital content creation. Students' engagement in designing and producing digital artefacts reflects a shift from procedural tool use toward purposeful, creative production, consistent with sociocultural and constructionist views of creativity that emphasise design, iteration, and learner agency (Glăveanu, 2014; Papert & Harel, 1991). Teachers also reported that the scenario-based format enhanced the visibility and assessability of creative processes. Competences related to DigComp Area 5 emerged primarily through contextualised reflection and discussion embedded in the scenarios. Activities addressing digital equity, sustainability, and professional digital identity encouraged students to consider ethical and social implications of technology use, supporting prior research indicating that responsible digital participation is best developed through authentic, dilemma-based contexts (OECD, 2019; UNESCO, 2018). Both students and teachers perceived the *Innovative Tech Challenges* as positively influencing engagement and learning, with students reporting increased motivation and collaboration and teachers noting a shift toward facilitative teaching practices and greater learner autonomy. These findings align with existing evidence on the potential of scenario-based and project-oriented learning to support pedagogical change in digital contexts (Tondeur et al., 2017).

Overall, the findings suggest that the *Innovative Tech Challenges* complement DigComp and related frameworks by operationalising abstract competence descriptors through concrete, classroom-ready scenarios. However, the reliance on self-reported data and the absence of performance-based measures limit claims about learning outcomes, indicating a need for future research using objective and longitudinal assessment designs.

## 7. Conclusions

This study demonstrates that the *Innovative Tech Challenges* constitute a viable and pedagogically robust approach to operationalising DigComp-oriented goals in secondary education. By integrating narrative framing, creative digital production, and structured reflection within scenario-based learning designs, the challenges support the development of digital content creation competences and foster responsible, ethical participation in digitally mediated contexts. The findings suggest that positioning learners as active designers and problem-solvers enhances engagement, creativity, and learner agency,

while simultaneously encouraging a shift in teachers' roles toward facilitation and formative assessment. Importantly, the *Innovative Tech Challenges* function as a practical bridge between abstract competence frameworks and everyday classroom practice, offering adaptable and scalable pedagogical models that can be implemented across diverse educational contexts. While further research is needed to examine long-term learning outcomes, the results indicate that scenario-based, competence-oriented pedagogies hold significant potential for advancing creative and responsible digital education in Europe.

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