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ORIGINAL ARTICLE

Educational Hackathons as Pedagogical Systems of Co-Creation: Stakeholder Engagement for Sustainable Innovation Outputs

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ABSTRACT

Educational hackathons are integrated into higher education (HE), yet their contribution to sustainable innovation beyond ideation remains unclear. This study examines educational hackathons as pedagogical systems of co-creation, asking how external stakeholder engagement relates to co-creation maturity and which practices support sustainable innovation outputs. Using collaborative autoethnography (CAE), two innovation educators examined 17 hackathons conducted in Finnish HE institutions between 2016 and 2026. The cross-case analysis identified four levels of external stakeholder engagement. Greater engagement across hackathon phases was associated with more sustainable innovation outputs and process development. Weak stakeholder engagement or inadequate post-hackathon phases left student-generated ideas and prototypes underused, constituting a recurring "torso problem" in educational hackathons. The study contributes to co-creation research in HE by applying the dimensions of stakeholder value logic, relational design, and learning orchestration to educational hackathons and by identifying stakeholder engagement and post-hackathon continuation as practices supporting the development of ideas into implementable innovation.

Keywords: Educational hackathons; co-creation; innovation; stakeholder engagement.

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INTRODUCTION

Hackathon research has developed beyond computer science from descriptive studies of purpose and format to the processes and outcomes (Chau & Gerber, 2023; Costa et al., 2026). Educational hackathons have become mainstream as multidisciplinary pedagogical tools integrated into higher education (HE) curricula (Chau & Gerber, 2023; Costa et al., 2026; Jussila & Suominen, 2025). Yet their learning outcomes remain inconclusive (Schulten & Chounta, 2024), and understanding of how hackathons contribute to sustainable longer-term innovation beyond ideas and prototypes remains limited (Chen et al., 2025; Marrujo-Ingunza & Paico-Campos, 2025; Oyetade, Zuva, et al., 2024; Vanhée et al., 2024).

Co-creation has gained traction in HE to engage students and other stakeholders as active partners in value creation (Nguyen et al., 2026; Omland et al., 2025). Although hackathons inherently involve collaboration and creation, their analysis with co-creation as a framework remains limited in educational hackathon research (e.g. Costa et al., 2026). Thus, a timely research gap remains at the intersection of these literatures: understanding educational hackathons as deliberately structured pedagogical systems of co-creation in HE curricula.

This study uses collaborative autoethnography (CAE) to examine co-creation within HE curricula (Bovill et al., 2016; Bovill & Woolmer, 2019), with particular attention to engagement with external stakeholders. The analysis draws on experiences from 17 educational hackathons, conducted in Finland between 2016 and 2026. The analysis applies Nguyen et al.'s (2026) co-creation as a pedagogical system maturity framework with three dimensions: stakeholder value logic, stakeholder relational design, and stakeholder learning orchestration. We examine how stakeholder engagement relates to the sustainability of innovation outputs in educational hackathons in HE. Accordingly, we ask: RQ1 *"How does external stakeholder engagement relate to the co-creation maturity of educational hackathons?" and* RQ2 *"Which co-creation practices support the development of hackathon ideas into sustainable innovation outputs?"*

THEORETICAL BACKGROUND

> "**A hackathon** is one type of organized, goal-driven innovation contest, a short time-bounded event with a challenge to be solved creatively in coopetition and collocation of teams, whose results are presented and recognized in a ceremony at the end of the event" (Halvari et al., 2020, p. 11).

Hackathons typically comprise three phases: a pre-hackathon phase, the event, and a post-hackathon phase (e.g. Komssi et al., 2015; Pe-Than et al., 2019). Like corporate hackathons, educational hackathons vary widely in scale, format, and design (Jussila et al., 2020). Falk Olesen and Halskov (2020) distinguish between studies on hackathons as a phenomenon and studies with hackathons as a research method. While early research focused on innovation contests organized by governments, nonprofit organizations, and corporate actors, recently research on hackathons in educational contexts has grown rapidly, reflecting their evolution from programming events into multidisciplinary pedagogical tools integrated into HE curricula (Chau & Gerber, 2023; Costa et al., 2026). Extracurricular hackathons (Garcia, 2022) and those integrated into HE curricula (Jussila & Suominen, 2025) require different pedagogical approaches.

Although computer science remains the major field in hackathon research (Chau & Gerber, 2023), interest in hackathons in the context of innovation, education, and interdisciplinary collaboration is growing (Chau & Gerber, 2023; Costa et al., 2026; Marrujo-Ingunza & Paico-Campos, 2025). Studies of educational hackathons emphasize their integration into HE curricula, active learning and the development of disciplinary and transferable skills (Marrujo-Ingunza & Paico-Campos, 2025). More broadly, hackathon research has shifted from purpose and format toward understanding the processes and outcomes they produce (Chau & Gerber, 2023). Despite their importance, outcomes represent a smaller portion of the literature (Chau & Gerber, 2023). Although learning is described both as motivation and an outcome, studies rarely show hackathons intentionally designed as learning environments in HE, and educational theory remains limited (Schulten & Chounta, 2024). Educational hackathons also pursue a dual outcome: learning and innovation outputs such as prototypes, concepts or services (Suominen et al., 2019). A central criticism concerns the limited continuation of hackathon outcomes, including, for example, innovation outputs and learning, particularly when post-hackathon activities are often absent (Chau & Gerber, 2023; Costa et al., 2026; Emmanouil et al., 2024; Heller et al., 2023; Marrujo-Ingunza & Paico-Campos, 2025; McIntosh & Hardin, 2021; Nolte et al., 2020; Resch et al., 2026). In this study, sustainable innovation outputs refer to ideas, concepts, or prototypes that continue toward application or implementation beyond the event.

Reviews and scoping studies highlight that educational hackathon research is carried out through related but distinct frameworks such as collaboration, experiential learning, and innovation culture, focusing on team-based learning, participatory problem-solving, and knowledge sharing (cf. Garcia, 2022, 2023; Oyetade, Harmse, et al., 2024; Oyetade, Zuva, et al., 2024). Studies also show methodological diversity and hybrid approaches, with design thinking, agile methodologies, and Challenge-Based Learning as the most frequent frameworks (Costa et al., 2026). Although collaboration and creation are central elements of hackathon methodology, co-creation has not been a focal framework for educational hackathons, since only a few studies mention the term without defining or referencing it (e.g. Islind & Norström, 2020; Jaskiewicz et al., 2019; Page et al., 2016; Yuen & Wong, 2021). Thus, a critical conceptual gap remains in explicitly framing of hackathons in terms of co-creation.

> **Co-creation** is defined as “enactment of interactional creation across interactive system-environments (afforded by interactive platforms), entailing agencing engagements and structuring organizations” (Ramaswamy & Ozcan, 2018, p. 200).

Originating in a business context, the concept was introduced by Prahalad & Ramaswamy (2004) to represent value created jointly through ongoing dialogue between companies and customers, co-creation has since been applied across fields. Its common feature is active stakeholder involvement in the development process (Osborne et al., 2016). Beyond providing feedback, stakeholders, such as customers, citizens or students, actively contribute to the co-created output (Voorberg et al., 2015), and conceptually it is linked to value co-creation (Greenhalgh et al., 2017). Ramaswamy and Ozcan (2018) further describe co-creation as an “*interactional creation*” process in which various actors create in interactive environments. Thus, co-creation can be considered an umbrella term, referring to a variety of forms of collaborative innovation, learning and value creation.

Bovill (2019) presents a typology of co-creation in HE, grounded in the understanding that the co-creation of learning and teaching occurs:

> “when staff and students work collaboratively with one another to create components of curricula and/or pedagogical approaches” (Bovill et al., 2016, p. 196).

Within this framework, a distinction is made between co-creation of the curriculum and in the curriculum. The former concerns the collaborative design of a course or programme, whereas the latter takes place within, and usually during, an existing course or programme (Bovill et al., 2016; Bovill & Woolmer, 2019). Co-creation has been associated with greater motivation and more meaningful learning outcomes (Bovill, 2019; Omland et al., 2025).

Adopting Bovill et al.’s definition, Omland et al. (2025) deliberately excluded student–external stakeholder collaboration from their literature review on co-creation in HE. Nguyen et al. (2026) identify this privileging of learner-educator partnerships, along with weak theorization of assessment and governance, as limitations that offer little guidance for systematically designing, evaluating, and sustaining co-creation across complex stakeholder configurations in formal education programmes. Nguyen et al. (2026) conceptualize co-creation as a pedagogical system with coordinated design, comprising three interdependent dimensions: (1) stakeholder value logic, in which value is articulated for multiple stakeholders; (2) stakeholder relational design**,** involving reciprocal contribution and shared authority; and (3) stakeholder learning orchestration**,** in which learning is orchestrated and linked to assessment or governance. These conditions distinguish co-creation from participatory activities. Their maturity model includes four stages: (1) activity-based; (2) relationally enabled; (3) orchestrated; and (4) institutionally integrated co-creation (Nguyen et al., 2026). Moreover, co-creation theory specifically emphasizes collaborative value creation among relevant stakeholders (Austin & Seitanidi, 2012; Bal et al., 2023; Ramaswamy & Ozcan, 2018). It can range from interaction between two actors (cf. Prahalad & Ramaswamy, 2004) to value co-creation among multiple stakeholders, including societal and environmental actors (Miličević et al., 2025).

Costa et al.'s (2026) review of hackathon studies in education hardly identified co-creation as a framework or even as a concept, with the exception of Wiljer et al. (2017). However, it included studies encompassing collaboration with industry and/or stakeholders with university students by Avalos et al. (2017), in educational hackathon by Mtsweni & Abdullah (2015), and combining educational and innovation hackathon by Jussila et al. (2020). Educational hackathons can bridge universities, industry, and the wider community. They strengthen cooperation and mutual commitment among stakeholders (Rys, 2025; Zhuang & Shi, 2024), while facilitating the transfer of knowledge across institutional boundaries. They can thereby contribute to innovation ecosystems that extend learning and innovation beyond the traditional academic boundaries (Gama et al., 2018). Chau and Gerber (2023) argue that the impact of hackathons should be evaluated not only during the event but also through project continuation in universities, nonprofits, industry, and communities. Such long-term impact requires infrastructure that enables promising projects and partnerships to continue beyond the event.

Educational hackathons and co-creation in the HE curricula are therefore intersecting concepts: hackathon is a form of co-creation method and environment for stakeholder interaction, joint value creation, and learning. However, failing to view students, instructors or other stakeholders through a co-creation lens limits the systematic study, design, and assessment of educational hackathons as structured co-creation processes beyond universities. Hackathon studies also identify a lack of longitudinal research and method systematization, particularly concerning sustained skills and the translation of outputs into real (business) projects (e.g. Chen et al., 2025; Marrujo-Ingunza & Paico-Campos, 2025; Medina Angarita & Nolte, 2020; Oyetade, Harmse, et al., 2024; Oyetade, Zuva, et al., 2024; Vanhée et al., 2024). Consequently, our understanding of hackathons' long-term impact beyond the immediate educational context remains limited.

METHOD AND DATA

Qualitative CAE was employed (Lapadat, 2017). Autoethnography systematically describes and analyses personal experience to interpret broader cultural contexts (Ellis et al., 2011), and CAE extends this approach through joint interpretation of pooled researcher experiences (Chang et al., 2016).

The empirical material draws on the experiences of two innovation educators who contributed to 17 hackathons in Finnish HE institutions between 2016 and 2026, mainly within courses (Table 1). Their roles included pedagogical and practical design with colleagues and external stakeholders, event organization and execution, and, where applicable, evaluation of students' pre- and post-hackathon learning exercises. These insider roles provided direct access to the design rationales, stakeholder interactions, event practices, and post-hackathon activities, but also required reflexive attention to how the authors' own involvement shaped interpretations. Using Nguyen et al.'s (2026) three dimensions, the authors conducted a reflective cross-case comparison and developed four external stakeholder-engagement levels. The case judgements were based on the CAE evidence base: the researchers' retrospective recall and collaborative reflections, compared with available event documentation, meeting and field notes, recordings where available, design materials, implementation notes, participant/team statistics, and records of stakeholder involvement. The classification was treated as an analytic judgement about the pattern and continuity of stakeholder engagement across the pre-hackathon, event, and post-hackathon phases.

Cases were assigned to the highest level for which the required pattern of stakeholder was evidenced. High stakeholder engagement required substantial involvement in challenge design and hackathon event activities, together with demonstrated and substantive post-hackathon implementation or application of outputs; Medium entailed substantial involvement in challenge design, event activities, or hackathon process development without evidence of post-hackathon implementation; Low engagement denoted bounded, episodic, or otherwise limited stakeholder involvement, whereas Minimum engagement indicated no substantive external stakeholder involvement or only incidental participation. When engagement differed across phases, cases were not averaged; instead, the absence of post-hackathon implementation engagement capped the classification below High. The resulting four-level classification is used as an analytical heuristic for cross-case interpretation, not as a validated or generalisable classification framework.

RESULTS

Table 1 summarizes the hackathons by type, collocation, course integration, co-created innovation outputs and external stakeholder engagement, and presents the results of stakeholder engagement level analysis, as well as practices regarding the three dimensions of the pedagogical framework of co-creation (Nguyen et al., 2026). Based on external stakeholder engagement, the 17 educational hackathons were classified into four levels: High, Medium, Low and Minimum. The four engagement levels were associated with differences in the sustainability of innovation outputs and the continuity of hackathon process development. At the 'High' level, stakeholders engaged in challenge design, participated in the event, and received implementable innovations alongside ideas and concepts. Furthermore, the stakeholders engaged in implementation. As an example, a food industry side-stream challenge involving multiple stakeholders produced 'Cucumber Ale', a student-developed product implemented by a company and sold in stores using the participating companies' know-how and resources.

Tab. 1. A summary of collective experiences of co-creation in hackathons.

Pedagogical framework for co-creation: 3 dimensions (Nguyen et al., 2026)	SH Case **) Public*	SH Field	Challenge Theme	Year	Student Participants/Teams	HE Course-level integration	Collocation	Innovation output	Collaboration with SH: Application of output	Challenge design	During event	Post-hack w. students	SH Learning orchestration	Level of stakeholder engagement
Learning orchest-ration						X	X			X	X	X	X	
Value logic		X	X					X	X					
Relational design	X				X									
	Comp. A, B	Food products	Side streams	2022	27/8	M	H	P	X	X	X	X	X	High
	Comp. C	Energy	AI implementation AI Strategy Visual RDI model Corp. responsibility	2026 2025 2024 2023	29/6 23/6 23/5 15/4	M M M M	H H VI H	IC IC IC IC	X X X X	X X X X	X X X X		X X X X	Med
	Comp. D–I)*	Multiple	Leveraging SAP technologies	2016	100/23	V	H	PT	X	X	X	X	X	Med
	Comp. D–I)*	Multiple	Leveraging SAP technologies	2017	80/15	V	H	PT	X	X	X	X	X	Med
	HE 1	Collab Project	Virtual cultural travels	2019	120/16	M	R	IC	X		X			Med
	Comp. J	Furniture manufact.	Business model for recycled furniture	2021	22/4	M	R	IC	X	X	X			Low
	HE 2	SMEs	SD forum	2020	25/5	M	R	IC		X	X			Low
	Entrepr. Assoc.	Entre-preneurs	City planning	2018	11/3	M	R	IC		X	X			Low
	Comp. K	City biking	City biking app	2020	20/4	M	R	IC	X		X			Low
	Comp. L	Textile	Fabric upcycling	2020	10/5	M	VI	IC	X		X			Low
	Comp. M	Media	Novel living solutions	2017	28/5	M	R	IC			X			Low
	HE 3		Food waste	2024	22/5	M	R	PT	X			X		Low
	HE 4		Food waste	2024	22/5	V	R	PT	X			X		Min
	Comp. N	Machinery manufact.	Telemetric data utilization	2022	16/4	M	VI	IC						Min

SH = external stakeholder
HE Course level integration: M = Mandatory, V = Voluntary
Collocation: R = Radical i.e. face-to-face, VI = Virtual, H = Hybrid
Innovation output: IC = Idea/Concept, PT = Prototypes, P = Product

Company A supplied surplus cucumbers, which students proposed for Company B's brewery process for 'Cucumber Ale'. Bio- and food technology lecturers and researchers mentored the process, enabling implementable co-creation during the event. Students also designed the product's branding, including labels and marketing, and participated in implementation and market launch, while final decisions and procedures remained with the stakeholder company. The HE institution supported brand recognition by offering a tasting at the project's final seminar.

The 'Medium' level included Company cases C, D-I, as well as HE 1. In the Company C case, the stakeholder engaged iteratively over the long term in challenge design, event activities such as the challenge presentation and jury, and the development of the educational hackathon process. The outputs remained ideas or concepts due to a strategic choice: Company C operates in the regulated energy field, where student involvement in company operations is legally limited. Nevertheless, the challenges addressed current company problems or opportunities, such as artificial intelligence (AI). Researchers from the HE institution's GPT-Lab mentored the AI challenge, enabling expert validation of the student-created concepts. Company C reported that these concepts were applicable to its work practices.

At the 'Low' level, in company J–M, HE 2–3, and Entrepreneur Association cases, stakeholders engaged in challenge design, in some cases participated in the event jury, and received student-created ideas or concepts. Process development was a one-off activity, and interactions between HE institution and stakeholder were short-term. Nevertheless, stakeholders could receive concepts for further development. For example, Company J challenged students to co-create sustainable business models for previously used school furniture, was positively surprised by the breadth of ideas, and reported plans to combine several concepts into a novel business model.

A special 'Minimum' level example was HE 4 conducted 'Food Waste Challenge', which had no external stakeholder, aimed generally to reduce or eliminate food waste. Students could pitch their idea at the FRUSH startup event, where one team found a company partner to develop an implementable concept further. Most teams did not use this opportunity.

Based on the authors' collective experience, educational hackathons offer attractive co-creation opportunities for HE instructors because they provide sustained access to a pool of students and a short event format that is relatively straightforward to organize. An idea mindset supports early-stage co-creation by encouraging learners to generate, iteratively develop, and share incomplete or speculative ideas without immediate pressure for feasibility or implementation. In contrast, an innovation mindset emphasizes transforming ideas into implementable solutions that create value beyond the learning context. It also recognizes real-world constraints such as time, resources, and stakeholder expectations. We observed that integrating stakeholders' resources and knowledge into innovation-oriented co-creation was less straightforward than expected and required long-term stakeholder collaboration, deliberate challenge and event design, and HE subject-matter experts as mentors.

Stakeholder engagement was associated with the co-creation processes and outputs. When students ideated solutions without the problem owner's participation, co-creation remained limited to teacher–student collaboration, and the outputs remained ideas and concepts. When external problem owners engaged at medium to high levels, the outputs, the hackathon process, or both showed greater continuity. Such outcomes were associated with educational hackathons in which stakeholder engagement was intentionally designed and implemented in collaboration with stakeholders. Nevertheless, the cases revealed a recurring issue: although generally well-structured, many hackathons lacked robust post-hackathon phases for students, resulting in underutilized innovation outputs.

Table 1 maps the case practices onto Nguyen et al.'s (2026) three dimensions. Higher stakeholder-engagement levels were associated with broader enactment of stakeholder value logic, relational design, and learning orchestration, indicating increasing co-creation maturity across the cases.

DISCUSSION AND CONCLUSIONS

Viewing our results through Nguyen et al.'s (2026) framework of co-creation as a pedagogical system (Table 1), the three dimensions reveal an intertwined logic in educational hackathons. Co-creation output sustainability and hackathon process development varied with external stakeholder engagement: greater engagement was associated with more sustainable outputs. Regarding stakeholder value logic, engagement helped articulate the value and relevance of the innovation outputs. Regarding stakeholder relational design, engagement increased reciprocal contributions and supported greater sharing of authority in both the development process and its outcomes. These two dimensions were closely intertwined through stakeholder learning orchestration, as stakeholders jointly shaped both the value of the outputs and the processes through which they were developed.

Across the pre-hackathon, event, and post- hackathon phases, hackathons can provide a structured framework for co-creation. Internal hackathons in which students ideated without the problem owner lacked the active involvement of relevant partners required for co-creation, and therefore these events did not fully meet the co-creation criterion of collaborative value creation among relevant stakeholders (Austin & Seitanidi, 2012; Bal et al., 2023; Ramaswamy & Ozcan, 2018). For stakeholders, learning orchestration appeared as the long-term, iterative co-development of the hackathon process in collaboration with HE institutions. For students, it appeared mainly through mandatory course integration; when students did not participate in further idea or concept development, the deficient post-hackathon phase limited continuation beyond the event and weakened the sustainability of its outputs. The cases confirmed a recurring issue identified in earlier research (Chau & Gerber, 2023; Costa et al., 2026; Emmanouil et al., 2024; Heller et al., 2023; Marrujo-Ingunza & Paico-Campos, 2025; McIntosh & Hardin, 2021; Nolte et al., 2020; Resch et al., 2026): generally well-structured hackathons lack robust post-hackathon phases, resulting in underused innovation outputs. We term this recurring blind spot the "torso problem": educational hackathons without relevant stakeholders and/or post-hackathon practices remain incomplete in terms of co-creation. HE institutions therefore need practices that create a continuum for student ideas, concepts, and prototypes initiated during hackathons (Figure 1). Such practices can sustain the further development of these outputs and help realize the benefits of co-creation. Therefore, the study contributes to research on co-creation in HE curricula (Bovill et al., 2016; Bovill & Woolmer, 2019; Nguyen et al., 2026) and educational hackathons (Costa et al., 2026; Garcia, 2022, 2023; Jussila et al., 2020; Jussila & Suominen, 2025; Oyetade, Harmse, et al., 2024; Oyetade, Zuva, et al., 2024; Rys, 2025; Suominen et al., 2019) by evaluating the co-creation maturity of educational hackathons through Nguyen et al.'s (2026) three dimensions. Interpreted through Nguyen et al.'s (2026) framework, the cases most commonly exhibited characteristics of Stage 2 “Relationally enabled”, while the strongest examples approached Stage 3 “Orchestrated co-creation” maturity level through sustained stakeholder engagement and post-hackathon continuation practices. Thus, the study applies Nguyen et al.'s (2026) framework to educational hackathons and identifies the “torso problem”: incomplete co-creation without stakeholder engagement or post-hackathon continuation.

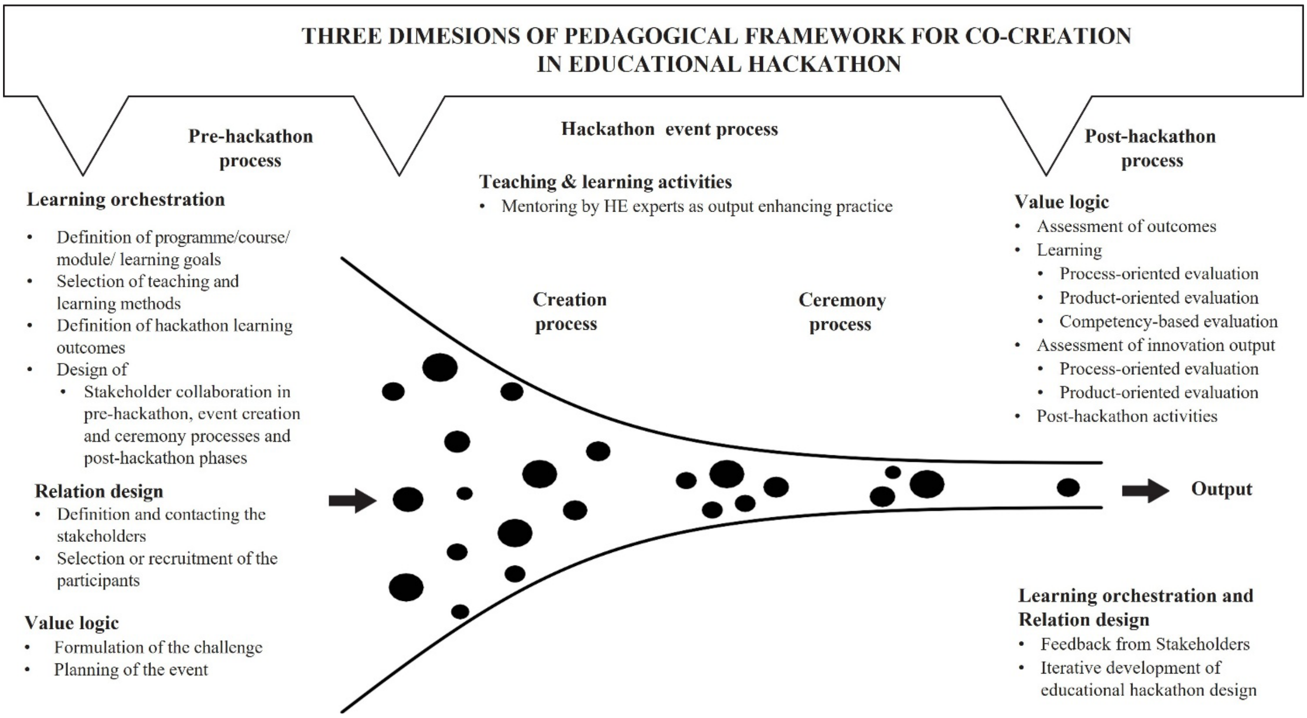

Fig. 1. Educational hackathon co-creation process viewed through Nguyen et al.'s (2026) pedagogical framework for co-creation.

This study has several limitations. The stakeholder-engagement levels were developed through CAE and applied to a specific set of 17 educational hackathons; they should therefore be understood as a contextually derived analytical heuristic rather than a validated classification framework. Future research could empirically test, refine, and validate these levels using larger comparative datasets and evidence from students, stakeholders, and independent observers. Moreover, the study relies on the experiences of only two educators, which limits the transferability of the findings to other institutional, cultural, or disciplinary contexts. Future studies should examine post-hackathon continuation practices, including follow-up and advanced courses, thesis pathways, business collaboration models, pre-incubation and startup incubation, as well as funding mechanisms for early-stage development. Comparative studies across innovation ecosystems could further clarify how stakeholder constellations influence the transition from an idea mindset to an innovation mindset and how educational hackathons can support sustainable innovation beyond the event itself. Structured post-hackathon continuation models also warrant further investigation as a means of addressing the "torso problem" and sustaining the development of innovation outputs.

In conclusion, greater external stakeholder engagement was associated with higher co-creation maturity (RQ1), while sustained stakeholder engagement and post-hackathon continuation practices were associated with more sustainable and implementable innovation outputs (RQ2). These findings suggest that educational hackathons can function as pedagogical systems of co-creation, provided that stakeholder engagement extends beyond the event itself and supports the continued development of innovation outputs.

CONFLICTS OF INTEREST

None to declare.

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