Social Entrepreneurship Review
2026, Vol. 1

OPEN ACCESS

10.15678/SER.2026.1.01

Digital Educational Innovation in the Social Economy: A Configurational Analysis Using the Technological Innovation Systems Framework

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Abstract: **Background:** Although digitalisation delivers business-level benefits and higher education institutions (HEIs) are expected to advance the digital social economy (SE), many universities still lack coherent digital transformation strategies. Consequently, SE curricula do not integrate digital tools and competences adequately, thus limiting the graduates' ability to address complex social challenges.
Research objectives: This study examined how digital competences are integrated into SE education not merely instrumentally but as a substantive learning domain. It asked: (a) how SE initiatives teach digital and technological innovation and (b) what system functions enable the development and scaling of such innovations.
Research design and methods: Using the technological innovation systems framework, the study involved a configurational analysis of eight cases of SE education in four European countries.
Results: Three clusters emerge, namely civic platforms, institutional living labs, and lifelong learning initiatives, which reflect distinct constellations of enabling conditions shaped by institutional density, funding logics, and regional disparities.
Conclusions: The findings challenge universal models of digital SE education, underscoring the need for context-sensitive and pluralistic implementation strategies.

Keywords: education, digital, innovation, social economy, technological innovation framework,
JEL Codes: I23, L26, O33, O35

Suggested citation:
Bandini, F., Canestrini, P., Ćwiklicki, M., Galani, Ch., Kyratzopoulos, S. E., Kantsiou, S., Laurisz, N., Nalmpantis, S., Pilch, K., Prudentino, M. V., & Tzekou, E. E. (2026), Digital educational innovation in the social economy: A configurational analysis using the technological innovation systems framework. *Social Entrepreneurship Review, 1*, 9–25. https://doi.org/10.15678/SER.2026.1.01

Introduction

The accelerating digital transition profoundly reshapes contemporary socio-economic development, marking a defining era of pervasive change. The European Union has integrated digitalisation at the core of its strategic priorities. The Digital Education Action Plan 2021–2027 (European Commission, 2020) aims to adapt education systems to the digital age by fostering inclusive and digitally competent learning environments, while the Digital Decade policy

programme 2030 (European Commission, 2025) sets ambitious goals for digital empowerment across economic and societal domains. Within entrepreneurship, digital technologies have become key drivers of value creation, enabling novel business models, improved competitiveness, and transnational collaboration. For the social economy (SE), the stakes are even higher, as organisations can leverage technological possibilities to enable digital social innovation by mobilising digital tools to create both economic and social value in response to complex societal challenges. Recognising this potential, policy frameworks (European Commission, 2021) and academic debates (Gagliardi et al., 2020) converge on the need to strengthen digital competences in SE.

However, SE education has not kept pace with this transition. Although digitalisation generates business-level benefits (Zahra et al., 2023) and higher education institutions (HEIs) play a pivotal role in fostering digital social entrepreneurship and innovation (European Commission, 2020), many universities still lack comprehensive digital transformation strategies in their educational processes. Consequently, curricula, particularly SE, remain limited in systematically integrating training in digital tools, platforms, and competences (DigiSE5.0, 2025a). This gap restricts the ability of SE actors to respond effectively to evolving social challenges.

Against this backdrop, we investigated how one can meaningfully integrate digital competences into SE learning environments, not only as a pedagogical tool but also as a subject of learning in its own right. Moving beyond instrumental uses of technology, it examines how SE education can embed digital innovation within curricula to foster the creation of both economic and social value. We asked: (a) how do different SE education initiatives teach digital innovation, and (b) what system functions enable the development and scaling of such innovations? To address these questions, we employed the technological innovation systems (TIS) framework and a configurational analysis of eight case studies in four European countries, thereby illuminating the systemic conditions and interdependencies that shape, facilitate, and configure the emergence and scaling of digital innovation within SE higher education.

The remainder of the article is structured as follows. Firstly, we review the literature on SE education in the context of and for digital transformation and introduce the TIS framework. Secondly, we explain in detail the research design and the configurational approach that guided the analysis. Next, we present the empirical findings and discuss their implications for digital innovation in SE education. The article concludes with reflections on policy, research limitations, and future research directions.

Literature Review

SE education for digital transformation

The literature demonstrates the benefits of digitalisation at the economic, business, and institutional levels, highlighting the crucial role of HEIs in promoting and stimulating digital social entrepreneurship. Nambisan (2017) states that the adoption of digital technologies allows the entrepreneurial process to be more dynamic and less bound than in the traditional economy. Furthermore, he highlights the generativity, re-programmability, and re-combinability of digital artefacts as features that support adaptive business models and responsiveness to a shifting digital ecosystem. Prior studies have timely addressed the effects of digital transformation adoption and diffusion within organisations, highlighting that it profoundly reshapes the mobilisation and reconfiguration of resources (e.g., Inceoglu et al., 2024; Kazantsev et al., 2024).

Digitalisation is particularly relevant for companies with a sustainable or social mission. Gregori and Holzmann (2020) found that the application of a digital logic in sustainable businesses, i.e., businesses that generate a positive environmental and social value through financially viable business models (Bocken et al., 2013), leads to multidimensional value capture. In fact, digital technologies can promote the simultaneous growth of financial performance, social impact, and environmental sustainability. Moreover, Gregori and Holzman identified a spillover effect of value stemming from the adoption of digital technologies and their capacity to 'mobilise and connect individuals' (2020, p. 7). This dynamic contributes to increased awareness and sensitivity towards the social and environmental values promoted by the organisation, ultimately resulting in a rise in perceived educational value. Recently, Galindo-Martín et al. (2023) confirmed that digitalisation improves both entrepreneurial activity and business competitiveness. They showed that environments conducive to digitalisation were crucial for stimulating innovation, increasing productivity, and fostering global competitiveness.

With specific reference to the SE, the European Commission (2021, pp. 16–19) reports that although new digital business models are emerging within this context, further efforts are needed to enhance the use of digital tools by SE actors. The reports also emphasise the role of HEIs in promoting and stimulating digital social entrepreneurship, calling on higher education institutions to make 'full use of European Universities to stimulate social economy and entrepreneurship' (European Commission, 2021, p. 15).

The connection between education, digitalisation, and social innovation is both evident and well-supported by existing research. Qureshi et al. (2021) define digital social innovation as the use of technologies to develop innovative solutions, products, or services that address societal challenges or aim to improve the well-being of disadvantaged groups. Consistently, Buck et al. (2025) demonstrated that knowledge of digital technology positively influences digital social innovation. This refers to a deep and comprehensive understanding of digital tools and their potential applications for creating social value (Buck et al., 2025). In this light, the European Commission (2022) explicitly highlights the need to improve higher education curricula by fostering a 'multidisciplinary understanding of the technologies enabling new business models' (p. 27). Gagliardi et al. (2020) state that it is crucial to develop a tech-friendly environment for the SE. Along with appropriate infrastructure and policies, this implies the creation of specific educational pathways aimed at enhancing digital skills and transversal competences, enabling the SE to effectively interact within an increasingly digital context. Consequently, institutions and academics increasingly advocate the integration of digital skills into social economy (SE) education and urge higher education institutions to embed these skills effectively within SE curricula.

Notably, SE education addresses a broad range of objectives from raising awareness on social entrepreneurship, fostering social entrepreneurship values and intentions, supporting existing start-ups, building relevant capabilities and facilitating employment into SEs (Shahid & Alarifi, 2021). Given this plurality of goals, studies have shown that for an effective engagement in social entrepreneurship, it is crucial to apply a practical approach. SE education theories frequently rely on theories such as Bandura's social learning theory (Chen & Shabbir, 2024), which emphasised an experiential and action-based approach to learning, where people acquire knowledge and behaviours through observation, modelling, reflection, and social interaction (Bandura, 1977). Howorth et al. (2012) offer a comparative analysis of two social entrepreneurship education programmes, demonstrating how social learning theory, especially practice-

based learning activities, community engagement, and reflective thinking, are crucial for preparing students for the hybrid social-commercial contexts of social entrepreneurship.

Experiences such as Living Labs enhance the practical approach, stakeholder participation, and continuous interdisciplinary dialogue. Leminen et al. (2012) define Living Labs (LLs) by stressing the characteristic of collaboration between heterogeneous actors to co-create innovative products or services. Several years later, Westerlund et al. (2018) identified the key characteristics and constructs of contemporary LLs, provided a new definition. They describe them as: 'sociotechnical platforms with shared resources, collaboration framework, and real--life context, which organises its stakeholders into an innovation ecosystem that relies on representative governance, open standards, and diverse activities and methods to gather, create, communicate, and deliver new knowledge, validated solutions, professional development, and social impact' (Westerlund et al., 2018, pp. 56–57). Thus, LLs are carriers not only of innovation but also of knowledge and social impact, making them an ideal tool for integrating digital social innovation into SE education.

Technological Innovation Systems as Theoretical Framework

The analysis of educational initiatives developed within the framework of the SE education draws on the concept of technological innovation systems (TIS), as developed by Bergek, Hekkert, and Jacobsson (Bergek et al., 2008; Hekkert et al., 2007). Notably, TIS assumes that innovation does not emerge in isolation, but results from dynamic interactions among actors, resources, institutions, and functional processes. Accordingly, the analytical focus shifts away from organisational or technological structures toward the processes that enable the emergence, development, and diffusion of innovation trajectories.

In this study, we conceptualised digitalisation in SE education as a socio-technical innovation domain. It encompasses not only the adoption of digital tools and platforms, but also the development of new competences, practices, and institutional arrangements that enable digital social innovation. From this perspective, one can analyse educational initiatives as part of an innovation system insofar as they contribute to building capabilities, mobilising resources, and legitimising digitally enabled forms of social value creation.

Although TIS originated in the study of high-tech sectors, such as energy and biotechnology, its functional logic has been extended to the analysis of social and educational innovations, especially in contexts where market efficiency is not the sole criterion of success, and values such as solidarity, inclusivity, and the common good play a central role (Marques et al., 2020; Howaldt et al., 2016). Building on the canonical set of TIS functions (Hekkert et al., 2007; Bergek et al., 2008), we selected and adapted those most relevant to the analysis of non-market-oriented educational initiatives in SE. Functions primarily associated with market formation and industry-specific external economies were not operationalised as separate analytical dimensions, as the studied initiatives operated predominantly within public and educational contexts rather than competitive market environments. Simultaneously, we operationalised user engagement as a distinct systemic function, reflecting the centrality of participatory and co-creative processes in social and educational innovation settings. We captured elements associated with directional guidance (e.g., shared expectations, priorities, and discursive alignment) mainly through legitimation and knowledge development processes, which in this context structure expectations, recognition, and the strategic orientation of initiatives.

For this study, we thus operationalised five system functions grounded in the theoretical foundations of TIS and adapted them to the specific characteristics of educational innovations

in the SE. Each dimension corresponded to a core system function whose presence, strength, and interrelation condition the capacity of an initiative to emerge, evolve, and become institutionally embedded within the innovation ecosystem. These functions were:

- Knowledge development – creation, accumulation, and diffusion of knowledge relevant to the initiative's domain (technological, educational, social). This refers to the processes of creating and disseminating the knowledge necessary for the initiative's development, including pedagogical, technological, and social knowledge. In the SE, knowledge is often created collectively and involves many stakeholders.
- Entrepreneurial experimentation – piloting, prototyping, and testing of solutions in open, real-world environments. It refers to testing solutions in practice, i.e., through prototyping, piloting, and learning by doing. In this context, experimentation means the introduction of innovative educational models in real-world conditions.
- Resource mobilisation – mobilisation of financial, human, infrastructural, and relational resources necessary for development and implementation. This includes obtaining the necessary resources for an initiative to function. In a social context, relational capital and community resources play an important role.
- Legitimation – institutional and social acceptance, visibility, and recognition of the initiative within relevant ecosystems and discursive arenas. It refers to the acquisition of institutional and social acceptance. Legitimacy is crucial in the context of initiatives that challenge dominant educational norms or introduce alternative solutions.
- User engagement – participation of end users in the co-creation, implementation, and evaluation of the innovation. This refers to the active participation of end users in the creation and implementation of innovations. Participation increases the relevance of solutions and their anchoring in the social context.

Research Method and Material

We used a multiple case study research design (Ćwiklicki & Pilch, 2021; Greene & David, 1984; Yin, 2017) to identify configurations of interacting functional conditions that jointly determine the success or limitations of digital educational innovation. We adopted a configurational comparative approach, inspired by qualitative comparative analysis (QCA) (Ragin, 2008; Fiss, 2011). The configuration approach is well recognised in organisation studies, where organisations, treated as cases, demonstrate distinct exemplifications of certain sets of conditions. It assumes that organisational phenomena occur within specific spatial and temporal contexts (Fiss, 2009). Scholars understand configurations as 'multidimensional constellations of conceptually distinct characteristics that commonly occur together' (Meyer, Tsui & Hinings, 1993, p. 1175). They are defined as 'sets of interconnected variables to explain performance outcomes' (Leonhardt et al., 2018). This approach is grounded in systems thinking, which considers 'multiple simultaneous interdependencies' in a given situation (Leppänen et al., 2023) being a structure producing certain results (Meadows & Donella, 2009). As Huang et al. (2024, p. 1744) explain, 'each condition usually does not have its own unique impact on the outcome – rather, it may instead only have an impact in combination with other conditions.' The approach serves to reveal the multifaceted nature of phenomena, showing how each element (dimension, area, etc.) interacts with others to relate to specific outcomes. Researchers have successfully used this approach, for example, to analyse combinations of human, technological, and relational resources that contribute to technological innovation (Castro et al., 2013), to analyse the inter-

action between creativity, innovation networks, and resources (Del-Corte-Lora et al., 2023) as well as to identify specific institutional structures that influence innovative capacity (Erzurumlu et al., 2022) or digital innovation governance configurations that achieve high performance (Leonhardt et al., 2018). This approach is considered well-suited for studying complex phenomena, such as digital innovation (Huang et al., 2024).

We combined a configuration approach with the TIS model to examine digital innovation within the SE education. The different levels of dimensions comprising the analytical framework allowed us to identify patterns related to the studied phenomenon, namely, the implementation of digital educational innovation in SE. This enables the observation of various value parameters (across multiple levels of analysis) in successful cases. By merging these parameters, we can generalise types of configurations that lead to desired effects. The result will consist of configurational propositions that present combinations of elements shaping the implementation of digital innovation in teaching SE. This approach is grounded in the premise that there is no single pathway to innovation, recognising that no single function is either necessary or sufficient on its own, what matters are the interactions and co-occurrences among functions.

Data collection method

The sampling strategy employed purposeful ad hoc variation, following Patton's maximum variation sampling approach (Patton, 2002). The initial desk research resulted in a comprehensive overview of more than twenty good practices identified at the national, supranational, and international levels (DigiSE5.0, 2025b). Next, we conducted a qualitative selection process to map and analyse the case studies. We convened to evaluate each candidate against a predefined set of selection criteria, ensuring diversity across (a) geography, (b) institutional type, (c) pedagogical approach, (d) level of technological integration, and (e) target groups involved. In an unanimous consensus, all team members selected the final set of cases. The short descriptions of the selected cases are presented in Table 1, while detailed accounts are provided in the report (DigiSE5.0, 2025b).

Table 1. Cases Description

No.	Shortname	Name of the practice	Description	Place
1	DIGI SEII	Digital innovation for social Economy and Inclusive Industries	This project promotes digital transformation in the SE through training, resources, and collaboration to foster inclusivity and sustainability.	Belgium
2	DISSE	Concepts and skills in digital innovation and the social and solidarity economy	This initiative is a program developing participants' digital competencies and understanding of the social and solidarity economy to foster collaboration and social entrepreneurship.	Greece
3	GraTy	Game based learning	This practice uses games as educational tools to promote learning, social engagement, and civic participation. It provides a collaborative coworking space for participants to develop innovative projects.	Poland
4	FARI	AI for the common good	A research initiative advancing ethical, transparent, and human-centered AI, data, and robotics to address societal challenges and support sustainable development in the Brussels region.	Belgium

No.	Shortname	Name of the practice	Description	Place
5	Kalomathe	Educational platform	A digital learning platform offering open educational resources, interactive tools, and community support to strengthen SE education and lifelong learning opportunities.	Greece
6	Savona Living Lab	Campus of Savona 'Living Lab Smart City'	A university campus transformed into a living laboratory integrating smart ICT and energy systems, showcasing sustainable solutions that cut carbon emissions and produce most of its own energy.	Italy
7	Sprawni-wpracy	Online platform for Employment activation of people with disabilities	A free online job-matching platform connecting employers with candidates with disabilities. It promotes inclusive employment opportunities.	Poland
8	Teach-BEASTs	Teach-BEASTs – teaching to BE aware students	This project enhances STEM education by training teachers in active, design thinking–based methods and providing digital resources to foster student creativity and entrepreneurship.	Italy

Source: own elaboration.

We selected semi-structured interviews to collect detailed data. For each case, we conducted the interview with one or two main actors involved in the organisation and/or implementation of the identified good practices. The interviews covered themes such as (a) stakeholder involvement; (b) technological integration and pedagogical approaches (digital technologies and LL approach); (c) barriers; and (d) transferability/replicability in SE curricula. Prior to all interviews, we disseminated and applied consent forms and procedures to ensure ethical and academic compliance. We collected complementary evidence from secondary sources, such as websites describing the cases. We subjected the interview transcripts to deductive coding (Bingham, 2023), structured around the TIS framework. We documeted each case in a standardised format, allowing for comparability, through a cohesive comparative analysis, and triangulation across sources (Miles & Huberman, 1994).

Data Analysis

We treated cases as holistic constellations of functional features, rather than as collections of independent variables. Each case underwent a separate qualitative analysis using a set of five analytical functions that formed the basis for further configuration modelling: knowledge development; entrepreneurial experimentation; resource mobilisation; legitimacy; and user involvement.

The TIS functions enabled us to evaluate individual cases along a five-point ordinal scale that differentiates the degree to which each function is fulfilled, from marginal presence to full development. In the annex, we present the specific scale values assigned to each dimension, along with illustrative examples.

The application of the TIS matrix made it possible to assess the systemic maturity and institutional embeddedness of the analysed SE-oriented educational initiatives. It allowed the identification of cases characterised by a robust and balanced activation of system functions, as well as those with functional deficits that may limit their sustainability, scalability, or potential integration into formal education.

We conducted the analysis on an individual basis for each case, with consideration given to its context and specific characteristics. We determined the level of presence of each case

within a given function separately based on systematic analysis of the interview transcripts and supplementary documentary sources. The national research team conducted scoring in accordance with the operationalised scale criteria detailed in the annex. On this basis, we developed a functional profile of each, constituting a description of the configuration of dimensions within a given case.

In the next step of the analysis, we determined the optimal number of clusters using the elbow method and the silhouette coefficient. The result indicated three groups, which we then used in the k-means clustering procedure. Each cluster was characterised by distinct mean values across the five TIS dimensions.

Subsequently, we conducted a configuration analysis, which comprised a synthetic comparison of cases. Using the collected matrix data, we identified patterns of similarities and differences between cases, paying particular attention to the co-occurrence of specific functions and their intensity. We grouped the cases according to configuration similarity, with a view to identifying significant relationships and dependencies between functions in different contexts.

The final stage of the analysis involved using the constructed matrix, which enabled reflection on the possible mechanisms of links between system functions and their mutual reinforcement or weakening, as well as the conditions for activating them in different institutional systems.

Results

Table 2 presents the results of the assessment of good practices in educational innovation within the TIS framework. The cases show clear variation across the five TIS dimensions.

Table 2. Assessment of the Good Practices Across the Technological Innovation Systems Dimensions

No.	Good Practice	Knowledge Development	Entrepreneurial Experimentation	Resource Mobilisation	Legitimation	User Engagement
1	DigiSEII	4	3	4	3	3
2	DISSE	3	2	2	2	1
3	FARI	4	4	4	4	4
4	GraTy	4	4	3	4	4
5	Kalomathe	4	2	3	2	4
6	Savona Living Lab	2	3	3	3	3
7	Sprawniwpracy	4	2	3	4	3
8	Teach-BEASTs	3	3	3	3	3

Source: own elaboration.

Knowledge development emerged as a dominant feature, rated as a core function in five out of eight cases, reflecting the knowledge-intensive character of these initiatives. Meanwhile, on average, *entrepreneurial experimentation* was evaluated as having moderate to consistent presence, indicating limited but structured forms of prototyping and user testing. In the area of *resource mobilisation*, most initiatives relied on project-based resources with limited durability:

five cases scored 3 on the 0–4 scale. *Legitimation* presented a more differentiated pattern: two cases achieved partial legitimacy, three formal recognitions, and three a high level of institutional legitimacy. Finally, *user engagement* varied substantially. One case (DISSE) was assessed as having marginal user participation, while the remaining initiatives demonstrated either permanent participation mechanisms (four cases) or co-creation models (three cases).

FARI represented the most advanced form of educational innovation, achieving the highest scores across all TIS dimensions (average value: 4.0). Close to this result was GraTy, with an average score of 3.8. The next group of cases, i.e., DigiSEII, Sprawniwpracy, Teach-BEASTs, and Kalomathe, demonstrated a consistent presence across the TIS dimensions, with average values ranging between 3.0 and 3.4. Slightly below this level was the Savona Living Lab (average 2.8), while the DISSE showed the lowest overall score (average 2.0), primarily due to its lower level of user engagement.

Cluster analysis identified three distinct groups composed of the following cases:

– Cluster 1: GraTy, DigiSEII, FARI,
– Cluster 2: Savona Living Lab, Teach-BEASTs,
– Cluster 3: Sprawniwpracy, Kalomathe, DISSE.

Figure 1 presents average values for each cluster.

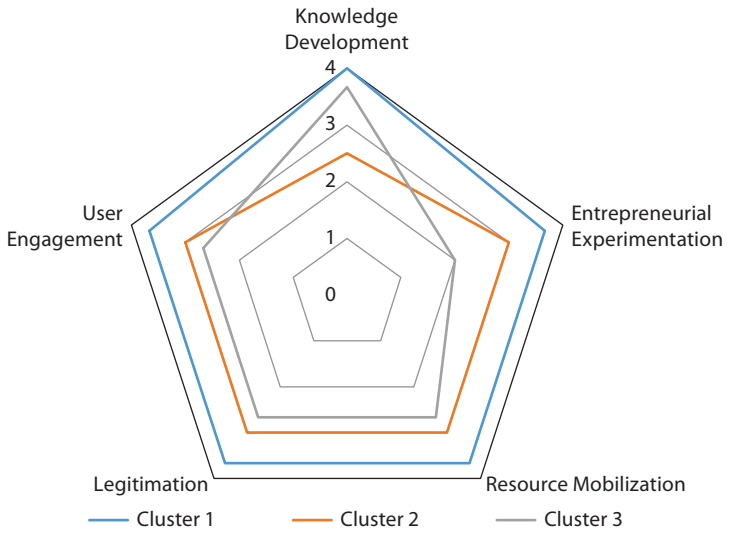

Figure 1. Comparison of Good Practice Clusters by TIS Functions

Source: own elaboration.

The first cluster was characterised by high values across all TIS dimensions, particularly in knowledge development. The nature of these practices involved the participatory use of digital platforms by society; hence, we may refer to this group as *civic platforms*. These solutions demonstrated high legitimacy and strong resource mobilisation. As all TIS functions were well developed, this cluster also exhibited a high degree of societal embeddedness.

The second cluster showed moderate values across the TIS dimensions but compared to Cluster 1, it demonstrated a lower focus on knowledge creation. The cases forming this group were institutionally embedded within higher education systems that possessed substantial

technical and educational infrastructure. They offered stable environments functioning under *a living lab model*. The formalised institutional context of these labs structured resource mobilisation and supported sustained experimentation. Both cases were characterised by technology-based learning and formal educational settings.

The third cluster comprised cases with more varied scores across TIS dimensions. Sprawniwpracy and Kalomathe displayed a stronger orientation toward knowledge development, whereas the DISSE showed generally lower values but maintained an emphasis on knowledge creation. This cluster exhibited the lowest level of entrepreneurial experimentation compared to the other two and is best described as representing a *lifelong learning for social inclusion model*. Despite lower overall intensity across TIS functions, these cases illustrate the potential of digital tools to support learning for inclusion rather than technological advancement.

Discussion

This section interprets and contextualises our empirical findings through dialogue with the relevant literature and articulates the study's theoretical contribution. We examined how educational initiatives in the SE integrate digital innovation by combining the TIS framework with a configurational perspective. Across the eight good practices, knowledge development emerged as the dominant system function, whereas entrepreneurial experimentation and user engagement showed more variation. Building on these differences, the cluster analysis revealed three distinct configurations of TIS functions, i.e., civic platforms, institutional living labs, and lifelong learning for social inclusion, which represent alternative pathways for embedding digital innovation in SE education.

Findings confirmed the knowledge-intensive nature of digital social entrepreneurship highlighted in prior work. The consistently high scores in the knowledge development function resonate with Nambisan's (2017) view of digital entrepreneurship as grounded in generativity and reprogrammability. It also relates to Gregori and Holzmann's (2020) observation that digital technologies enable multidimensional value creation in sustainable business models.

Simultaneously, the moderate levels of entrepreneurial experimentation and the heterogeneous patterns of user engagement nuanced the more practice-oriented narratives in SEE. While social learning theory and related studies (Bandura, 1977; Howorth et al., 2012; Chen & Shabbir, 2024) emphasise learning through action, observation, and community engagement, our cases show that digital SE education often prioritises knowledge production and organisation over the systematic experimentation with new models and the deep involvement of users in co-creation.

The first cluster, 'civic platforms,' represented the most advanced configuration of TIS functions. Here, high levels of knowledge development were combined with strong entrepreneurial experimentation, robust resource mobilisation, and advanced legitimation and user engagement. These initiatives closely resemble the kind of digitally enabled ecosystems described by Gregori and Holzmann (2020), where digital artefacts mobilise and connect individuals and generate spillover effects in terms of awareness and social impact.

From a TIS perspective (Bergek et al., 2008; Hekkert et al., 2007), this cluster approximated a fully functioning innovation system, where the core functions reinforced each other and the initiatives were embedded in their societal context. In this sense, the civic platforms provide empirical evidence of how digital social innovation (Qureshi et al., 2021; Buck et al., 2025) can be institutionalised through participatory, platform-based educational arrangements.

The second cluster, 'institutional living labs,' was characterised by moderate but well-balanced levels across the TIS functions. These initiatives operated within HEIs that provide substantial technical and educational infrastructure. They adopted living lab-like models with structured experimentation in real-life settings. This configuration aligns with the literature on living labs as socio-technical platforms with shared resources and representative governance (Leminen et al., 2012; Westerlund et al., 2018), and with policy calls for HEIs to act as drivers of digital social entrepreneurship (European Commission, 2021, 2022; Gagliardi et al., 2020).

However, compared to the civic platforms, the institutional living labs placed relatively less emphasis on sustained knowledge creation and broad user co-creation, and more on providing stable environments for technology-based learning. This suggests that the institutionalisation of digital SEE within formal HEI settings may prioritise infrastructural and organisational robustness over systemic experimentation and deep societal engagement.

The third cluster, 'lifelong learning for social inclusion,' displayed the lowest overall intensity across the TIS functions, particularly in entrepreneurial experimentation and resource mobilisation. However, these initiatives consistently prioritised knowledge development and focused on supporting disadvantaged groups through digital tools. This resonates with Qureshi et al.'s (2021) definition of digital social innovation as oriented towards addressing societal challenges and improving the well-being of vulnerable populations.

From a TIS perspective, these cases represent low-intensity innovation systems that nonetheless generate meaningful social value. In line with recent extensions of TIS to social and educational innovations (Marques et al., 2020; Howaldt et al., 2016), our findings suggest that we should not measure the success of digital SEE solely in terms of technological sophistication or systemic completeness, but also in terms of its contribution to lifelong learning and social inclusion.

The study contributes to the TIS literature by showing how core system functions are configured in the context of digital SE education. In our cases, legitimation and user engagement emerged as particularly critical for differentiating configurations, underscoring the importance of societal anchoring and participatory practices in educational and social innovations (Marques et al., 2020; Howaldt et al., 2016), beyond the traditional focus on technological performance.

Simultaneously, adopting a configurational lens (Meyer et al., 1993; Fiss, 2009; Huang et al., 2024) demonstrated that there was no single optimal combination of TIS functions. The three identified clusters represented distinct constellations of conditions that align with different value propositions and institutional contexts. This supports the view that digital innovation outcomes arise from multiple, equifinal paths rather than from individual factors considered in isolation.

Conclusions

This section summarises the main takeaways and outlines the study's implications, limitations, and avenues for future research. Overall, our configurational TIS analysis of eight European SE education initiatives shows that knowledge development is consistently the most salient system function, while entrepreneurial experimentation and user engagement vary substantially, yielding three alternative pathways for embedding digital innovation in SE education, i.e., civic platforms, institutional living labs, and lifelong learning for social inclusion. Each of them is characterised by distinct combinations of resource mobilisation and legitimation.

Digitalisation plays a critical role in enhancing entrepreneurship, competitiveness, and value creation. Moreover, EU policies and research recognise that HEIs can further enhance digital social innovation. While digital competencies are important for social entrepreneurs, hands-on experience can constitute an integral part of more effective SE education, and experiences such as living labs enhance stakeholder involvement. For the analysis of the educational initiatives, we utilised the TIS concept. This approach focuses on the processes that lead to innovation rather than organisational or institutional structures. Within the scope of the analysis, we developed five different system functions to elucidate how an initiative can emerge, develop, and become part of an innovation ecosystem.

We defined knowledge development, entrepreneurial experimentation, resource mobilisation, legitimation, and user engagement as five core functions with the capacity to enhance an initiative. To identify patterns that shape digital innovation in SE education, we utilised the configuration approach alongside the analytical framework built on TIS. This approach offers area-sensitive analysis and enables multilayer examination of different phenomena and parameters shaping digital innovation. To ground the research, we applied a multiple case study design. We initially identified twenty good practices at national, supranational, and international levels, from which we deliberately selected eight for further analysis.

We examined the eight selected thoroughly and independently based on the five TIS functions, using a five-point scale where the lowest value indicated marginal presence and the highest indicated full development. The FARI initiative had the highest average score among the five functions compared to the other seven case studies, demonstrating saliency in educational innovativeness related to SE. A similar performance was evident in GraTy, while the next category comprising DigiSEII, Sprawniwpracy, Teach-BEASTs, and Kalomathe had lower average scores. In the course of further analysis, we identified three clusters of initiatives: 'civic platforms,' 'institutional living labs,' and 'lifelong learning for social inclusion.'

The first cluster (FARI, GraTy, DigiSEII) demonstrated a high performance level in knowledge development while performing moderately in the other functions. This cluster exemplifies how the digital innovation and knowledge development functions can be institutionalised through participatory-based platforms. The second cluster (Savona Living Lab and Teach-BEASTs) represents a model of how HEIs can provide a stable and sustainable environment for digital initiatives to flourish, while having limited experimentation in challenging existing institutions. Finally, the third cluster (Sprawniwpracy, Kalomathe, DISSE) is oriented mainly toward lifelong learning to address societal challenges such as exclusion. By presenting the three clusters identified through the analysis, it becomes evident that there is no single formula for implementing digital education for the social economy, and that all possible options should be considered, as the cases are context sensitive.

The findings carry important implications for policymakers who support digital innovation in SE education. As for practical implications, the findings suggest that policy makers and HEIs should not seek a single ideal model of digital education for the social economy but should rather recognise and support a diversity of viable models. The identified clusters showed configuration diversity, supporting the recommendation to avoid a one-size-fits-all approach.. Civic platforms, institutional living labs, and lifelong learning initiatives respond to different needs and institutional environments, and each requires tailored support in terms of resources, legitimation and user engagement (European Commission, 2021, 2022; Gagliardi et al., 2020). Different models reveal that not all functions included in the TIS model are developed. It suggests supporting technical assistance to strengthen weaker functions. As some of the identi-

fied good practices characterise novel and experimental learning, such components should be included in funded programmes.

The study is not without limitations. The analysis drew on eight purposefully selected European cases and qualitative interview-based assessments operationalised through the TIS matrix. While this enabled in-depth, context-sensitive evaluation of knowledge development, experimentation, resource mobilisation, legitimation, and user engagement, the fact remains that ordinal scoring and researcher interpretation may have introduced subjectivity and limited statistical generalisability. However, the aim was analytical rather than statistical generalisation. The TIS framework proved applicable beyond high-tech sectors, as it captures systemic processes shaping educational innovation in the social economy. Future research could expand the sample, adopt longitudinal designs and combine qualitative and set-theoretic methods to further refine the typology of digital SE education systems.

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Annex. TIS System Functions and Assessment Scale for Educational Initiatives in the SE

TIS Function	0 – Not Observable	1 – Marginal Presence	2 – Moderate Presence	3 – Consistent Presence	4 – Core eature
1. Knowledge development	No knowledge-related activity.	Occasional use of external materials; limited knowledge circulation.	Partial creation or contextualisation of content.	Systematic development of educational or methodological content	Knowledge as a central component of the initiative.
Generation and diffusion of relevant knowledge (technological, social, educational)	Example: Passive use of content only, without adaptation or sharing.	Example: Use or sharing of other people's documents, online courses or links without adaptation.	Example: Adaptation of open content or courses, creation or co-creation of simple educational materials.	Example: Creation and use of own (digital) educational modules, content or tools.	Example: Development of original educational programs, internships or apprenticeships and/or innovative evaluation programs or frameworks.
2. Entrepreneurial experimentation	No testing or piloting.	One-off activities and pilot activities, without follow-up or repetition.	Limited experimentation with informal user involvement.	Structured prototyping with feedback.	Experimentation as an integral part of the activity.
Testing, prototyping, iterative learning	Example: Predefined activities, no evaluation.	Example: One-off testing of activities without further action (including evaluation).	Example: Testing tools and making changes based on feedback from stakeholders and customers.	Example: Testing-evaluation-adjustment cycle with user participation (Deming cycle).	Example: Prototyping in real-world conditions (Living Lab), evaluation, and continuous adaptation.
3. Resource mobilisation	Action based solely on internal or informal resources.	Ad hoc external support.	Project-based resources with limited durability.	Stable resources and partnerships.	Institutional and multisectoral support.
Access to human, financial, material and relational resources	Example: Volunteer work, lack of funding or partnerships.	Example: One-time support, donation, or lending of space.	Example: Short-term funding, low-budget or incidental projects, temporary employment	Example: Permanent cooperation with NGOs, universities or local governments.	Example: Participation in long-term public-private initiatives or consortia.
4. Legitimation	No recognition or visibility.	Local or informal recognition.	Partial legitimacy in specific areas.	Formal recognition by institutions.	High level of legitimacy.

TIS Function	0 – Not Observable	1 – Marginal Presence	2 – Moderate Presence	3 – Consistent Presence	4 – Core eature
Social and institutional recognition and acceptance	Example: Informal activity, largely unknown	Example: Known in the community or among practitioners, but without formal support/ endorsement/ recognition.	Example: Recognition within a network or subsector. Participation or acceptance in sectoral bodies.	Example: Functioning in formal and informal networks. Or certified activity or program supported by public entities.	Example: Permanent functioning in various formal networks, including those covered by formal documents (law, strategies).
5. User engagement	No user participation.	Sporadic feedback.	Partial co-creation.	Permanent participation mechanisms.	Users as co-authors and co-responsible actors.
Participation of users in co--creation and evaluation	Example: Users only consume services or created content, no feedback.	Example: Surveys or interviews with no real impact.	Example: Regular meetings and/or workshops with users, participatory evaluation.	Example: Users co-create the goals, content, and strategies of the initiative.	Example: Regular meetings and/or workshops with users, participatory evaluation.

Source: own elaboration.

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All authors have read and agreed to the published version of the manuscript.

AI Declaration Statement

The authors declare that no AI tools were used in the preparation of this manuscript.

Acknowledgements and Financial Disclosure

This work was co-funded by the European Union under Project No. 2024-1-PL01-KA220-HED-000252300. The views and opinions expressed are solely those of the authors and do not necessarily reflect the views of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

Conflict of Interest

The authors declare that the research took place without any commercial or financial relationships that could be construed as a potential conflict of interest.

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