

Article

Leveraging Entrepreneurship Education in Italy's Inner Areas: Implications for Regional Planning

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Abstract

This paper examines how place-sensitive, transdisciplinary entrepreneurship education can catalyze inclusive innovation in peripheral regions. Drawing on the *Pathways to Innovation and Entrepreneurship* initiative—implemented in Southern Italy through a collaboration between the University of Naples Federico II and Cornell Tech with the support of the US Diplomatic Mission to Italy—this study explores the role of universities as active agents in regional innovation ecosystems. Adopting an action research methodology across inner and peri-urban territories, the initiative combined transdisciplinary learning, international knowledge exchange, and applied innovation to support regional planning. Findings highlight three interdependent causal pathways: (1) experiential learning and the development of transversal competencies, (2) network formation across scales, and (3) context-sensitive innovation practices. The results show how a locally embedded yet globally networked approach contributes to innovation capacity building of peripheral regions, aligning global knowledge flows with territorial strengths. The paper concludes with implications for embedding EE into regional innovation strategies, fostering diverse network management, and promoting sustainable, place-based development in left-behind places.

Keywords: entrepreneurship education; regional innovation ecosystems; peripheral regions; trans-disciplinarity; university–industry collaboration; left-behind places



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1. Introduction

Peripheral and left-behind regions have re-emerged as critical frontiers in the global pursuit of inclusive and sustainable development [1,2]. While economic agglomeration theory has long highlighted the advantages of clustering in urban centers, increasing evidence shows that such benefits rarely spill over to structurally disadvantaged areas [3,4]. Instead, development traps perpetuate underperformance, eroding not only economic prospects but also social cohesion and political trust [5,6]. As inequalities deepen, these regions grow increasingly vulnerable to democratic disaffection and institutional disengagement [3,7].

In this context, universities are widely recognized as potential drivers of regional innovation, through human capital formation, entrepreneurship, and the production and diffusion of knowledge [8,9]. Yet their contribution remains uneven, particularly in peripheral areas where institutional capacity is weak, science–industry linkages are uneven, and access to global innovation networks is limited [10,11]. University–business partnerships often underperform, failing to translate academic excellence into local development outcomes [12,13].

Small and medium-sized enterprises (SMEs), meanwhile, tend to rely on informal networks and market-driven experimentation rather than structured R&D or university

partnerships [14–17]. As innovation increasingly stems from relational and experiential processes rather than codified knowledge, the key question becomes: how can universities help build regional innovation ecosystems in structurally disadvantaged areas?

This article addresses that question by examining the role of entrepreneurship education (EE) as a mechanism through which universities can realign their missions with territorial needs, fostering sustainable transitions. Recognized by international organizations as a driver of local development [18–21], EE has evolved from a business school offering into a multidisciplinary platform for cultivating technical, transversal, and civic competences [22,23]. Its purpose is not only to stimulate venture creation, but—more importantly—to nurture entrepreneurial mindsets and collaborative capacities that are adaptive to uncertainty and increasingly oriented toward sustainable transformation [24–26].

This study focuses on Italy, where, despite the expansion of EE programs through corporate academies [27], the entrepreneurial landscape remains constrained by structural and cultural barriers. Global Entrepreneurship Monitor (GEM) data show persistently low early-stage entrepreneurial activity, shaped by rigid financial systems, insufficient institutional support for EE, and high fear-of-failure rates [28,29]. Total Entrepreneurial Activity (TEA) also varies sharply across provinces (0.5% to 2%), revealing entrenched territorial disparities, particularly in inner areas and the South [30]. These data underscore the relevance of examining how EE can address such gaps by shaping entrepreneurial mindsets, bridging external knowledge flows, and embedding innovation within peripheral regions.

In particular, our study investigates how EE can bridge global knowledge flows and localized learning, enabling innovation in peripheral contexts. It draws on the *Pathways to Innovation and Entrepreneurship* initiative, implemented in select inner areas of the Campania Region (NUTS 2) in Southern Italy—an area marked by youth unemployment, moderate innovation capacity, and high outmigration, despite recent growth in entrepreneurial activity [31,32]. The initiative integrated action research, non-traditional training, stakeholder engagement, and international collaboration to address structural barriers to knowledge diffusion through both high-tech and traditional industries.

Building on the case analysis, the central claim of this article is that entrepreneurship education can work as connective infrastructure within regional innovation ecosystems. More than a training device, EE—when designed as a participatory, transdisciplinary, and ecosystem-oriented practice—enables universities to co-produce sustainable innovation in collaboration with firms, governments, and civil society. This conceptual shift has profound policy implications: it requires moving beyond narrow output-driven metrics (e.g., patents, spin-offs) toward pedagogies and governance models that deliberately support knowledge translation and use. Such a shift is a precondition for aligning R&D with inclusive and sustainable industry growth, and regional development.

The article contributes to scholarship at the intersection of EE research and EE pedagogy, innovation studies, regional development, and innovation policy. Pedagogically, it advances a model of entrepreneurship education that integrates sustainability and transdisciplinarity, while reconciling university research excellence with economic returns on R&D investment. From a policy perspective, it provides empirical insights for designing EE programs that meet the needs of regional innovation ecosystems [33] and complement place-based innovation strategies [34,35]. By embedding EE at the heart of policy design, the article offers a roadmap for transforming higher education into a catalyst for socio-economic revitalization.

The remainder of the article is structured as follows: Section 2 reviews the literature on entrepreneurship education and regional innovation; Section 3 outlines the research context and case study design; Section 4 presents the main findings; Section 5 discusses

their implications in light of existing scholarship; and Section 6 concludes with key lessons for policy and practice.

2. Literature Review

The study of EE is interdisciplinary and multidisciplinary [36], involving teaching and learning approaches, entrepreneur traits, intentions, behaviors, and achievements, as well as its consequences for economic development [37–41]. The following sub-sections delve deeper into these areas that will help illuminate the case.

2.1. Entrepreneurial Mindset and Transversal Competencies

One of the central strands in EE literature focuses on developing an entrepreneurial mindset—a set of attitudes and cognitive dispositions oriented toward opportunity recognition, creativity, risk taking, and proactive behavior. Informed by experiential learning theory [42], this perspective frames entrepreneurship as a way of thinking and acting. Entrepreneurial education, in this view, is a transformative process that builds learners' capacity to navigate uncertainty, persist through adversity, and act resourcefully.

Recent studies highlight the critical role of pedagogy in this process, particularly interactive methods that mirror real-world entrepreneurial contexts [22,38,43,44]. These approaches are rooted in learning-by-doing and reinforce entrepreneurial competencies through active engagement, self-assessment, and mentorship [45]. Developing a growth mindset through challenge, reflection, and feedback, students learn that failure can become a learning opportunity while ambiguity can be a space for innovation [46]. However, neuroscience and behavioral economics underscores the influence of cognitive heuristics and subjective risk perceptions [47], pointing to emotional and psychological barriers—especially in slow growing economies with fragile institutional frameworks. In disadvantaged contexts, the fear of failure—captured by Hirschman's [48] notion of *fracasomania*—can inhibit entrepreneurial activation. Conversely, Hirschman's [49] "Hiding Hand" effect suggests that underestimated challenges can unlock latent creative and entrepreneurial capacities.

2.2. Theories of Entrepreneurship and Human Capital Formation

Entrepreneurship economics explores how incentives shape entrepreneurial behavior and how entrepreneurship, in turn, affects the economy, with risk assessment at its core [50]. Individuals are more likely to choose entrepreneurship over employment when expected returns exceed risks. Such entrepreneurial capacity is closely tied to human capital, and is not bound by conventional technological constraints. Entrepreneurs may create new technologies and products that generate discontinuous change, shifting paradigms, and disrupting organizational routines [51].

Human capital theory posits that individual attitudes and intentions stem from knowledge, abilities, and skills acquired through education [52]. Highly educated talent enhances entrepreneurship and innovation through research and development (R&D), expanding an economy's absorptive capacity [53–55]. In peripheral areas, however, labor mobility and institutional weaknesses diminish returns to education, driving brain drain and reinforcing territorial inequalities [8,30,56,57]. A meta-analysis of 42 quantitative studies confirmed significant links between EE, human capital assets, and entrepreneurship outcomes, while also highlighting uneven effects across regions [58].

2.3. Regional Science and Innovation Studies Shaping Entrepreneurship Education

Regional science examines how industry specialization, diversification, and localized learning foster entrepreneurship and innovation [59]. Business studies highlight the role of informal networks, trust, and co-location in enabling knowledge exchange [60]. In advanced ecosystems, university-led R&D collaborations drive regional innova-

tion [61], but in peripheral regions, weak science–industry linkages constrain innovation capacity [10,11,14,16,61,62].

University–business collaborations extend beyond formal R&D to include experiential learning and informal exchanges within supply chains [15,16,63]. The challenge is how EE can better connect research and business to improve the quality and productivity of regional innovation ecosystems [64].

Studies of university programs in business development show that EE enhances student employability when institutions foster localized knowledge flows, align curricula with business realities, and engage industry professionals in teaching—thus building trust between firms and universities [13,41,65]. External knowledge sources are also critical, often introduced by MNEs, global research centers, or international supply chains [66]. While some studies [67] emphasize MNE engagement models—venture arms, incubation programs—that can enhance local knowledge sharing, others [68] note their ambivalent influence on incentive structures for early-stage entrepreneurs, trainers, and educators, and [69] caution that foreign entrants may also crowd out local firms, limiting patenting. EE must therefore equip students to navigate these multi-level environments and incorporate global–regional dynamics into their learning [70].

From an ecosystem perspective, these interdependencies highlight the need to view EE outcomes not in isolation, but in terms of their contribution to broader networks of firms, institutions, and individuals that leverage knowledge, resources, and specialized capabilities across regions and scales [33,35,37,38,40,60]. From this angle, the innovation output of universities—and of individual researchers within them—cannot be understood in isolation from their surrounding context. Productivity and impact depend not only on the quality of individual research but also on the extent to which researchers are embedded in dense, interactive environments that support cumulative knowledge building, iterative discovery, and engagement with entrepreneurial actors. Thus, the presence of innovation-driven entrepreneurs in geographical proximity enhances the likelihood that public research will be translated into commercially viable outcomes [35].

2.4. Sustainability Dimensions to Incorporate in EE

The notion of the innovation ecosystem draws on an economic complexity perspective [71,72], which highlights the interdependent dynamics of systems rather than the simple aggregation of their parts. This lens is particularly useful for analyzing outcomes in complex environments and for addressing sustainability transitions [73]. Research in this field [74] examines radical and non-linear societal change, focusing on agency, uncertainty, and multiple futures through scenario analysis. These approaches are applied to:

- Integrating human–environment systems, which evolve across scales, sectors, and institutional networks;
- Modeling participatory processes, incorporating diverse perspectives to build adaptive and innovative capacity in the face of undecidability;
- Supporting adaptive management, enabling institutions to respond more dynamically to real-world change [73].

Most importantly, such perspectives can orient innovation ecosystems toward sustainability-centered solutions [73,75,76]. Embedding them in entrepreneurship education opens space to examine how sustainability transitions—often recursive, ambiguous, and multifaceted—unfold as public and private actors negotiate pathways through collaboration.

2.5. Toward a Model for EE Program Design and Assessment

Although the theoretical perspectives reviewed have evolved along distinct trajectories, their integration offers valuable insights for designing EE programs capable of addressing regional innovation and sustainability challenges. The different strands of research, encapsulated in Table 1, contribute to shaping a model of innovation-driven EE that serves as connective infrastructure at the core of regional innovation ecosystems. More than a training device, EE can enable universities to co-produce innovation with firms, governments, and civil society. By building skills, forging networks, and nurturing trust among diverse actors who would otherwise remain fragmented, EE becomes a pathway through which academic knowledge translates into corporate and territorial renewal.

Table 1. Theoretical perspectives, causal mechanisms, and selected references.

Theoretical Perspectives	Multilevel Causal Mechanisms EE Programs Can Activate to Generate Change	References
Innovation theories Entrepreneurship education research	University-Industry Collaborations Learner-centric pedagogy Experiential learning Transdisciplinarity Knowledge co-production/co-creation	[10–12,22,37,43,44]
Human capital theory, Regional science and development Sustainability science	University system R&D expenditure Skilled workforce development Investment and risk capital Venture creation Venture capital Adaptive management Participatory processes of governance	[8,55,57,58,64,73]
Entrepreneurship economics Entrepreneurship education research Entrepreneurship education outcomes	Career choice Risk propensity Attitudes toward entrepreneurial behavior/self-employment Entrepreneurial mindset Student employability Innovation and entrepreneurship culture and desirability perception Values/Concerns for Societal impact Risk sharing mechanisms Intrapreneurship	[49,65,77]
Business innovation studies	R&D public and private expenditure Platforms for knowledge sharing Alliances between MNEs and startups Licensing, acquisitions Open innovation	[67–69]

Table 1. *Cont.*

Theoretical Perspectives	Multilevel Causal Mechanisms EE Programs Can Activate to Generate Change	References
Regional innovation Regional development Sustainability science	Innovation partnerships Local and global networks Commercialization and acceleration programs Market size Regional vs. global knowledge sources Place-based innovation ecosystem policies Participatory processes of governance Relationship with entrants Regional and global value chains Human nature interactions Specialization vs. diversification of production	[33,35,41,59,75]

Three interrelated dimensions define EE as a participatory, transdisciplinary, and ecosystem-oriented practice:

- Experiential and transdisciplinary learning: moving beyond disciplinary boundaries to generate new frameworks for sustainable, innovation-driven entrepreneurship [78,79]. A transdisciplinary approach creates models, solutions, and research impacts unattainable through disciplinary or even interdisciplinary collaboration [80].
- Network diversity management: addressing regional socio-economic, environmental, and ethical challenges requires not only technical expertise but also the capacity to orchestrate diverse perspectives and foster collective sense-making across professional identities, institutional logics, and personal motivations. This process is rarely linear. Too much diversity without coordination risks fragmentation, while excessive homogeneity risks redundancy and limited innovation potential [81–84].
- Applied innovation in spaces: shaping learning outcomes by revealing how innovation emerges in interaction with territorial demands and stakeholder configurations. These spaces illuminate how groups operate, how strategies are leveraged, and how concrete applications unfold.

Figure 1 illustrates how these dimensions act as mechanisms explaining how EE programs can lead to ecosystem development, forming the backbone of a recursive logic model. Experiential learning stimulates transdisciplinary knowledge production, which nurtures networks and partnerships, enabling applied innovation. Successful applications, in turn, feed back into enhanced learning, improved research productivity, socio-political legitimacy, and institutional support. The effectiveness of this cycle depends critically on implementation choices and contextual conditions, which determine whether learning translates into sustained collaboration or remains episodic. The model is therefore recursive—characterized by feedback loops, potential reversals, and reconfigurations—sustained by trust, reflexivity, and a shared vision of possibility [40,85]. Section 3 turns to illustrate the research design of the study this article draws on.

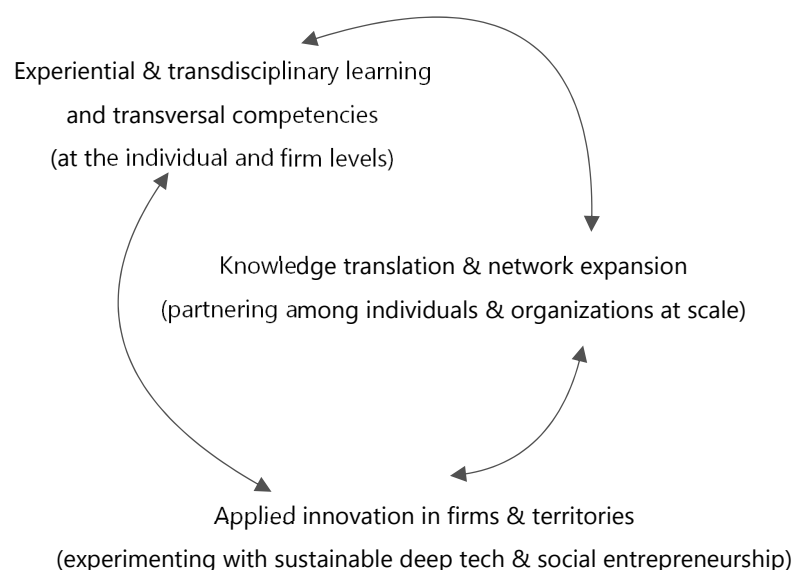


Figure 1. Potentially recursive causal mechanisms in innovation-driven entrepreneurship education.

3. Methods

3.1. Project Design and Criteria for Participant Inclusion

Pathways to Innovation and Entrepreneurship is an EE initiative of the University of Naples aimed to stimulate innovation-driven entrepreneurship by cultivating learning environments rooted in collaborative exchange. The initiative was framed as a pilot intervention operating across peripheral contexts within the Campania region, including inner and peri-urban localities. Departing from conventional classroom-based training, the initiative blended territorial workshops, iterative informal learning and networking experiences, and a capstone course in New York City. Table 2 schematizes the key activities implemented throughout select localities alongside the target groups.

Table 2. Activities, locations, and target groups in the *Pathways* initiative.

Activities	Offerings	Selected Locations	Target Groups
Territorial Workshops	Experiential, place-based learning journeys in entrepreneurial ecosystems, including aerospace, agri-food, electronics, arts and culture	Eastern part of Naples Cava de' Tirreni Altavilla Irpina Caggiano	Researchers and Entrepreneurs
Summer School	International immersion and advanced entrepreneurial training at Cornell Tech	New York	Researchers, Entrepreneurs and Mid-career Professionals
Cross-sector Networking	Linking researchers, entrepreneurs, and science, technology, and arts and culture agents	Across all sites	Multi-stakeholder territorial communities

Territorial workshops prioritized hands-on learning and peer collaboration, connecting primarily young and emerging researchers with both startups and well-established entrepreneurs. While the workshops served as spaces for networking across multiple professional and entrepreneurial circuits, the New York Summer School offered participants the opportunity to connect with global networks of scientists, entrepreneurs, and professionals, broadening their understanding of top tier innovation ecosystems.

The initiative pursued two overarching goals: reshaping the outlook of emerging researchers and entrepreneurs and mobilizing a broader network of territorial actors.

Rather than treating these groups as separate audiences, the project deliberately brought them into dialogue, encouraging the exchange of techno-scientific and tacit knowledge across institutional and sectoral boundaries.

Stakeholders were considered as active co-designers of training activities, selected according to three criteria:

- **Functional expertise:** participants contributed specific technical knowledge relevant to sustainable innovation. For instance, young and emerging researchers were chosen for their disciplinary specialization, which provided insights on innovation processes across industries.
- **Institutional knowledge:** participants understood how strategies and activities were embedded within university structures, policies, and decision-making processes.
- **Social legitimacy:** participants had credibility and representativeness within local ecosystems, such as institutional leaders, stakeholder representatives, or faculty members with governance roles. Their perspectives were essential for assessing how training activities were perceived and valued.

Based on these criteria, nine young researchers were selected through consultations with PhD coordinators and the project's scientific committee—five in industrial engineering, two in chemistry, and two in social innovation. Entrepreneurs were invited from highly specialized sectors crucial to the regional economy, including aerospace, electronics, agri-food, and cultural and creative industries. Their involvement was meant to capture concrete needs and policy suggestions. Local institutions and consultants supported scouting efforts through preparatory fieldwork ahead of the territorial workshops. As shown in Table A2 (in Appendix A), more than sixty entrepreneurs participated actively in roundtables on innovation needs, while over 500 stakeholders attended the events.

The intervention logic rested on two interrelated premises. First, integrating advanced knowledge into local dynamics must align with firms' demands and absorptive capacities, especially in inner areas [53,55]. Embedding techno-scientific insights within local supply chains was expected to increase the relevance of training, if firms recognized their external knowledge needs. In this respect, university–industry collaboration was conceived as a dynamic channel of knowledge exchange among science, technology, and industry actors [11], bridging research outputs with enterprise and community challenges in fragile contexts.

Second, fostering innovation in peripheral regions requires linking local learning processes to global innovation networks. Localized experimentation gains traction when combined with international exposure, allowing cross-fertilization between less-developed areas and leading-edge ecosystems. The immersive training in the New York metropolitan area offered participants firsthand observation of how advanced ecosystems scale, evolve, and integrate into global markets. The city's innovation landscape—shaped by rapid growth in STEM employment, startups, and emerging technologies—was complemented by the strong presence of Italian-American entrepreneurs and researchers. This diaspora played a vital role in facilitating connections, opening access to global R&I circuits, and reinforcing a shared identity rooted in cultural affinity and common traditions.

The initiative unfolded along four interconnected components: (1) curriculum co-design with academic and non-academic actors; (2) field immersion in target territories to ensure context-sensitive implementation; (3) capacity building through workshops, a Summer School, mentoring, and networking; and (4) reflexive evaluation through iterative action research cycles. In sum, the initiative coupled the exploration of local contexts with global innovation perspectives, reinforcing the need to integrate place-based and international knowledge flows in entrepreneurial training offerings aimed at revitalizing economically fragile territories.

3.2. The Place-Based Approach Through the Ecoregion Lens

Departing from conventional policy frameworks tied to administrative jurisdictions—such as Italy’s Strategy for Inner Areas—the selection of target territories followed a multilevel scale, enabling the identification of localized nodes of entrepreneurship and innovation. A distinctive feature of the initiative was its focus on multiple geographies: areas larger than municipalities but smaller than provinces (according to the European Union nomenclature NUTS 3) yet embedded within broader regional spaces that do not correspond to administrative or statistically defined regions (classified as NUTS 2). This spatial delimitation was guided by the ecoregion lens, a geo-statistical approach that identifies clusters sharing environmental and socio-economic characteristics and development potential [86].

Using this lens, four pilot sites were selected as workshops for delivering non-conventional training and networking (see Table 1):

- The East periphery of the City of Naples–San Giovanni a Teduccio—home of the technology pole of the University of Naples Federico II;
- The internal Municipality of Cava de’ Tirreni (in the district of Salerno);
- The inner localities of Altavilla Irpina (in the district of Avellino), and Caggiano (in the district of Salerno, but located in the Diano Valley, almost at the border with Basilicata Region).

Together, these sites span urban peripheries, peri-urban corridors, and rural communities across the Tyrrhenian and Apennine ecoregions, mirroring conditions typical of left-behind territories in Southern Europe, North Africa, and the Middle East. Their economies are dominated by SMEs in agri-food, traditional manufacturing, and emerging cultural industries, but innovation is constrained by labor shortages, outmigration of graduates, limited research-business linkages, climate change, and population decline [27]. Among them, Altavilla Irpina stood out for its specialized labor market in agri-food and mineral extraction. Yet labor outflows to regional urban centers persisted (see Figure 2), while environmental monitoring showed air quality crises linked to agricultural practices, a pattern common in Mediterranean contexts [87].

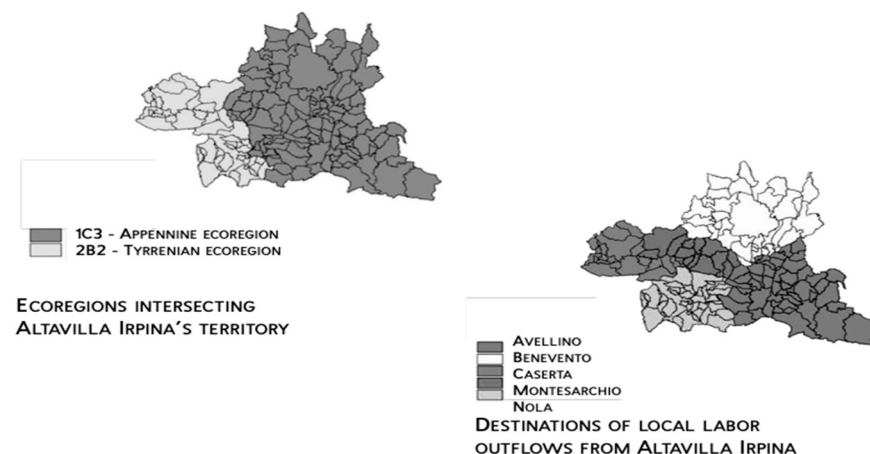


Figure 2. Altavilla Irpina: Ecoregional boundaries and labor outflows. Source: Our elaboration on [86].

Across the territories involved in the *Pathways* initiative, demographic decline eroded labor markets and community cohesion [27]. Aging populations, youth outmigration, and low female labor participation reinforced cycles of skill depletion and economic stagnation, echoing dynamics in the literature on left-behind places [2,3]. These trends shaped local perceptions of vitality and fueled feelings of marginalization and abandonment [1].

Against this backdrop, the initiative did not aim to import innovation into peripheral areas but to reveal, connect, and amplify innovation already latent within slow-growing ecosystems. Beyond the rise of innovative startups throughout the region [28], each site offered distinct entry points for localized action: in San Giovanni a Teduccio (Naples), university-led regeneration supported talent attraction and industry collaboration [88,89]; in Cava de' Tirreni, transport upgrades and sectoral diversification spurred digital entrepreneurship; in Altavilla Irpina, green economy projects repurposed former mining sites into eco-tourism; and in Caggiano, the Morra Foundation's Living Archive catalyzed cultural innovation, linking rural communities to artists' international networks [90]. These differentiated trajectories underscored the potential for cross-sectoral knowledge exchange that *Pathways* sought to sustain.

3.3. Action Research, Data Collection, and Analysis

The initiative adopted an action research approach [91], triggering cycles of experimentation and inquiry that emphasized iterative learning and stakeholder engagement. The methodology focusing on project results relied on participant observation, formal and informal interviews, and reflexive meetings conducted by the program team throughout the training activities, and complemented by an independent evaluation of Summer School end-of-course questionnaires.

The core group of researchers was informally interviewed repeatedly across all workshops; in addition, 14 semi-structured interviews were video-recorded at the Summer School's conclusion, including end-of-course responses documenting learning outcomes. Field data were collected through fieldnotes, recordings, and informal interviews with entrepreneurs and institutional representatives, who provided their feedback both before and after each event.

All qualitative material was transcribed and coded using a dual approach: conceptual categories from the literature (see Table 1)—including risk perception, career choice, entrepreneurial skills, and the nature of interactions between university and business representatives—and empirical codes probing the causal mechanisms in Figure 1. Participant observation extended beyond documenting goals and pedagogy to tracing the pathways through which instructional inputs led to intermediate outcomes and, ultimately, ecosystem impact.

Causal inference drew on a theory-based evaluation framework [92,93] to reconstruct the causal pathways linking program strategies to outputs, outcomes, and broader impacts. Causal pathways—understood as the mechanisms through which interventions produce effects—are essential for explaining how and why outcomes emerge and for designing effective evaluation strategies [94]. The analysis followed an abductive logic, combining deductive insights from the literature on regional innovation ecosystems and entrepreneurship education with inductive evidence from the field. Findings were thematically analyzed, recalling the theoretical categories summarized in Table 3.

As an action research project, the study was exploratory and not intended for statistical generalizability. Its purpose was to understand how and why learning processes emerge within specific territorial interactions. All participants who collaborated with the project team contributed insights that shaped both the intervention's design and the knowledge it generated. While this approach ensured local adaptability and sustained stakeholder involvement across design, delivery, and evaluation, it also risked introducing biases regarding project outcomes. The team sought to mitigate these through systematic reflexivity, though future iterations could strengthen analytic robustness by incorporating time-sensitive data and comparison sites.

Table 3. Key outcomes and causal pathways for ecosystem-impact.

Causal Pathways (Codes)	Evidence Gathered	Source of Data
Learning and Competency Development	Experiential learning and strengthened entrepreneurial, evaluative, and engagement competencies among young and emerging researchers and entrepreneurs.	End of course evaluation questionnaire, and reflexive meetings with participants
Building Networks	Creation of local-global, multi-stakeholder partnerships linking inner areas to international hubs.	Direct observation
Applied Innovation	Cross-sector application of advanced technologies (e.g., aerospace into agri-food and cultural sectors) to local challenges.	Video-interviews with participants

4. Results

The initiative channeled inputs into knowledge diffusion, network building, and localized innovation experiments. Early outcomes pointed to experiential learning, continued training opportunities participants obtained after the project ended, the reorientation of innovation perspectives, the cultivation of relational networks essential for territorial regeneration, and the acknowledgement of the educational model by national and international higher education agencies. While Table A2 in Appendix A reports the initiative's key performance indicators, three interconnected causal pathways were reconstructed in context following the recursive model outlined above. Woven together, these pathways begin to articulate a theory of change for how innovation can take root in peripheral places, as illustrated in Figure 3.

Specifically, the first mechanism centered on transdisciplinary learning and strengthening relational and ethically oriented skills. Participants—ranging from PhD students to entrepreneurs and community leaders—confronted real-world challenges that led them to reconsider their roles, values, and disciplinary assumptions. Learning thus became a situated form of agency, directly linking knowledge to public value. The second mechanism revolved around network building, emerging from the translation and socialization of transdisciplinary knowledge in workshops and problem-solving exercises giving rise to informal groups and networks that aligned diverse actors around shared goals. These relational dynamics proved critical for initiating collaboration and will remain essential for sustaining ecosystem development over time. The third mechanism involved applying innovation to face local challenges as well as long-term optimization needs. For some participants, this meant launching startups after their PhD (practices) or testing technologies in new contexts; for others, it entailed rethinking institutional roles—in public policy, business development, or university–community partnerships. Innovation here was not limited to technical advances but extended to institutional and cultural transformation in practice.



Figure 3. Logic model for EE program addressing inner areas and peripheral contexts.

While other mechanisms might also be at play, these three collectively led to novel practices, which, although small in scale and provisional, revealed critical enabling conditions for ecosystem development: flexible and patient funding, high-quality implementation, institutional autonomy, collaborative governance, firms' absorptive capacity, and leadership committed to experimentation. These conditions cannot simply be replicated by design, as they emerge through situated adaptation and institutional learning [3,11]. The reminder of this section goes deeper into the three causal pathways.

4.1. Experiential and Trans-Disciplinary Learning

The first causal pathway featured experiential learning and competency development, but not in the conventional sense. Learning was about creating conditions where participants could confront real-world problems and rethink their own role in addressing them.

Trans-disciplinary engagement required moving beyond disciplinary silos to forge a shared vision [78,80]. While initially tacit, such a vision gradually emerged as a coordi-

nating mechanism that aligned diverse expertise and expectations, fostering motivation, resilience, and mutual recognition in uncertain contexts [95]. Within the *Pathways* initiative, a shared vision was not imposed a priori; it evolved through co-creation, reflexive dialogue, and sense-making. Participants surfaced assumptions, questioned prevailing narratives, and negotiated values and objectives. In the project work on vineyards profitability (see later), researchers in biotechnology, local entrepreneurs, and sustainability specialists collectively framed problems and designed solutions. Their deliberations considered not only feasible technologies but also processes of implementation, the actors involved and anticipated societal consequences. The vision that emerged aligned economic goals with environmental sustainability and social responsibility, resulting in an ethically informed innovation process supporting sustainability transition visions.

Across the four workshops and the Summer School, *Pathways* emphasized sharing vocabularies and integrating diverse expertise into problem-solving activities rooted in real-world challenges. Transdisciplinarity here was not an abstract aspiration but a cognitive and emotional challenge: learners were pushed to leave their comfort zones and engage with unfamiliar concepts, methods, and perspectives [50,78]. The following excerpts from video-interviews with participants encapsulates this evidence:

«The beauty in this project is to learn how other people in other fields approach a problem. . .the trans-disciplinary approach, because I believe for me and for many researchers, is missing. Because the academic world, maybe especially in Italy, is so focused on our single research. So you have to dig more and more vertically in your research area [. . .] This project enabled me to take my head outside my hole in which I was digging and see what is outside, what the other researchers, other people do, and maybe also that I can dig horizontally, not only vertically. Second thing, especially in the summer school, I learnt to be aware of the whole environment. I was so focused on developing technical skills in my field without being aware of what the global context actually is, how my research, my action cause changes in the real world. . . Now I know that impact is the first thing to think about and then plan the actions and the technical aspects». (video-interview conducted on 28 June 2024)

«When we started the project work in the classroom at the very beginning, I had the feeling somehow that everyone was very much focused on his or her own knowledge and expertise, and over the days, also benefiting from the knowledge that was, let's say, transferred to the participants. The students mainly, let's say, managed to go a little bit beyond their comfort zone and they were able to apply the knowledge gained in the project work that we were expected to carry out». (video-interview conducted on 28 June 2024)

«I'm a scientist and a researcher, so this is all new to me because the fields of economics and sociology are quite different from what I do. So this is really challenging and inspiring for me in terms of acquiring new perspectives». (video-interview conducted on 28 June 2024)

«Starting from the fact that I am from aerospace engineering, so it is totally another field [. . .] for me it's very interesting because I had the opportunity to open my mind under different aspects because I didn't know anything about innovation and entrepreneurship. . . I think that in the future, I hope that in the future I will return to study these topics». (video-interview conducted on June 28, 2024)

Evidence from the evaluation report highlights the emergence of shared technoscientific and local knowledge among researchers and entrepreneurs, influencing both mindsets and risk perceptions [95]. Researchers reflected on the challenges of translating knowledge into commercially viable outcomes, addressing applied research, go-to-market phases, team building, customer discovery, startup funding, venture capital, and coordi-

nation with industry and scientific partners. Transversal competences to navigate these processes were seen as essential—not only for launching new ventures, but also for securing international research funding and managing collaborative projects. Such efforts require a clear assessment of societal implications and the managerial capacity to lead applied research in partnership with businesses and international actors [96].

Entrepreneurs valued the training for both networking and professional growth, as evidenced by interviews and round-tables. Beyond relationship-building, they gained direct exposure to global expert knowledge flows and opportunities for collaboration with universities, research centers, and technology labs. Participants also reconsidered the advantages of university–industry partnerships, particularly their capacity to reduce costs and mitigate risks compared to traditional R&D models. The following interview excerpts illustrate a clear mindset shift toward embracing greater complexity and risk-taking.

«The ability to interact with the other participants and build together some knowledge that none of us would have been able to just construct by themselves, that's the main thing that I can bring home with me» (interview conducted on May 24, 2024).

«Encountering the university was a real advantage as normally it is difficult to identify the entry point. . .we want to develop collaborations and have many innovation needs but end up going around the world in search for solutions we need to look for on the market» (interview conducted on May 24, 2024).

Across the workshops and Summer School, participants were confronted with real-world constraints—scientific, technical, environmental, financial, and organizational—and gained a deeper understanding of how to design solutions that are scientifically robust, environmentally sustainable, economically viable, and socially inclusive. This learning reshaped participants' assumptions about science, business opportunity, and their own research fields, fostering situated agency to reorient knowledge toward firm-level, market, and territorial applications, as explored in the remainder of this section.

4.2. Network Expansion

The second causal pathway the initiative initiated revolved around scientific and institutional collaborations that activated tangible and intangible resources together with diplomatic representation offices, local governments, and non-profit and trade organizations. As shown in Table A1 (Appendix A), collaborations across technology, science, and public administration expanded the initiative's visibility and helped foster an inclusive culture of innovation-driven entrepreneurship across local and global contexts. What these interactions led to was an expanded network, aligning diverse agendas around shared challenges that were key to starting collaboration, but can also grow over time, strengthening ecosystem transformation.

International collaboration—particularly with the U.S. and Italian diplomatic representatives as well as with the Jacobs Technion–Cornell Institute at Cornell Tech, was central to gain access to global innovation networks, providing a concrete benchmark for evaluating alternative models of entrepreneurship education, incubation, acceleration, and university–industry collaboration. While these partnerships endowed the project with a distinctive transnational character, attracting interest from foreign investors, incubators, and accelerators, they did not seek to transplant standardized models but supported context-sensitive adaptations, helping participants critically assess how global frameworks could be tailored to territorial needs, and facilitating access to fellowships and grants, extending professional development opportunities beyond the formal scope of the project.

Local governments in rural areas played a particularly proactive role, supporting logistics, scouting entrepreneurs, and promoting community engagement and media outreach—ensuring both territorial anchoring and visibility at national and regional levels. Often

dismissed as weak or passive, mayors and municipal staff in participating localities displayed political vision and operational capacity: mobilizing stakeholders, identifying business leaders, and shaping workshop agendas. Their proactive involvement challenged prevailing narratives of left-behind places, illustrating how political ambition, coupled with pragmatic implementation, can foster territorial renewal.

Private sector partners reinforced the initiative's transnational and network-building goals by mobilizing entrepreneurial champions locally and across the New York metropolitan area both in the agri-food and aerospace industries. This expanding ecosystem fostered collaborative learning, peer exchange, and institutional experimentation (see Table A1 in Appendix A), but also exposed challenges of financial sustainability: while partners provided scholarships, infrastructure, and services in kind, securing stable resources beyond the initial seed grant remained difficult. Sustaining such a diverse coalition required balancing inclusivity with organizational focus and capacity.

4.3. *Applied Innovation*

The third causal pathway the initiative gave rise to consisted in applied innovation, understood in its broadest sense—not merely as the commercialization of research within a tech transfer deal, but the capacity to reconfigure institutions from within. As previously mentioned, for some participants, this meant considering the development of a startup after their PhD program or testing technologies in new environments (e.g., preventive maintenance from airplanes to agriculture, or drones applied in monitoring viticulture or in performing arts). For others, it meant shifting how public institutions approach local development to fight educational poverty, for instance, or how universities design their engagement strategies through inclusive performing arts throughout urban peripheries and rural villages.

A concrete opportunity emerged during the Altavilla Irpina workshop, where representatives from the Consortium for the Protection of Denominated Wines of Irpinia—an association of over 800 small and medium-sized wine producers—presented the Wine Villages Promotion Project, challenging young and emerging researchers to develop strategies for improving vineyard profitability in rural areas facing demographic decline, labor shortages, and the adverse effects of climate change.

What began as a broad exploratory idea among university researchers quickly gained momentum, evolving into a collaborative group activity that combined precision agriculture with social innovation to support the revitalization of denominated wine-producing villages. Participants engaged in the application of artificial intelligence, biotechnology, and drone systems to address real-world challenges in vineyard management and sustainability. For example, they examined the potential use of hydrogels to reduce water stress and improve irrigation in steep terrains, while exploring AI-enabled drone solutions for monitoring key stages of vine cultivation.

The group extended its focus beyond technical innovation to include the socio-economic dimensions of territorial development. Specific project proposals encompassed strengthening sustainable tourism by promoting arts and culture initiatives linked to vineyard landscapes, wine tasting, and viticulture traditions. Participants also envisioned expanding vocational training programs for both youth and older farmers, addressing ongoing socio-economic constraints such as rural depopulation and declining agricultural productivity. By combining technological solutions with the assessment of local needs, participants engaged with sustainable transitions, with the aim to bridge the gap between scientific research and community-based impact.

Although the initiative did not result in immediate funding for proof-of-concept development or social innovation ventures, the process increased participants' awareness—both

among researchers and wine producers—of what is involved in shifting from a research-oriented mindset to one oriented toward commercialization and business development. Importantly, experimentation enabled participants to recognize that technology-driven sustainable transitions required more than technical expertise and deployment. Sustainable transitions demanded negotiation, adaptation, and local acceptance to address specific territorial challenges effectively. Moreover, these experiences illuminated the critical role of risk awareness and uncertainty management in driving tech-driven sustainable transitions. These realizations marked a significant shift in how participants conceptualized technological solutions—not as a standalone intervention, but as part of a wider regional development strategy responsive to both place-specific challenges and systemic opportunities. Section 5 discusses these results considering regional planning and sustainability concerns.

5. Discussion

Grounded in a regional innovation ecosystem perspective, the *Pathways* initiative replaced the “transfer” paradigm with a “co-creation” logic, where innovation emerges through the interaction of diverse actors working across multiple scales. As mentioned earlier, three interrelated mechanisms guided this process as the levers through which innovation was activated in marginalized territories (see Figure 2). While other mechanisms might also be at play, these three collectively catalyzed novel practices that reshaped how innovation-driven EE was organized and assessed.

As shown earlier, Figure 3 reconstructed the *Pathways* logic model that situates EE within the socio-economic and political-institutional context [35], considering inputs, activities, outcomes, and mechanisms in relation to assumed durable ecosystem-based transformations. Key assumptions for this change to consolidate over time are detailed below:

- Researchers continue to benefit from access to diverse innovation ecosystems at multiple scales;
- Companies and startups show increased interest in university knowledge;
- Commercially relevant research is disclosed;
- University-business collaborations result from transdisciplinary knowledge creation and sharing that can also lead to patenting and licensing; and
- Local communities and institutions remain engaged in co-designing solutions through Responsible Research and Innovation (RR&I) [96].

As previously mentioned, the outcomes observed revealed critical enabling conditions for ecosystem development—flexible and patient funding, high-quality implementation, institutional autonomy, collaborative governance, firms’ absorptive capacity, and leadership committed to experimentation. As these conditions emerged through situated adaptation and institutional learning [3,11], the recursive logic highlighted thus far illustrates the range of actions universities can directly pursue, or undertake in partnership with other stakeholders, to advance ecosystem-based innovation strategies. Building on these considerations, three discussion points are relevant for designing EE programs that contribute to regional planning and sustainability.

5.1. From Individual Skills to Ecosystem-Oriented Pedagogy

EE must evolve beyond individual skill acquisition toward a transdisciplinary pedagogy that prioritizes problem solving and context-sensitive innovation for addressing sustainability challenges, such as climate adaptation, resource management, and socio-economic resilience [37,38,40,60]. The *Pathways* initiative showed how experiential learning rooted in real-world challenges can support cross-sector collaboration, trust-building, and the development of transversal skills, including critical reflection, and self-evaluation. This

vision seeks to revitalize peripheral territories not through linear technology transfer but through the long-term cultivation of codified and tacit knowledge, coupled with social innovation practices that cut across disciplinary, professional, and sectoral boundaries. Within this learning trajectory, EE can foster professionals capable of both advancing disciplinary knowledge and mobilizing it for territorial innovation and sustainability transitions. *Research-preneurs* embody this transdisciplinary perspective by integrating analytical rigor with practical problem-solving, while maintaining sensitivity to ethical and societal impacts [79,97].

International exposure reinforced this perspective by reframing peripheral regions as active nodes in transnational innovation systems. Diaspora networks illustrated how cultural affinity and shared identity can sustain global linkages [98], avoiding the risk of reproducing epistemic and governance hierarchies between incumbents and startups [68], between technical and social domains [99], and between North American and Southern European institutions. These risks are particularly recurrent in Greenfield FDI, where MNEs can heavily influence patenting and innovation trajectories [69]. Addressing such asymmetries requires reflexive EE designs attentive to political economy constraints.

5.2. Building Networks Through the Ecoregion Lens

Building networks requires EE to move beyond a firm-level focus and address systemic territorial challenges. Here, the ecoregion framework proved particularly valuable, as it overcomes the rigidities of conventional administrative boundaries by aligning innovation efforts with the interdependencies—environmental, economic, and socio-cultural—that shape territories [86].

By working at this functional scale, the *Pathways* initiative was able to anchor activities in place-specific assets while addressing broader systemic constraints. Within this framework, the university acted as a connective node—producing, translating, and circulating knowledge between local actors and global networks. Engagement with international R&D systems, especially in North America, activated global knowledge flows, while sustained dialogue with SMEs, cooperatives, municipalities, and cultural organizations enabled the co-design of territorially grounded innovation initiatives. For example, in Altavilla Irpina, discussions between agricultural cooperatives and researchers led to envision collaborative initiatives in sustainable viticulture across localities, and research groups, illustrating how the ecoregion lens can bridge local knowledge with global innovation circuits.

However, managing such heterogeneity raised challenges well-documented in network and transdisciplinarity research: balancing openness and closure, navigating cognitive diversity, and reconciling divergent rationalities [78,82,100]. Open networks expand access to diverse knowledge but often lack interpretive frameworks; closed networks facilitate trust and cohesion but risk redundancy [83,84]. *Pathways* balanced these logics: open ties (e.g., with diaspora and international experts) expanded horizons, while closed ties among experts within expert domains, developed through repeated collaboration, fostered trust and rapid interpretation [81,82].

Three levers were crucial to managing this diversity:

- Access to contextual knowledge, which situated technical expertise in territorial realities;
- Dense relational structures, which promoted trust and provided safe spaces for experimentation;
- Knowledge brokerage, where some participants translated insights across domains, preventing fragmentation and enabling workable solutions [101,102].

These dynamics align with broader findings in network research, which stress that ecosystems thrive when dense, trust-based ties intersect with heterogeneous expertise

and disciplinary diversity [101,102]. Importantly, knowledge brokerage was not limited to trainers: participants themselves often assumed coordination roles, ensuring that both specialized and general knowledge were integrated into collective outputs.

5.3. Applying Innovation Through Policy Alignment and Long-Term Ecosystem Capacity

Applying innovation depends on institutional capacity, sustained R&D investment, and multilevel policy frameworks that can nurture ecosystem-wide initiatives over time. The Irpinian Wine Villages Promotion Project illustrated two complementary logics of innovation: problem-driven innovation, based on structured, capacity-building processes for long-term optimization, and crisis-driven innovation, marked by rapid, adaptive responses to urgent disruptions. Problem-driven innovation is proactive, addressing systemic inefficiencies through incremental improvements in agricultural practices, sustainable business models, and production strategies—requiring data-driven planning and institutional coordination [103]. Crisis-driven innovation, by contrast, is reactive, relying on fast adaptation and experimental problem-solving, as shown using AI and drones to monitor water stress in real time, providing rapid, context-specific responses to climate-related challenges.

This dual logic highlights that while human capital development is essential, sustainable transformation also requires long-term capacity building. Yet entrepreneurial training, typically exploratory and place-based, remains misaligned with policy and financing approaches still tied to narrow performance metrics. Funding allocations based on patents, licenses, spinouts, and research excellence in publicly supported R&D—generally routed through universities or research centers—risk underfunding experimentations better suited to explore the complex realities of lagging regional ecosystems [33,35,41].

Consolidating promising small-scale advancements therefore requires sustained political commitment and long-term financial support to legitimize the educational ecosystem-based model, with universities playing a central role [64]. Financial sustainability is critical to building adaptive, outcomes-oriented capacity able to support diverse perspectives and portfolios of interventions that move beyond startup-focused funding logics [103]. On the demand side, incentives for researchers and entrepreneurs must generate reciprocal, tangible value through licensing, applied research collaborations, and firm-level innovation investments that deliver measurable socio-economic returns [35].

Together, the study findings provide actionable guidance for regional planners and policymakers seeking innovation strategies that are globally connected, locally embedded, and responsive to the socio-economic imperatives of sustainability.

6. Conclusions

This article has explored how place-sensitive and transdisciplinary entrepreneurship education can catalyze innovation and territorial regeneration in structurally disadvantaged regions. Through the *Pathways to Innovation and Entrepreneurship* initiative in Southern Italy, the study demonstrates that EE—when embedded in local ecosystems and supported by international networks—can strengthen human capital, expand institutional connectivity, and foster context-sensitive innovation.

The initiative positioned the university as an active knowledge broker within a multi-scalar ecosystem—linking global flows of expertise with localized needs and capacities. This g-local model challenges the dominance of corporate-driven innovation and illustrates how universities can help reimagine the role of peripheral regions in transnational R&I circuits.

However, the study also highlights persistent bottlenecks—financial, institutional, and cognitive—that hinder scaling and sustainability. Addressing these requires dedicated

investment, multilevel policy alignment, and the institutionalization of boundary-spanning roles that bridge academic, civic, and entrepreneurial domains.

For regional planners and policymakers, the findings suggest that EE should not be siloed as a university offering but incorporated into broader strategies for innovation and territorial cohesion. This includes recognizing ecoregions as planning units, integrating transdisciplinary learning into Smart Specialization strategies [34], and leveraging diasporic and international networks to overcome local path dependencies.

Ultimately, revitalizing peripheral areas depends not only on technical interventions but on fostering ecosystems of learning, trust, and co-creation. EE, if properly designed and resourced, offers a educational tool to activate these ecosystems and support inclusive, place-based innovation across Europe and beyond.

Although the study presents limitations as a time- and context-bound case study analysis, the relevance of its findings is both European and global. For Europe, it complements the competitiveness agenda by showing that investment in frontier technologies should be matched by the cultivation of pathways that connect innovation to slow-growing regions. For North America and other global contexts, the lessons resonate with universities struggling to balance global academic excellence with responsiveness to local needs [13]. At a time when inequality and disaffection undermine trust in institutions, this article demonstrates that universities—through innovation-driven entrepreneurship education—can act to transform global challenges into local opportunities of democratic engagement.

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Abbreviations

The following abbreviations are used in this manuscript:

- EE Entrepreneurship Education
- MNEs Multinational enterprises
- RIS Regional Innovation Scoreboard

Appendix A

Table A1. Partnerships and collaborations.

Academic and Cultural Partners	Private Profit and Non-For Profit Organizations	Institutional Supporters
Cornell Tech	Youbiquo	Municipality of Cava de’ Tirreni
City University of New York	DOCG Wine producers’ consortia in Irpinia	Municipality of Altavilla Irpinia
Columbia University	Foundation G. Morra	Municipality of Caggiano

Table A1. *Cont.*

Academic and Cultural Partners	Private Profit and Non-For Profit Organizations	Institutional Supporters
Long Island University	SVIMAR-Association for Southern Rural Areas Development	Italy's Consulate in New York
University of Aquila	ASMEL—Association for Subsidiarity and Modernization of Local Admin Institutions	Italian Trade Agency
University of Basilicata	Italy-America Chamber of Commerce in New York	OECD-EECOLE
University of Salerno	Mare Group	EIT—European Institute for Innovation and Technology
CUGRI	Naples' Union of Companies	US Mission to Italy
Academy of Fine Arts of Naples	DNA Maratea	AIRIcerca (Association of Italian Researcher in New York)
Italian Institute of Culture in New York	Meditech	
ISSNAF—Italian Scientists & Scholars in North America Foundation	I ³ :NYC—Italian Innovators Initiative	

Table A2. Key Performance Indicators (KPIs).

Stage	Indicator	Value
Immediate Outcomes (During Program)	Number of academic and outreach staff	5
	Number of training sessions (workshops, Summer School, informal meetings)	20
	Average number of attendees per event	50
	Total number of stakeholders engaged	>500
	Number of researchers involved	9
	Number of scientific fields represented	5
	Number of experts involved	26
	Number of companies involved	44
	Number of universities and research centers involved	10
	Number of localities participating in territorial workshops	13
	Number of partners engaged	22
	Funding secured (EUR)	47,800
	Additional in-kind support (EUR)	15,000
	Number of scholarships assigned for Summer School	8
	Scholarships assigned (EUR)	28,000
	Fees collected from external participants (EUR)	4000
	Number of evaluation questionnaires collected (mobile app)	15
	Percentage of international institutional partners	30%
	Percentage of international experts involved	50%
	Percentage of female university researchers in workshops	33%
Intermediate Outcomes (6–12 Months After Program)	Percentage of female participants in Summer School	46%
	Percentage of municipalities located in National Strategy for Inner Areas	85%
	Percentage of companies located in National Strategy for Inner Areas	48%
	Number of university-business partnerships continued after 6–12 months	1
	Number of fellowships participants obtained after program completion	2

Table A2. Cont.

Stage	Indicator	Value
Long-Term Outcomes (Sustainability Indicators)	Number of new university-business or institutional partnerships initiated	2
	Sustainability of the training offering delivery	1

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