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Entrepreneurship education, the digital divide, and AI readiness in Italy's Inner Areas: a secondary data analysis towards a model of territorial entrepreneurial engagement

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Abstract: Italy's Inner Areas combine demographic decline, distance from essential services, and uneven access to educational and digital opportunities. This study examines how entrepreneurship education, the digital divide, and emerging artificial-intelligence (AI) readiness intersect in these territories and develops a pedagogical model of Territorial Entrepreneurial Engagement (TEE). A secondary-data design integrates official and institutional sources at territorial, educational, and entrepreneurial levels, including the SNAI municipal classification, ISTAT indicators, INDIRE monitoring data, INVALSI open data, OECD-PISA evidence, Unioncamere-InfoCamere business-demography data, and the register of innovative start-ups. The analytical strategy combines descriptive comparison between Inner Areas and urban poles, correlational analysis of territorial digital skills and innovative youth entrepreneurship with demographic, educational, and macro-regional controls, and interpretive synthesis. Published aggregate evidence indicates a cumulative territorial divide: weaker digital skills and connectivity, persistent educational disparities, declining youth entrepreneurship, and a marked metropolitan concentration of innovative start-ups. These patterns support three testable hypotheses concerning overlapping disadvantage, spatially heterogeneous associations between digital capability and innovative youth enterprise, and the mediating role of education. The proposed TEE model links infrastructural enablement, competence development, authentic task design, and agency and belonging, reframing entrepreneurship education as a place-based pedagogy of engagement.

Keywords: entrepreneurship education; digital divide; AI literacy; territorial engagement; Inner Areas

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1. Introduction

Educational engagement is commonly treated as a multidimensional construct involving behavioural participation, emotional investment, and cognitive commitment. In contemporary media environments, however, engagement is also conditioned by the places in which educational and professional trajectories are imagined and enacted. Material infrastructures, access to services, local labour markets, educational provision, and community expectations shape whether young people can convert aspirations into viable courses of action. This territorial dimension is especially salient in Italy's Inner Areas, where distance from essential

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

services intersects with demographic decline, youth out-migration, and long-standing socioeconomic fragilities. The 2020 classification adopted within the National Strategy for Inner Areas (Strategia Nazionale per le Aree Interne, SNAI) identifies 3,834 municipalities as Inner Areas, corresponding to almost half of Italian municipalities, around 60% of the national territory, and approximately 13.2 million residents. These territories therefore constitute neither a residual nor a marginal object of inquiry; they represent a substantial part of the country and a crucial setting in which to examine the relationship between educational opportunity, digital equity, and agency. (Fredricks et al., 2004; Kahu, 2013)

The central argument of this study is that engagement in peripheral territories cannot be understood solely as an individual psychological disposition. It is also an ecological accomplishment, enabled or constrained by the interaction between learners, educational institutions, digital infrastructures, economic opportunities, and place-based cultures. We use the term territorial engagement to describe young people's capacity to imagine, design, and pursue meaningful educational, entrepreneurial, and professional trajectories that can remain connected to their territories of origin. This formulation does not imply that mobility is undesirable. Rather, it distinguishes freely chosen mobility from mobility experienced as the only credible route to advanced education, innovation, or professional fulfilment. When high-quality digital infrastructure, advanced training, innovative firms, and knowledge-intensive networks are concentrated in urban poles, engagement may become oriented primarily towards leaving the territory, reinforcing the demographic dynamics that place-based development policies seek to counteract. This ecological reading is consistent with place-based approaches that emphasise territorial assets, constraints, and institutional capacities (Barca, 2009; Barca et al., 2012; Rodríguez-Pose, 2018).

Within this perspective, the digital divide becomes a pedagogical as well as an infrastructural issue. Access to broadband remains important, but meaningful participation in digital society also depends on skills and on the capacity to translate digital resources into tangible educational, social, and economic outcomes. The diffusion of generative and predictive AI systems adds a further layer. AI readiness requires not only access to tools but also the competence to understand their capabilities and limits, use them responsibly, evaluate outputs critically, and connect them to purposeful learning and work practices. Unequal access to such competences risks producing a new multiplier of territorial inequality: places already disadvantaged in infrastructure and educational opportunity may also be disadvantaged in the ability to appropriate AI for local development. Digital-inequality research similarly distinguishes access, skills, uses, and tangible outcomes (Helsper, 2021; Scheerder et al., 2017; van Deursen & Helsper, 2015; van Dijk, 2005).

Entrepreneurship education offers a productive lens through which to investigate these dynamics. The European Entrepreneurship Competence Framework (EntreComp) defines entrepreneurship broadly as the capacity to act upon opportunities and ideas and transform them into value for others (Bacigalupo et al., 2016). This conception is compatible with an agentic view of human development, in which individuals exercise intentionality, forethought, self-regulation, and reflective capability in interaction with their environments (Bandura, 2001). Entrepreneurship education can therefore be understood not simply as

preparation for business creation but as a pedagogical setting in which learners identify problems, mobilise resources, collaborate with others, tolerate uncertainty, and produce socially meaningful value. In Inner Areas, these capabilities are particularly relevant when they are connected to authentic local challenges rather than taught as decontextualised employability skills. Evidence on entrepreneurship education further shows effects on intentions and attitudes that vary by pedagogy, prior exposure, context, and outcome measure (Bae et al., 2014; Fayolle & Gailly, 2015; Nabi et al., 2017).

The study has two linked aims. First, it develops a secondary-data strategy for mapping the relationship between educational conditions, digital capability, AI readiness, and youth entrepreneurship across Italy's territorial gradient. Second, it advances an integrated pedagogical model of Territorial Entrepreneurial Engagement (TEE) that specifies the conditions under which entrepreneurship education may support locally meaningful agency. The empirical component is deliberately framed as an analysis of existing official and institutional data; where municipal-level integration remains to be completed, the paper distinguishes published aggregate evidence from hypotheses to be tested. This distinction is essential to avoid interpreting descriptive territorial disparities as causal relationships.

2. Materials and Methods

2.1. Research design and unit of analysis

The study adopts a secondary-data research design integrating territorial, educational, and entrepreneurial indicators. The intended unit of analysis is the municipality wherever the source permits municipal georeferencing. Municipalities are classified according to the SNAI territorial taxonomy, which distinguishes poles and intermunicipal poles from belt, intermediate, peripheral, and ultra-peripheral municipalities on the basis of accessibility to essential services. For analytical purposes, the principal comparison contrasts urban/service poles with the municipalities included in the Inner Areas, while retaining the more detailed SNAI categories for sensitivity analyses. This approach is preferable to a simple North-South comparison because remoteness and service accessibility cut across macro-regional boundaries, even though their intensity and socioeconomic consequences are spatially uneven.

The design is ecological: it examines territorial distributions and associations rather than individual-level causal mechanisms. Consequently, municipal or regional indicators cannot be used to infer the skills, motivations, or entrepreneurial intentions of specific individuals. The analytical objective is instead to identify territorial configurations in which educational, digital, and entrepreneurial opportunities accumulate or diverge, and to use those configurations to inform a pedagogically grounded model of engagement.

2.2. Data domains and indicators

At the territorial level, the analysis draws on ISTAT sources, including the SNAI municipal classification, demographic structure, population change, educational attainment, and available indicators concerning household connectivity and digital skills. Particular attention is paid to measures that can capture both

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

infrastructural availability and effective capability. Because digital-skills indicators are not always available at municipal resolution, the analysis must explicitly document the geographical level of each variable and avoid artificial disaggregation. Where indicators are available only at regional or other aggregate levels, they are used for contextual comparison rather than treated as municipality-specific observations. This distinction is consistent with DigComp 2.2 and multi-level digital-divide research (European Commission, 2022; Scheerder et al., 2017).

At the educational level, the study integrates INDIRE monitoring data on educational innovation, INVALSI open data on learning outcomes and implicit dropout, and OECD-PISA evidence on the territorial distribution of student achievement and career expectations. These sources capture distinct but complementary dimensions. Achievement indicators provide information on accumulated learning opportunities; implicit dropout identifies students who formally complete schooling without reaching expected competence levels; and career expectations provide a window onto the relationship between educational experience and imagined futures. The analysis treats these indicators as contextual conditions rather than deterministic predictors of entrepreneurial behaviour.

At the entrepreneurial level, Unioncamere-InfoCamere Movimprese data are used to describe business demography and youth entrepreneurship, operationalised through enterprises led by people under 35 according to the definitions adopted in the source. The official register of innovative start-ups is used to identify the spatial distribution of firms operating within the relevant legal category. When municipal georeferencing is available, counts are converted into population- or business-stock-adjusted densities to reduce the mechanical influence of municipality size. The distinction between youth enterprise and innovative start-up is maintained throughout: the former captures age-related business participation, whereas the latter reflects a specific institutional category associated with innovation-oriented firms.

2.3. Analytical strategy

The analytical strategy is organised in three phases. Phase 1 consists of descriptive comparison across territorial categories. For each indicator, distributions are examined for urban poles and Inner Areas and, where data quality permits, for intermediate, peripheral, and ultra-peripheral municipalities separately. Descriptive statistics should include central tendency, dispersion, and distributional plots rather than relying only on national averages. Macro-regional stratification is used to determine whether the Inner Area gradient is independent of, or largely nested within, the broader North-Centre-South divide.

Phase 2 tests the association between territorial digital capability and innovative youth entrepreneurship. The primary hypothesis is that stronger digital capability is positively associated with the density of innovative youth enterprises. Models should control, as data availability permits, for demographic structure, population size or density, educational attainment, and macro-regional location. Because neighbouring municipalities are not statistically independent, spatial diagnostics are necessary before interpreting conventional regression estimates. If residual spatial autocorrelation is substantial, spatially robust or spatial regression specifications should be preferred. The analysis should also test non-linearity and interactions between digital capability and educational variables, since infrastructure may

produce different outcomes depending on the competence environment in which it is embedded. The modelling strategy is also informed by agency and entrepreneurial-intention research (Ajzen, 1991; Bandura, 2001; Liñán & Chen, 2009; Zhao et al., 2005).

Phase 3 consists of an interpretive synthesis. Quantitative patterns are read against the conceptual dimensions of entrepreneurship education, digital inequality, and place-based development to refine the TEE model. The purpose of this phase is not to infer causal pedagogical effects from aggregate data. Instead, it identifies plausible leverage points for educational design and generates propositions that can subsequently be investigated through school-level, learner-level, or mixed-method research.

2.4. Research hypotheses

Three hypotheses guide the municipal-level analysis. H1 proposes that gaps in connectivity, digital skills, educational outcomes, and innovative entrepreneurship overlap and mutually reinforce one another in Inner Areas, producing an engagement divide. H2 proposes that territorial digital capability is positively associated with the density of innovative youth enterprises, but that the strength of this association varies spatially; some Inner Areas are expected to show greater vitality than their structural conditions would predict. H3 proposes that educational variables constitute a critical mediating or conditioning layer, such that infrastructure alone is insufficient to explain entrepreneurial and innovation outcomes. These hypotheses are treated as empirically testable propositions rather than as conclusions already established by the aggregate evidence.

2.5. Ethical and methodological considerations

The study uses secondary, aggregate, and institutional data and does not involve direct intervention with human participants. Ethical attention nevertheless remains necessary. Territorial indicators can easily become instruments of deficit labelling, especially when peripheral areas are represented only through distance, scarcity, or underperformance. The analytical framework therefore avoids treating Inner Areas as homogeneous and interprets statistical disadvantage together with local resources, community capacity, and possible positive deviance. Data are used to inform educational design rather than to rank territories or naturalise structural inequalities. Any subsequent use of microdata or linked individual records would require compliance with the access, privacy, and ethical requirements applicable to those datasets.

3. Results

3.1. Published aggregate evidence: a cumulative territorial divide

The evidence currently available at aggregate level points to a cumulative rather than single-dimensional divide. On digital capability, ISTAT data for 2023 indicate that fewer than half of people aged 16-74 in Italy possess at least basic digital skills, a level below the European benchmark and characterised by marked territorial disparities (ISTAT, 2023). The disadvantage is more pronounced in southern regions and in smaller or less densely connected municipalities, categories in which

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

Inner Areas are disproportionately represented. Connectivity has improved through public investment, but peripheral and ultra-peripheral municipalities continue to face weaker conditions in ultra-broadband availability and effective access than the most connected urban areas. These patterns suggest that infrastructure and skills should be analysed jointly: connectivity without capability may have limited educational impact, while skills development is constrained when reliable access and advanced digital ecosystems are absent.

Educational indicators reveal a parallel geography. OECD-PISA 2022 results and INVALSI reporting document persistent territorial differences in learning outcomes, including a substantial North-South gradient (INVALSI, 2024; OECD, 2023). In some southern regions, levels of implicit dropout are also substantially above the national average. Inner Areas are especially exposed because territorial remoteness may combine with school-system fragility, demographic contraction, reduced access to specialised educational opportunities, and narrower local labour-market signals. The aggregate evidence does not demonstrate that remoteness itself causes lower achievement; rather, it identifies a cluster of conditions that may restrict the conversion of schooling into perceived future opportunities.

The entrepreneurial evidence adds a further layer. Youth enterprises represent less than one tenth of the Italian business stock and have declined over the last decade. Their relative incidence is nevertheless comparatively high in the Mezzogiorno. This apparent paradox requires caution: a high share of youth-led firms does not necessarily indicate a strong innovation ecosystem, because entrepreneurship may reflect necessity, limited wage-employment opportunities, sectoral composition, or family-business continuity. Innovative start-ups show a different spatial pattern. They are concentrated in metropolitan and economically dense territories; in the 2024 official reporting, Lombardy alone accounted for roughly one quarter of the national stock, with Milan representing the largest provincial concentration (Ministero delle Imprese e del Made in Italy, 2024). The contrast between relatively high youth entrepreneurship in parts of the South and metropolitan concentration of innovative start-ups reinforces the need to distinguish entrepreneurship quantity from the opportunity structure supporting innovation-oriented enterprise.

3.2. From aggregate patterns to testable territorial relationships

Taken together, these descriptive patterns are consistent with H1 but do not yet constitute a municipal-level test of it. The same territories can be disadvantaged across connectivity, digital competence, educational outcomes, and innovation, creating a plausible cumulative mechanism. Yet the geographical scales of the available indicators differ, and national or regional averages can conceal substantial within-area heterogeneity. A municipality-level integration is therefore necessary before claims about overlap can be quantified. The appropriate empirical question is not simply whether Inner Areas perform worse on average, but how frequently multiple disadvantages co-occur, which combinations are most consequential, and where exceptions emerge.

The published evidence also makes H2 plausible without establishing it. Digital capability can reduce transaction costs, expand access to knowledge and markets, enable remote collaboration, and increase the feasibility of knowledge-intensive entrepreneurship in geographically distant places. However, the expected

relationship should not be assumed to be uniform. Some peripheral territories may convert modest infrastructure into strong outcomes through effective schools, local networks, civic institutions, specialised production systems, or targeted development initiatives; others may possess connectivity without the educational or organisational capacity needed to generate innovation. Identifying such positive and negative deviations is analytically important because they can reveal mechanisms obscured by national averages.

H3 follows from the mismatch between technological availability and meaningful appropriation. If educational attainment, digital competence, and learning outcomes condition the relationship between infrastructure and entrepreneurial innovation, then policies focused exclusively on connectivity are unlikely to close the engagement divide. The empirical test should therefore examine whether educational variables attenuate, mediate, or interact with the association between digital conditions and innovative youth enterprise. Given the ecological design, any mediation language must remain statistical and provisional until individual- or organisation-level mechanisms are investigated directly.

4. Discussion

4.1. Territorial Entrepreneurial Engagement as an ecological construct

The emerging picture supports a reconceptualisation of engagement in Inner Areas as a territorial and ecological construct. Conventional accounts of educational engagement are indispensable for understanding participation, affect, and cognition, but they do not fully capture whether learners perceive locally viable pathways through which effort can become consequential action. Territorial Entrepreneurial Engagement addresses this gap by connecting agency to the opportunity structures of place. It asks whether young people can recognise opportunities, acquire relevant competences, access enabling infrastructures, collaborate with local actors, and imagine that acting in and for their territory can produce valued outcomes. The territorial dimension also resonates with place-attachment scholarship, which conceptualises person-place relations through affective, cognitive, behavioural, social, and physical dimensions (Scannell & Gifford, 2010).

The proposed TEE model comprises four interdependent dimensions. The first is infrastructural enablement: reliable connectivity and practical access to digital and AI tools. Infrastructure is a necessary enabling condition but not a sufficient educational outcome. The second is competence development: digital skills, AI literacy, and entrepreneurial competences such as opportunity recognition, creativity, resource mobilisation, planning, collaboration, and learning through experience. The third is authentic task design: educational activities anchored to real territorial problems and developed with enterprises, municipalities, cultural organisations, and third-sector actors. The fourth is agency and belonging: the development of territorial efficacy, understood here as the belief that purposeful action within and for one's territory is both possible and worthwhile. The model is multiplicative in spirit: weakness in one dimension can reduce the value generated by strength in another. AI literacy is treated as a capacity to understand, use, critically evaluate, and ethically engage with AI systems (Long & Magerko, 2020; Ng et al., 2021).

This framework extends entrepreneurship education beyond start-up production. From an educational standpoint, the principal value of entrepreneurial learning is its capacity to connect knowledge with consequential action. Authentic projects can ask students to investigate local service gaps, cultural assets, environmental challenges, food systems, tourism models, welfare needs, or digital-access problems; to work with real stakeholders; and to develop prototypes, services, communication strategies, or data-informed proposals. Such tasks make learning visible as a form of participation. They can also counter a deficit narrative in which peripheral territories are represented only as places from which talented young people should escape. This orientation is consistent with a critical pedagogy of place that connects educational activity to the social, ecological, and economic conditions of inhabited places (Gruenewald, 2003).

4.2. AI literacy and the risk of a new territorial divide

AI introduces both opportunity and risk into this ecology. For geographically peripheral learners and organisations, AI-enabled tools can potentially reduce some barriers to specialised knowledge, language support, content production, data analysis, and remote professional collaboration. At the same time, these benefits depend on infrastructure, critical digital competence, institutional guidance, and the capacity to evaluate reliability, bias, privacy implications, and appropriate use. If advanced AI use becomes concentrated in already advantaged schools, firms, and urban innovation networks, the technology may amplify rather than reduce territorial inequality. Unequal opportunities to develop AI literacy may therefore reproduce existing second- and third-level digital divides (Long & Magerko, 2020; Ng et al., 2021; van Deursen & Helsper, 2015).

For this reason, AI literacy should be treated as part of basic place-based educational capacity rather than as an optional specialist topic. A pedagogically adequate approach includes functional competence, critical evaluation, ethical awareness, and purposeful application. In entrepreneurship education, students should learn not merely to prompt generative systems but to decide when AI is useful, verify outputs against authoritative sources, document human responsibility for decisions, protect sensitive information, and assess whether automated solutions respond to actual community needs. These practices align AI readiness with agency rather than technological dependence.

4.3. Implications for educational policy and local development

Three implications follow. First, entrepreneurship education in Inner Areas should be designed as a pedagogy of engagement. Its success should not be evaluated only by the number of businesses created after a programme. Relevant outcomes also include opportunity recognition, collaborative problem solving, digital and AI competence, perceived self-efficacy, knowledge of local resources, and the capacity to build networks across schools, institutions, and enterprises. Such outcomes are educationally meaningful even when learners later choose employment, further study, public service, or mobility rather than business ownership. This broader outcome set responds to reviews showing that entrepreneurship education research has often privileged short-term intentions over behavioural, competence-based, and longer-term outcomes (Bae et al., 2014; Nabi et al., 2017).

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

Second, digital policy and educational policy should be coordinated. Broadband investment can remove a structural barrier, but the educational return on infrastructure depends on competence, curriculum, teacher development, organisational capacity, and access to authentic contexts of use. Conversely, ambitious digital and AI curricula are unlikely to produce equitable outcomes where connectivity and devices remain unreliable. The TEE framework therefore treats infrastructural enablement and competence development as mutually dependent rather than sequential policy domains.

Third, educational research should be connected more systematically to territorial statistics and local development policy. Municipal-level data can help identify where educational and entrepreneurial disadvantages accumulate, but quantitative mapping should be followed by contextual inquiry. Territories that outperform structural expectations are particularly valuable cases for qualitative investigation because they may reveal transferable mechanisms: school leadership, civic networks, intermunicipal collaboration, specialised local industries, community enterprises, or partnerships with universities. The aim is not to produce a league table of municipalities, but to support differentiated educational design.

4.4. Limitations and future research

The present study has several limitations. First, the empirical evidence reported here is primarily based on published aggregate indicators; the planned municipal-level integration and correlational testing are necessary before the three hypotheses can be evaluated directly. Second, the relevant datasets differ in geographical resolution, temporal coverage, definitions, and update cycles. Any merged database must therefore document harmonisation decisions and conduct robustness checks for alternative years and territorial aggregations. Third, measures of AI readiness are still less mature and less territorially granular than conventional connectivity or educational indicators. AI readiness should consequently be operationalised transparently and, where direct measures are unavailable, should not be inferred from broadband coverage alone.

Fourth, ecological associations cannot establish individual causal mechanisms. A positive relationship between territorial digital capability and innovative entrepreneurship would not show that digitally skilled young people themselves created the observed firms, nor would it establish the direction of causality. Innovative ecosystems may attract skilled residents and investment, while education and digital capability may also contribute to ecosystem formation. Future research should therefore combine municipal analysis with school-level and learner-level studies, longitudinal designs where feasible, and qualitative case studies of Inner Areas that show unexpectedly strong or weak outcomes.

A further priority is to operationalise Territorial Entrepreneurial Engagement itself. Future studies could develop and validate a multidimensional instrument measuring perceived local opportunity, entrepreneurial self-efficacy, digital and AI capability, access to enabling networks, belonging, and intention to create value in or for the territory. Such an instrument should be complemented by behavioural and contextual indicators to avoid reducing engagement to self-report. Mixed-method designs could then examine how educational interventions alter both learner agency and relationships between schools and local ecosystems. Instrument development could build on entrepreneurial-intention and self-efficacy measures (Liñán & Chen,

2009; Zhao et al., 2005), while incorporating place attachment (Scannell & Gifford, 2010), digital outcomes (van Deursen & Helsper, 2015), and AI-literacy dimensions (Long & Magerko, 2020; Ng et al., 2021).

5. Conclusions

Italy's Inner Areas provide a critical setting for examining how educational opportunity, digital inequality, and entrepreneurial agency interact. The aggregate evidence reviewed in this study suggests that digital-skills gaps, uneven connectivity, educational disparities, and the metropolitan concentration of innovative enterprise can overlap in ways that narrow the range of futures perceived as locally attainable. These patterns should not be interpreted as evidence of territorial incapacity. They instead indicate that engagement depends on an ecology of conditions that can be strengthened through coordinated educational, infrastructural, and development action.

The Territorial Entrepreneurial Engagement model offers a pedagogical synthesis organised around infrastructural enablement, competence development, authentic task design, and agency and belonging. Its central proposition is that entrepreneurship education in peripheral contexts should be evaluated by its capacity to enlarge meaningful agency, not merely by its capacity to generate start-ups. In this perspective, digital and AI literacy are not add-on technical skills but components of territorial citizenship and economic participation. The next empirical step is to test the proposed hypotheses through harmonised municipal-level data and then investigate the mechanisms behind territorial exceptions through mixed-method research. Such work can contribute to a place-based educational policy in which data are used to design opportunity rather than to classify disadvantage.

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