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Evaluating Innovative Entrepreneurship as Public Policy: Evidence from Brazil's Federal Education Network

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Abstract

This study evaluates the outcomes of the Innovative Entrepreneurship Project (IEP), implemented by the Brazilian Ministry of Education (MEC), with the aim of assessing its effectiveness in fostering innovation and entrepreneurship within institutions of the Federal Network of Professional, Scientific, and Technological Education. A mixed-methods approach was adopted, combining survey data from all funded projects with in-depth interviews and secondary document analysis. This triangulation enabled a comprehensive assessment of the initiative across multiple dimensions, including infrastructure, competencies, innovation outputs, and entrepreneurial outcomes. The findings indicate that the IEP significantly strengthened research infrastructure, enhanced scientific and technological capabilities, and contributed to the dissemination of an entrepreneurial culture. It also promoted the development of both technical and behavioral competencies among participants. However, results related to commercialization and startup creation were limited, revealing constraints in translating research into market-oriented outcomes. The study identifies a misalignment between policy design and institutional capacity. While the policy emphasized entrepreneurship and market-oriented outcomes, participating institutions remain primarily oriented toward teaching and research. These findings highlight structural challenges in implementing innovation policies in emerging economies and suggest that future initiatives should prioritize ecosystem integration, entrepreneurship education, and stronger mechanisms for technology transfer and market engagement.

Keywords: Innovative Entrepreneurship; Public Policy; Innovation Policy; Emerging Economies; Brazil; Technology Transfer

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1. Introduction

Entrepreneurship is broadly understood as the process of generating value through the creation or expansion of economic activities, often involving the exploration of new products, processes, or markets (Rauch et al., 2009). A key distinction within this field lies in the role of innovation. While traditional forms of entrepreneurship may focus on incremental improvements or survival-oriented activities, innovative entrepreneurship is characterized by its capacity to generate novel solutions, disrupt existing markets, and operate under conditions of high uncertainty (Librelon, 2014; Gianesini et al., 2018; Ries, 2017).

The intersection between innovation and entrepreneurship, commonly referred to as Innovative Entrepreneurship (IE), has gained increasing relevance in both academic and policy debates. It integrates elements of technological development, business creation, and creative problem-solving, positioning itself as a critical driver of economic growth, job creation, and competitiveness (Balkienė & Jagminas, 2010; OECD, 2018). This relevance is particularly pronounced in emerging economies, where innovation-driven entrepreneurship is often seen as a pathway to overcoming structural constraints and fostering sustainable development (Szabo & Herman, 2012).

In recent decades, governments around the world have incorporated IE into their policy agendas, seeking to stimulate the emergence of high-growth, technology-based ventures, often referred to as "techno-starters" (Lundström & Stevenson, 2005; Dahlstrand & Stevenson, 2010). These initiatives typically aim to strengthen research capabilities, promote knowledge transfer, and encourage closer interaction between academia, industry, and government.

Brazil presents a particularly interesting case in this context. Although the country exhibits high levels of entrepreneurial activity, a significant portion of this is driven by necessity rather than opportunity (Ogliastri et al., 2019). As a result, many ventures lack an innovation component and present limited scalability. Despite the existence of multiple policies aimed at promoting innovation, national indicators suggest that progress has been slow and, in some cases, stagnant (de Negri et al., 2020; Koeller, 2017). This scenario reflects a broader challenge: the difficulty of translating policy efforts into effective innovation outcomes.

In response to these challenges, the Brazilian Ministry of Education (MEC) launched, in 2020, the Innovative Entrepreneurship Program (IEP), its first initiative explicitly designed to integrate entrepreneurship and innovation within the Federal Network of Professional,

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Scientific, and Technological Education (Rede Federal de Educação Profissional, Científica e Tecnológica - RFEPCT). Through a public call, the program funded 60 projects across 31 institutions, covering all regions of the country and focusing on strategic areas associated with Economy 4.0. By November 2022, these projects had been completed, providing students and faculty members with opportunities to develop startups and innovative solutions aligned with the emerging digital economy, the "new entrepreneurial paradigm" (Rippa & Secundo, 2019).

Given the growing importance of IE and the limited empirical evidence on the effectiveness of related policies in developing economies, this study aims to assess the outcomes of the Brazilian IEP. In particular, it evaluates whether the initiative contributed to creating an enabling environment for innovation and to fostering entrepreneurial outcomes within educational institutions. Accordingly, this study addresses the following research question: To what extent did the Brazilian IEP contribute to fostering innovation and entrepreneurial outcomes within Federal Network institutions?

By addressing this question, the study advances the literature in three main ways: (i) by providing empirical evidence on the implementation of innovative entrepreneurship policy in an emerging economy; (ii) by identifying a misalignment between policy design and institutional capacity; and (iii) by offering policy-relevant insights for improving innovation ecosystems in developing contexts.

The analysis is based on a combination of survey data, interviews with project coordinators, and secondary sources, allowing for a comprehensive assessment of the initiative.

2. Literature Review

2.1. The evolution of innovation and entrepreneurship policies

Innovation is widely recognized as a fundamental driver of economic growth and competitiveness. However, it is inherently complex, dynamic, and uncertain, involving nonlinear processes, feedback loops, and cumulative learning (National Research Council, 1986; Freeman & Soete, 2008; Pavitt, 2009; Kline & Rosenberg, 1986). Rather than occurring in isolation, innovation takes place within systems that require coordination among multiple actors, continuous knowledge exchange, and effective management (Sirilli, 1998), particularly in an increasingly globalized economic and scientific environment. This systemic perspective emphasizes the interdependence between firms, universities, research institutes, and government agencies, each fulfilling complementary roles in knowledge generation, diffusion, and commercialization processes (Cario et al., 2023).

Public policies emerge as a key mechanism for structuring and sustaining these interactions. Since the mid-twentieth century (particularly in the post-World War II period), governments have increasingly recognized the strategic importance of Science, Technology, and Innovation (STI) for long-term economic development (OECD, 1992). This recognition led to the establishment of institutional frameworks and policy instruments designed to stimulate technological advancement and enhance national competitiveness (Velho, 2011).

Over time, innovation policies have evolved from linear models, based on a straightforward progression from research to market, to systemic approaches that emphasize fostering cooperation and coordinated innovation efforts across institutional actors. This shift is reflected in the growing adoption of national innovation systems frameworks, which highlight the importance of networks, institutions, and learning processes in shaping innovation outcomes (Edler & Fagerberg, 2017; Cario et al., 2023).

In this perspective, innovation is understood as a collective and interactive process, in which public policies support and coordinate relationships within the innovation ecosystem, particularly where institutional articulation is critical for innovation performance (Cario et al., 2023).

Entrepreneurship has also gained prominence as a policy concern. Rooted in Schumpeterian theory, it is closely linked to innovation, as entrepreneurs introduce new combinations of resources and technologies into the market (Schumpeter, 2000). As a result, many countries have expanded their policy focus beyond innovation support to include the promotion of entrepreneurial activity, particularly in high-growth, technology-based ventures.

In many cases, innovation and entrepreneurship policies have become increasingly intertwined, giving rise to approaches often referred to as "innovative entrepreneurship policies" (Dahlstrand & Stevenson, 2007, 2010). These policies seek to bridge the gap between knowledge generation and market application, promoting the creation of startups, facilitating technology transfer, and strengthening linkages between research institutions and industry.

Recent analyses of global STI policy trends indicate a growing emphasis on IE as a strategic priority. In addition to traditional areas such as public research systems and STI governance, governments are increasingly focusing on fostering entrepreneurial ecosystems that support innovation-driven ventures (Vonortas & Castillo, 2022).

Despite these advances, there is still limited empirical evidence on the effectiveness of integrated policy instruments in emerging economies, particularly within educational systems.

Moreover, in the Latin America context, innovation policies must be adapted to local socio-economic and institutional conditions, requiring flexible and context-sensitive policy designs capable of addressing structural constraints (Cario et al., 2023). This study addresses this gap by providing an empirical evaluation of a nationwide initiative implemented in Brazil.

2.2. Innovation and entrepreneurship policies in Brazil

Brazil has a long-standing trajectory of public investment in STI, with significant developments dating back to the mid-twentieth century. Historically, science and technology policies in Brazil were primarily oriented toward expanding the supply of knowledge, with limited integration with the productive sector. Over time, this approach proved insufficient to generate significant innovation outcomes, highlighting the need for stronger interaction between academia and industry (Borges et al., 2021).

The 1950s marked a critical turning point, as the federal government began to prioritize the development of research and education infrastructure (Pelaez et al., 2017). Key institutions such as the National Research Council (CNPq) and the Coordination for the Improvement of Higher Education Personnel (CAPES), both established in 1951, played a foundational role in shaping the country's scientific and academic landscape.

CNPq has historically supported research activities through funding mechanisms, scholarships, and institutional grants, contributing to the advancement of scientific knowledge across multiple disciplines. CAPES, in turn, has focused on improving the quality of higher education, particularly through the expansion and strengthening of postgraduate programs and the qualification of academic staff. Together, these institutions have been instrumental in consolidating Brazil's research capacity.

In parallel, the Brazilian Development Bank (BNDES) was established to provide financial support for economic development, including initiatives related to innovation and technological advancement. By facilitating access to capital, BNDES has contributed to fostering innovation within firms and supporting strategic sectors of the economy.

The institutionalization of STI policies gained further momentum in the 1960s with the creation of the Brazilian Innovation Agency (FINEP) in 1967 and the National Fund for Scientific and Technological Development (FNDCT) in 1969. These initiatives signaled a growing political commitment to innovation as a driver of development (Herrera, 1973; Velho, 2011). However, this trajectory was not linear. During the 1970s, external economic crises led to a reduction in public investment in STI (Pelaez et al., 2017), highlighting the vulnerability of innovation policies to broader macroeconomic conditions.

A renewed emphasis on STI emerged in the 1980s and 2000s, particularly with the creation of the Ministry of STI and the adoption of systemic approaches to innovation policy. These developments were accompanied by efforts to strengthen university-industry collaboration, recognizing the importance of knowledge transfer and applied research (Rapini, 2007; Gielf et al., 2017).

A major milestone in this process was the enactment of the Innovation Law (Law No. 10.973/2004), which established a legal framework to promote collaboration between universities, research institutions, and firms (Alves et al., 2015; Brasil, 2004). The law introduced mechanisms to facilitate technology transfer, intellectual property management, and partnerships between public and private actors (Lotufo, 2009). It also mandated the creation of Technology Transfer Offices (TTOs), institutionalizing structures dedicated to managing innovation and fostering collaboration within the national innovation system, in alignment with the Triple Helix model proposed by Etzkowitz and Leydesdorff (1995).

Subsequent regulatory developments, including Decree No. 9.283/2018, further reinforced this framework, providing greater flexibility for partnerships and emphasizing the strategic role of innovation in national development. In addition, fiscal incentives such as the "Law of Good" (Law No. 11.196/2005) were introduced to stimulate private-sector investment in research and development.

More recently, the Brazilian National Innovation Policy (NIP), established by Decree No. 10.537 in 2020, represents a significant effort to strengthen innovation and competitiveness at the national level. Developed by the Ministry of Science, Technology and Innovation (MCTI) in coordination with actors from the Brazilian National System of Science, Technology and Innovation (SNCTI), the policy explicitly addresses structural weaknesses in the articulation between research, higher education, and innovation performance.

In addition to institutional frameworks, Brazil has implemented several national programs aimed at fostering entrepreneurship and innovation (Aranha, 2016). Initiatives such as the Entrepreneurial Brazil Program and Startup Brazil have provided financial support, training, and ecosystem development mechanisms. For instance, Startup Brazil, launched in 2013, supported more than 180 companies through a public-private partnership model, highlighting the government's efforts to stimulate technology-based ventures (Roncaratti, 2017). Recent federal initiatives, such as the Embrapii-Sebrae Program and Conecta Startup, combine financial support, acceleration services, and network-building mechanisms, illustrating a shift toward more systemic and integrated policy instruments designed to foster interaction among firms, research institutions, and other actors within the innovation ecosystem (Roncaratti, 2017; Borges et al., 2021). In parallel, innovation habitats such as business incubators have played an important role in supporting entrepreneurial activity. Evidence suggests that incubators integrated with science and technology institutions contribute significantly to the development of IE (Carmo & Costa, 2016)[1].

Despite these advances, the Brazilian innovation system continues to face significant structural challenges. While the country has developed a relatively robust institutional framework for STI policies (CGEE, 2016), innovation outputs remain limited, and university–industry linkages are still weak (Fernandes et al., 2010).

In addition, bureaucratic barriers, high operational costs, and limitations in entrepreneurship education continue to hinder the development of innovation-driven ventures (Degen & Harkiolakis, 2018; Sela, 2006). These challenges are explicitly recognized in national strategies such as the National Strategy of Science, Technology, and Innovation (ENCTI) (2016–2022), which outlines key priorities including improving institutional conditions for innovation, reducing regional inequalities, and promoting sustainable development (MCTIC, 2016).

[1]By 2016, Brazil had 369 active incubators, supporting over 2,300 companies and generating more than 53,000 direct jobs, with estimated revenues of approximately R$15 billion (ANPROTEC, 2016).

Taken together, this context reveals a paradox: despite the existence of a comprehensive policy framework and a growing entrepreneurial ecosystem, the interaction between ACADEMIA and the productive sector in Brazil remains limited, which continues to constrain the effectiveness of innovation policies and knowledge transfer processes (Borges et al., 2021). It is precisely within this gap that the IEP emerges as a relevant policy instrument, seeking to integrate innovation and entrepreneurship within the Federal Network institutions.

3. The Brazilian Innovative Entrepreneurship Project (IEP)

3.1. Objectives

The IEP was designed as a public policy instrument aimed at fostering innovation and entrepreneurship within institutions of the RFEPCT. The initiative was structured through a public call for proposals, allowing eligible institutions to submit projects focused on applied research and entrepreneurial development.

The primary objective of the program was to support the creation and development of innovative ventures aligned with the so-called Economy 4.0. This included technological domains such as the Internet of Things (IoT), Big Data, Artificial Intelligence, and digital transformation processes. In doing so, the policy sought not only to stimulate technological innovation but also to promote an entrepreneurial mindset within educational institutions.

More specifically, the initiative aimed to: (i) strengthen research and innovation capabilities within the Federal Network; (ii) encourage the development of technology-based solutions with market potential; (iii) foster the emergence of startups and innovative businesses; and (iv) integrate education, research, and entrepreneurship within a unified policy framework.

3.2. Structure and governance

The IEP was implemented through a governance structure involving multiple institutional actors, reflecting a systemic approach to innovation policy. Financial support was provided in the form of Research, Development, and Innovation (RD&I) grants, as well as resources for infrastructure, equipment, and operational activities.

The Secretariat of Professional and Technological Education (Setec/MEC) played a central role in coordinating the initiative, overseeing its implementation, articulating the program across participating institutions, and ensuring alignment with national education and innovation policies.

The RFEPCT itself represents a key component of the policy's institutional framework. Established in 2008, it comprises a nationwide network of institutions dedicated to professional and technological education, with a strong emphasis on applied research and regional development. Its decentralized structure allows for the dissemination of innovation activities across diverse territorial contexts[2].

In addition to governmental actors, the project involved important partner organizations. The Brazilian Support Service for Micro and Small Enterprises (SEBRAE) played a crucial role in providing training, mentoring, and consultancy services, particularly in areas related to business development and market orientation. This contribution was fundamental in bridging the gap between academic research and entrepreneurial practice.

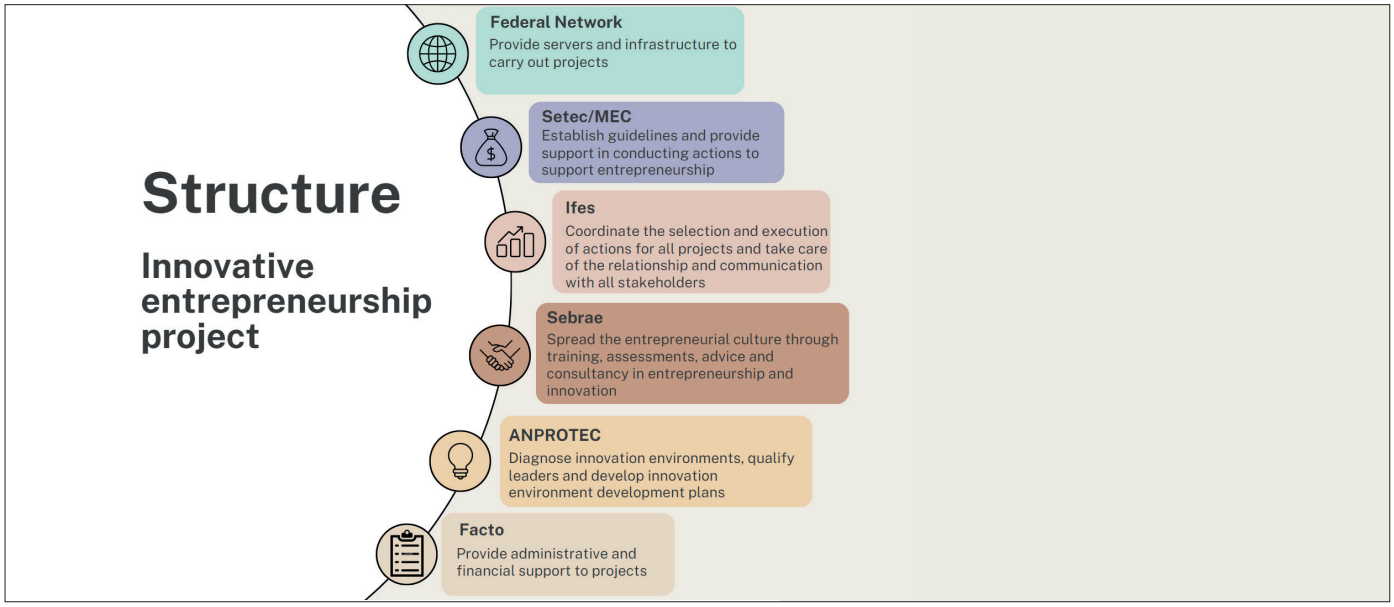
The National Association of Entities Promoting Innovative Ventures (Anprotec) also contributed by supporting the development and management of innovation environments. Its activities included maturity assessments and training programs aimed at strengthening institutional capacities for innovation management.

Furthermore, the Science and Technology Development Support Foundation (Facto) was responsible for providing administrative and financial support, ensuring the efficient allocation and management of resources.

Overall, the governance model is characterized by a multi-actor arrangement involving government agencies, educational institutions, and intermediary organizations. This configuration reflects a Triple Helix logic, emphasizing coordination between academia, government, and support entities, and highlights the importance of institutional articulation for the effective implementation of innovation policies (see Figure 1).

[2]The Federal Network was established in 2008 by Law No. 11.892 (Brasil, 2008) and is part of the federal education system under the MEC. It comprises 64 educational organizations of various types and is present in the country`s 27 federative units with 661 institutions.

Figure 1. Governance structure of the Innovative Entrepreneurship Project



Source: prepared by the authors.

3.3. Approved projects and participants

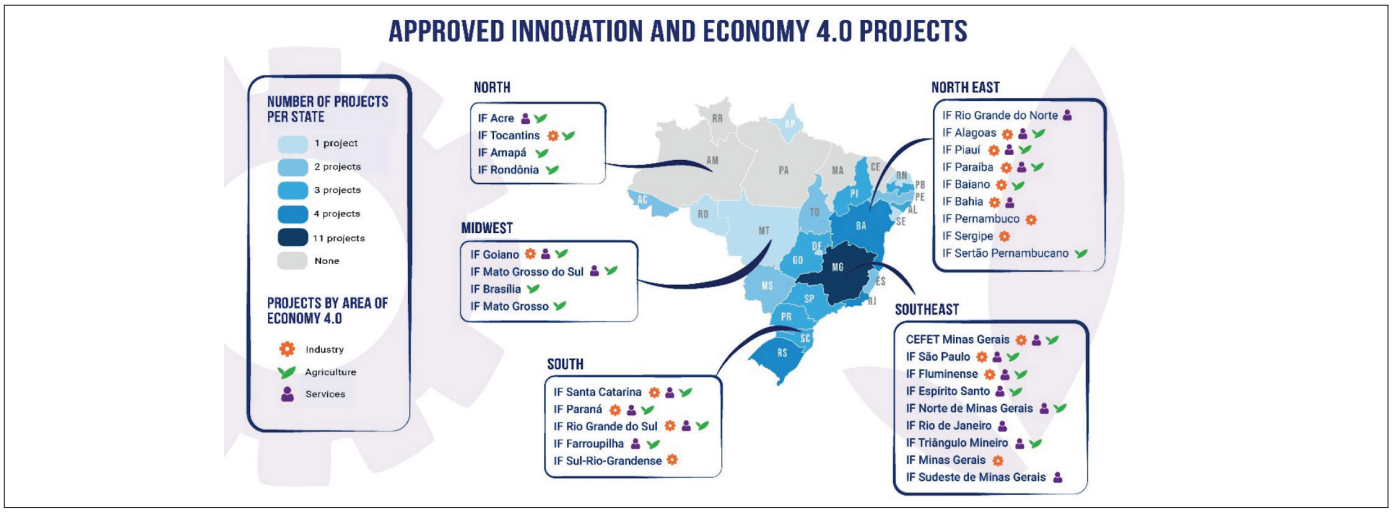
The IEP funded a total of 60 projects distributed across 31 institutions within the Federal Network, covering all five Brazilian macro-regions. As shown in Figure 2, there is a concentration of projects in the Southeast region, which accounted for 18 projects (30% of the total), with a particular emphasis on the state of Minas Gerais, responsible for 9 projects (15%). This distribution reflects both the higher density of institutions in this region and its relatively stronger research and innovation capacity.

The Northeast region also presented significant participation, with 17 projects (28%), indicating that the initiative was able to reach less economically developed areas and contribute to regional diversification. Overall, the geographical distribution suggests that, while existing institutional capacity influenced project concentration, the policy also achieved a certain degree of territorial diffusion.

In addition to their geographical distribution, the projects were aligned with different domains of Economy 4.0. Of the total, 23 projects (38.3%) were related to Agriculture 4.0, 17 (28.3%) to Industry 4.0, and 20 (33.4%) to Services 4.0. This distribution highlights the diversity of application areas and the relevance of digital and data-driven technologies across multiple sectors.

Importantly, all approved projects were required to develop both a research component and a business plan. The initiatives were designed for a 24-month implementation period and involved students and faculty members in the development of solutions oriented toward the creation of innovative products, services, or business models. These solutions were expected to be aligned with local demands while simultaneously contributing to technological advancement within the scope of Economy 4.0.

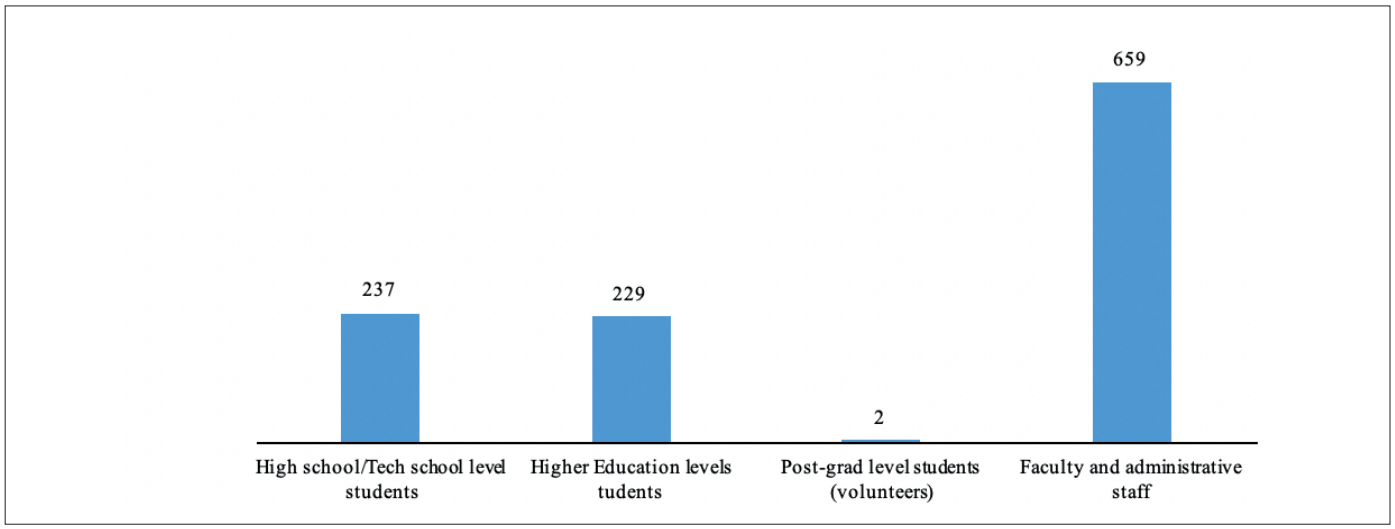
Figure 2. Distribution of the 60 approved projects in the IEP



Source: prepared by the authors.

As illustrated in Figure 3, the program mobilized 1,127 individuals, with a strong presence of high school and undergraduate students, alongside faculty and staff.

Figure 3. Individuals involved in the 60 approved projects

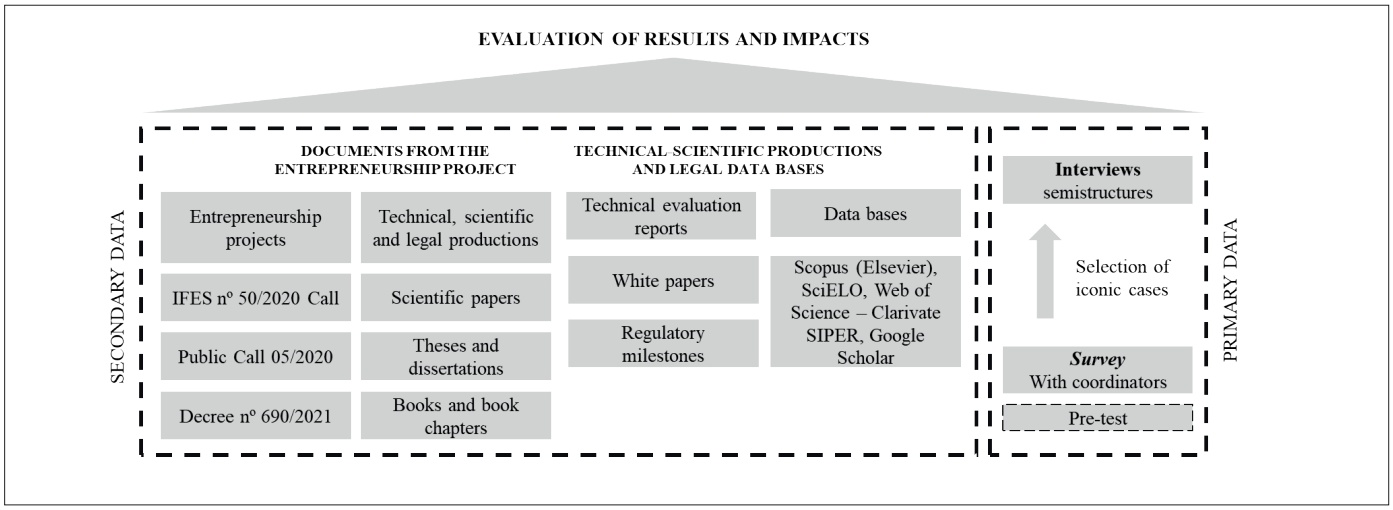


Source: prepared by the authors.

4. Methodology

To evaluate the outcomes of the IEP, this study adopted a mixed-methods approach, combining quantitative and qualitative data sources in a triangulated research design (Figure 4).

Figure 4. Data sources and evaluation techniques



Source: prepared by the authors.

The analysis draws on both primary and secondary data. Secondary data include official documents related to the IEP, as well as scientific, technical, and legal literature addressing innovation and entrepreneurship policies.

Primary data were collected through two main instruments: a structured survey and in-depth interviews. The survey was administered using an online platform and consisted of 28 closed-ended questions, some of which included optional fields for qualitative comments.

The questionnaire was structured into thematic categories designed to capture different dimensions of the IEP, including profiling, perception, RD&I resources, institutional arrangements, and spillover effects. Prior to data collection, the questionnaire was pre-tested with a small group of researchers and practitioners familiar with innovation and entrepreneurship projects. This procedure aimed to ensure clarity, relevance, and internal consistency of the instrument. Based on feedback obtained during this stage, minor adjustments were made to the wording and structure of selected questions before the final application.

Table 1 presents the analytical categories and their respective objectives, providing an overview of how the survey instrument was structured and aligned with the evaluation framework.

Table 1. Categories of analysis and objectives

Category	Objective of the questions
Profiling	To profile respondents, projects and institutions
Perception	To capture the coordinators' view on innovative entrepreneurship, the public call instrument and the promotion strategy as a whole, its priorities, selection criteria, assumptions, operationalization and convergence with other initiatives/programs/policies.
RD&I resources	To evaluate the set of physical facilities and material support conditions – equipment, resources, inputs and services – used by researchers to carry out RD&I activities, including possible costs related to the installation and adequacy of equipment allocated to the institutions. The questions aimed to assess the coordinators' level of satisfaction with the human, financial and technological resources funded by the Innovative Entrepreneurship Project for the implementation of their Business Plans and Research Projects.
Political-institutional arrangement	To evaluate the established institutional arrangement, the role of the agents involved in the implementation and management of the program and the respective counterparts.
Spillovers	Identify achieved results and impacts (direct, indirect, foreseen and unforeseen) with the development of projects, in the various dimensions of Economy 4.0 and in society.

Source: prepared by the authors.

Importantly, all project coordinators responded to the survey, resulting in a census of the 60 funded projects. This full coverage enhances the reliability and representativeness of the quantitative findings.

To complement the survey data, six in-depth interviews were conducted with selected project coordinators. The selection followed a purposive sampling strategy, aiming to capture diversity in project outcomes and experiences. Criteria included variation in levels of innovation generation, knowledge dissemination, intellectual property outcomes, and competency development. The interviews provided deeper insights into the processes underlying the observed results, allowing for a more nuanced understanding of both achievements and challenges.

The participants represent different institutions within Brazil's Federal Education Network, including Federal Institutes and a Federal Center for Technological Education, located across the Northeast, North, and Southeast regions of Brazil. In terms of demographic profile, the group is predominantly male (five out of six participants), with one female coordinator, and includes individuals aged between 30 and 44 years. Regarding racial background, three participants self-identified as brown (parda), two as white, and one as black. All participants hold academic positions as professors in technical and technological education (EBTT), with academic qualifications including four doctoral degrees and two master's degrees in fields such as engineering, chemistry, education, and computer science.

Survey results were analyzed using descriptive statistics, while interview data were examined through qualitative content analysis. This approach enabled the identification of recurring patterns, themes, and explanatory factors.

5. Results

The results of the IEP reveal a multifaceted set of outcomes related to research development, human capital formation, innovation activities, and entrepreneurial dynamics within the Federal Network institutions.

5.1 R&D infrastructure

Survey data indicate that approximately 91% of respondents perceived a positive impact on research infrastructure. As illustrated in Figure 5, most coordinators evaluated the adequacy of infrastructure, human resources, and technological resources as either "adequate" or "completely adequate", both for research projects and business plan development.

This perception suggests that the IEP was successful in providing the necessary conditions for the execution of RD&I activities. In particular, the high levels of satisfaction with technological and infrastructure resources indicate that the financial support effectively addressed critical bottlenecks that previously limited innovation activities within the institutions.

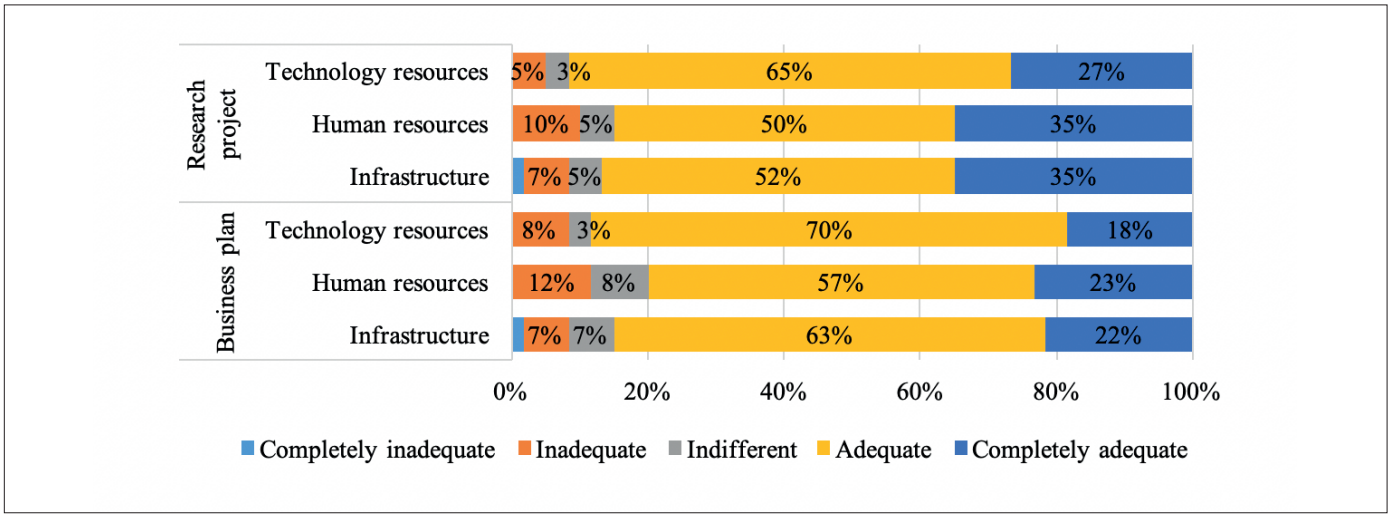
Beyond this overall assessment, qualitative evidence reveals that the development of R&D infrastructure occurred in three distinct ways. First, the funding enabled the establishment of previously nonexistent or deficient research environments, in some cases resulting in the creation of new laboratories. These spaces often became important institutional assets and, in some cases, were recognized as regional references in Economy 4.0-related research.

Second, the resources supported the acquisition of project-specific materials and equipment, such as data servers, sensors, and digital tools, enabling the continuity and consolidation of research activities.

Third, more advanced technological resources were incorporated, including 3D printers and high-performance computing equipment, significantly enhancing the material capacity of institutions to support research and develop new projects and partnerships.

However, despite these positive assessments, qualitative evidence from interviews highlights challenges related to procurement processes and administrative constraints. Delays in acquiring equipment and bureaucratic procedures were identified as factors that partially affected project execution, suggesting the need for more agile operational mechanisms in future policy designs.

Figure 5. Assessment of the adequacy of inputs provided for the development of research projects and business plans



Source: prepared by the authors.

5.2 Development of competencies and entrepreneurial culture

The IEP contributed significantly to the development of a wide range of competencies among participants, encompassing technical, intellectual, and behavioral dimensions. Beyond the acquisition of knowledge directly related to project domains (such as industry, agriculture, and services), the initiative generated indirect benefits associated with personal development, problem-solving abilities, and innovation-oriented skills.

Among student, participation in the projects enabled engagement in entrepreneurship and innovation activities that are rarely addressed in traditional curricula. Through hands-on experiences, students developed the ability to identify real-world problems and design practical solutions, strengthening their analytical and creative capacities. In addition, several respondents highlighted improvements in self-confidence, communication skills, and critical thinking.

Participation in the IEP also influenced students' career perspectives. Exposure to innovation and entrepreneurial practices led many participants to consider alternative professional paths beyond traditional employment, including entrepreneurship and research-based careers. In many cases, interaction among team members also fostered the development of social and emotional competencies, such as collaboration, empathy, and the exchange of cultural experiences, further enriching the learning process.

Among faculty members, the project contributed to the development of managerial and organizational competencies. Coordinators were required to engage in planning, organizing, and leading multidisciplinary teams, often managing financial and human resources on a scale that exceeded their previous experience. For many, this represented their first opportunity to lead projects of this magnitude.

The involvement of external partners, particularly SEBRAE, also played a key role in competency development. Continuous support from these institutions contributed to enhancing participants' knowledge of entrepreneurship, innovation management, and intellectual property. Researchers reported that this experience enabled them to better understand business models, market dynamics, and the broader context in which innovations are developed and applied.

Moreover, participation in the project led to a shift in how researchers perceive their own work. Beyond traditional academic outputs, such as publications, participants reported a growing awareness of the potential for transforming research results into market-oriented products and services.

In addition to individual learning outcomes, the project also contributed to the dissemination of an entrepreneurial and innovation-oriented culture within participating institutions. Training activities, mentoring sessions, and especially the organization and participation in events (such as workshops, seminars, and conferences) played an important role in promoting knowledge exchange and engagement with innovation practices. More than 60% of respondents reported involvement in organizing such events, indicating an active role in spreading these practices within their institutional environments.

The project also stimulated closer collaboration among different actors in the innovation ecosystem, including universities, firms, cooperatives, public agencies, and support organizations. These partnerships facilitated the exchange of knowledge and experiences, while increasing exposure to real-world challenges and opportunities.

Participation in external events further reinforced this process, allowing project teams to interact with startups, investors, and funding agencies. These experiences contributed to broadening participants' perspectives and strengthening their understanding of how innovation operates in practice, beyond the academic context.

Overall, the IEP contributed to the development of both hard and soft skills, while simultaneously fostering a cultural shift toward innovation and entrepreneurship. This combined effect highlights the importance of experiential and collaborative environments in shaping not only individual capabilities but also institutional orientations toward innovation.

5.3. Knowledge production and intellectual property

The IEP also contributed to scientific production and knowledge dissemination. Approximately 36.7% of the projects reported the generation of outputs such as journal articles, conference papers, and technical reports. These outputs increased academic visibility and contributed to the diffusion of knowledge generated within the projects, although their distribution was uneven across institutions, reflecting differences in research capacity and institutional priorities.

Despite this progress in knowledge production, the results related to intellectual property were more limited. The majority of innovations (63%) were not protected at the time of this research. According to interview data, some innovations were still in the process of protection, while others were not submitted due to strategic decisions, such as the preference for industrial secrecy or the perception that protection was not relevant. In some cases, innovations did not meet the necessary criteria for formal protection.

These findings suggest a gap between knowledge generation and its formal appropriation, reinforcing the idea that the transformation of research outputs into protected or commercializable assets remains a challenge.

At the same time, it is important to note that, beyond formal intellectual property outcomes, participation in protection processes contributed to the development of relevant competencies. Researchers reported gains in areas such as intellectual property management, legal procedures, and strategic decision-making regarding protection and commercialization. In addition, several projects resulted in the development of trademarks, fostering capabilities related to branding strategies, brand positioning, and market-oriented thinking.

5.4. New products, processes, and services

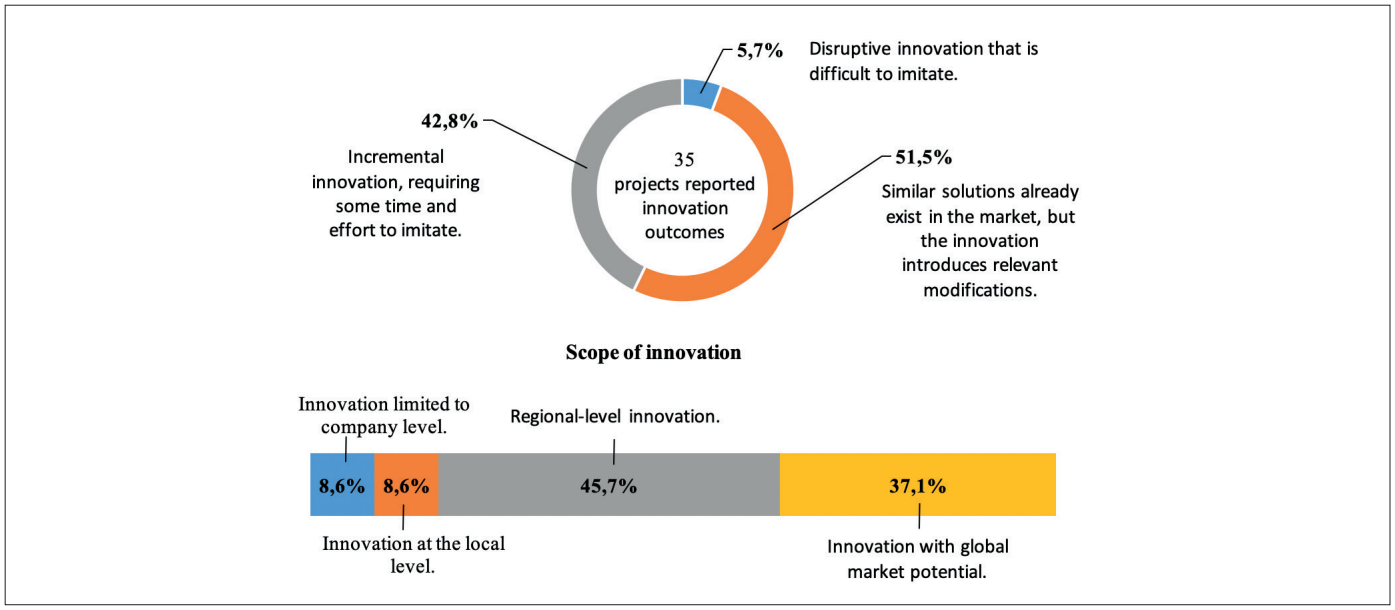
More than half of the projects (57%) reported the development of new products, processes, or services. These innovations spanned a wide range of applications, including digital platforms, agricultural technologies, and industrial solutions, many of which incorporated elements associated with Economy 4.0, such as artificial intelligence, IoT (Internet of Things), and data analytics.

However, as illustrated in Figure 6, the majority of these innovations can be characterized as incremental or adapted solutions, with a significant proportion presenting similarities to existing products or processes in the market. Only a smaller share of the innovations was considered disruptive or difficult to imitate.

This pattern suggests that, although the IEP was effective in stimulating innovation activities, the level of technological novelty remained limited. The predominance of incremental innovation reflects both the institutional context of the participating organizations and the early stage of development of many projects.

Furthermore, the results indicate that the innovations were primarily oriented toward local and regional markets, with fewer initiatives demonstrating potential for global competitiveness. This reinforces the idea that, in emerging economies, innovation policies often generate important learning and capability-building effects, even when high-impact or disruptive outcomes are less frequent (see Figure 6).

Figure 6. Characteristics of the type of innovation produced and its scope



Source: prepared by the authors.

To provide a more concrete illustration of the types of innovations generated within the IEP, Table A1 (see Appendix) presents a summarized account of selected outputs across different sectors, including agriculture, industry, and services.

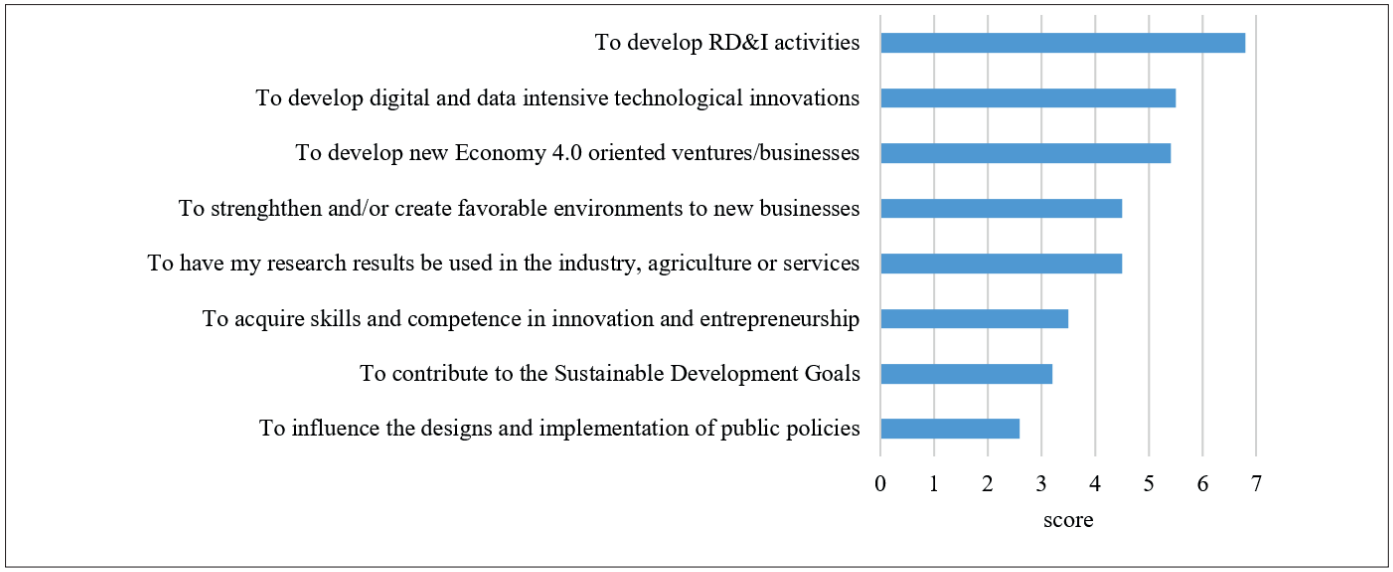
5.5. New ventures

The creation of new ventures was relatively limited. Only four startups were formally established as a result of the project, while others remained in early stages of development.

Survey data indicate that startup creation was not the primary motivation for most project coordinators. As illustrated in Figure 7, the main drivers for participation in the IEP were related to research development, infrastructure improvement, and access to funding, rather than the explicit goal of creating new businesses.

This finding provides important insight into the dynamics of the initiative. Although the policy was designed to foster innovative entrepreneurship, participants were primarily oriented toward strengthening research capabilities and institutional infrastructure. This mismatch between policy objectives and participant motivations helps explain the limited number of startups generated and reinforces the argument that institutional context plays a critical role in shaping policy outcomes.

Figure 7. Ranking of motivations for accessing the IEP's funds



Source: prepared by the authors.

6. Discussion

The findings of this study provide important insights into the effectiveness of innovation and entrepreneurship policies implemented within educational institutions in emerging economies. Overall, the results indicate that the IEP was successful in strengthening research infrastructure, enhancing human capital, and promoting an entrepreneurial culture within the Federal Network institutions. However, its impact on market-oriented outcomes, such as startup creation and innovation commercialization, remained limited.

The positive effects observed in terms of infrastructure and capacity building are consistent with the literature on national innovation systems, which emphasizes the importance of investments in knowledge generation and institutional capabilities as foundational elements for innovation (Lundvall, 2010; Nelson, 1993; Freeman, 1987). In this regard, the IEP contributed to improving the internal conditions necessary for innovation activities, particularly by addressing critical bottlenecks that previously constrained research and development efforts.

Research and innovation grants also played a broader role beyond technical support. In addition to enabling project execution, they also produced broader social benefits by supporting students' participation in research activities, in some cases contributing to household income. This highlights the multifaceted nature of innovation policies in educational contexts, where economic, social, and educational dimensions are closely intertwined.

The development of competencies observed in this study reinforces the importance of experiential learning environments in fostering entrepreneurial skills. In line with Kolb (2014), hands-on activities, mentoring, and project-based learning contributed to the development of technical, cognitive, and behavioral competencies. These evidences are consistent with Stuetzer et al. (2013), who argue that entrepreneurial skills are shaped more by diverse experiences than by formal education alone. Participants developed capabilities such as creativity, leadership, adaptability, and communication, which are essential in uncertain and dynamic environments (Haynie et al., 2012; Watchravesringkan et al., 2013).

At the institutional level, the IEP also contributed to strengthening collaborative networks within the innovation ecosystem. Increased interaction among universities, firms, cooperatives, public agencies, and support organizations facilitated knowledge exchange and broadened participants' exposure to real-world challenges. As emphasized by Kesting and Ulhøi (2010), the development of an innovation-oriented culture depends not only on individual capabilities but also on organizational and systemic conditions that support experimentation, collaboration, and knowledge sharing.

The dissemination of entrepreneurial culture occurred through a combination of training activities, mentoring, events, and partnerships, particularly with institutions such as SEBRAE. These mechanisms contributed to development of "entrepreneurial knowledge" (Gianesini et al., 2018), encompassing both conceptual understanding and practical application of entrepreneurship. This process extended beyond individual learning, influencing teaching practices, research orientations, and institutional dynamics.

Despite these positive outcomes, the limited translation of these advances into market-oriented results reflects structural challenges widely documented in the literature. Studies on national innovation systems highlight that the effectiveness of innovation policies depends on the interaction between multiple actors, including universities, firms, and government agencies (Freeman, 1987; Nelson, 1993). In the Brazilian context, these interactions remain weak, particularly in terms of university–industry collaboration, which constrains the commercialization of knowledge (Fernandes et al., 2010). This reinforces the need for adaptive and context-sensitive innovation systems capable of responding to regional specificities and institutional constraints, as emphasized in recent studies on Latin American innovation systems (Cario et al., 2023).

Furthermore, the predominance of incremental innovation identified in this study aligns with findings from research on emerging economies, where innovation activities tend to focus on adaptation rather than radical transformation (Fagerberg et al., 2010). This pattern reflects both resource constraints as well as the institutional orientation of participating organizations, which remain more strongly aligned with teaching and research than with market-driven innovation.

The limited number of startups generated by the IEP can also be interpreted through the concept of the "entrepreneurial trap". According to Lederman et al. (2014), developing economies often exhibit high levels of entrepreneurial activity but low levels of innovation and scalability. In the Brazilian case, this dynamic is reinforced by structural barriers such as weak demand for innovation, limited access to financing, and insufficient integration between knowledge producers and markets (Pinho & Fernandes, 2015; Jugend et al., 2018).

In addition, the findings regarding participant motivations reveal a misalignment between policy objectives and institutional behavior. While the IEP aimed to stimulate entrepreneurship, most participants were primarily motivated by research-related goals, such as improving infrastructure and advancing scientific work. This reflects a broader institutional logic in which organizations adapt external policies to their existing missions and capabilities.

Taken together, these findings suggest that financial support and program design alone are not sufficient to generate innovation and entrepreneurial outcomes. Instead, the effectiveness of such policies depends on the alignment between institutional capacities, incentive structures, and ecosystem conditions. As argued by Dahlstrand and Stevenson (2010), IE policies are more effective in environments with strong entrepreneurial ecosystems and high levels of interaction among actors.

These findings also suggest that the exclusive focus on Economy 4.0 technologies, while relevant, may have limited the exploration of opportunities in other sectors with strong potential for innovation and

entrepreneurship. A more diversified approach could enhance the impact of future policies by aligning them more closely with regional capabilities and market demands.

This study makes three main theoretical contributions. First, it provides empirical evidence on the implementation of IE policies within educational institutions in an emerging economy. Second, it demonstrates that policy effectiveness is strongly influenced by the alignment between institutional capacity and policy design. Third, it contributes to the literature on innovation systems by highlighting the role of educational institutions as key, yet constrained, actors in the innovation ecosystem.

While these findings provide important insights, they should be interpreted in light of the study's limitations, which are discussed in the concluding section.

7. Conclusions

This study examined the implementation and outcomes of the Innovative Entrepreneurship Project, launched by the Brazilian Ministry of Education in 2020, with the objective of fostering innovation and entrepreneurship within institutions of the Federal Network of Professional, Scientific, and Technological Education.

The findings demonstrate that the initiative made a significant contribution to strengthening research infrastructure and expanding the scientific and technological capabilities of participating institutions. The financial support provided enabled the acquisition of essential equipment and the establishment of research environments, creating favorable conditions for the development of innovation-oriented activities. In addition, the IEP contributed to the development of both technical and behavioral competencies among students and faculty, reinforcing the role of experiential learning in fostering entrepreneurial skills.

The initiative also promoted the dissemination of an entrepreneurial culture through training activities, mentoring, and participation in events, particularly with the support of SEBRAE. These interactions facilitated knowledge exchange and contributed to bridging the gap between academic and practical perspectives on innovation and entrepreneurship.

However, despite these positive outcomes, the study highlights important limitations in achieving market-oriented results. The creation of new ventures was limited, and the commercialization of innovations remained constrained. These outcomes reflect a broader misalignment between policy design and institutional capacity, particularly in terms of technological maturity, market access, and interaction with private-sector actors.

Overall, the study reveal a fundamental misalignment between policy design and institutional capacity. While the policy emphasized entrepreneurship and market-oriented outcomes, participating institutions remain predominantly oriented toward teaching and research. This divergence suggests that the policy design may have overestimated the entrepreneurial readiness of these institutions and underestimated the importance of capacity-building in areas such as business development, incubation, and technology transfer.

From a broader perspective, this study contributes to the literature on innovation policy in emerging economies by demonstrating that policy effectiveness depends not only on financial support and program design, but also on the alignment between institutional capabilities and ecosystem conditions.

These findings also generate important policy implications. First, future initiatives should adopt a more diversified strategic focus. While the emphasis on Economy 4.0 technologies has supported digital innovation, it may have limited the exploration of opportunities in other sectors. Policies should therefore encourage innovation across a broader range of domains, aligned with regional capabilities and development needs.

Second, strengthening entrepreneurship education is essential. Policies should promote the integration of entrepreneurial competencies into academic curricula, combining theoretical knowledge with practical, experience-based learning approaches. This includes fostering interdisciplinary collaboration and exposure to real-world challenges.

Third, stronger linkages between academia and industry are needed. The development of partnerships with firms, investors, and innovation intermediaries can facilitate the commercialization of research results and increase the likelihood of venture creation. Policy instruments should incentivize continuous interaction among these actors.

Fourth, improving support mechanisms for commercialization of innovation is critical. This includes access to funding, mentorship programs, incubation and acceleration services, and guidance on intellectual property management, all of which are essential for transforming innovative ideas into viable businesses.

Fifth, policies should promote a more integrated innovation ecosystem by engaging multiple stakeholders, including government agencies, educational institutions, private-sector actors, and support organizations. The experience of the IEP highlights the importance of intermediary institutions, such as SEBRAE, in bridging the gap between research and entrepreneurship.

This study has some limitations. The analysis is based primarily on self-reported data from project coordinators, which may introduce perception bias. In addition, the evaluation focuses on short-term outcomes, limiting the ability to assess long-term impacts such as firm survival and scaling. Furthermore, the context-specific nature of the study may affect the generalizability of the findings.

Future research should explore longitudinal analyses of policy impacts, particularly regarding startup survival, scaling dynamics, and long-term innovation outcomes. Comparative studies across different national contexts may also provide valuable insights into how institutional conditions shape the effectiveness of innovation policies.

Ultimately, evidence suggests that fostering innovative entrepreneurship in emerging economies requires not only well-designed policy instruments, but also the alignment of institutional capacities and ecosystem maturity.

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Appendix A – Produced innovations

Table A1. Summarized account of produced innovations within the IEP by field of Economy 4.0

	Innovation's description
Agriculture	Development of an IoT device that helps producers monitor soil moisture and irrigation management.
	KSplit software for agricultural soil mapping that uses intelligent methodology to generate maps.
	Method of increasing precision and accuracy in the flow, pressure and temperature measuring process.
	Soil moisture sensor that detects humidity variations in the location where the probe is buried for an irrigation management system.
	Product and process innovation in embedded computing for trap and capture processes.
	Development of social networks (Instagram, Facebook) for local ceramic producers.
	Development of a web platform that aims to integrate/connect the different actors involved in sheep and goat farming.
	A system with a differentiated business vision and development of brand identity.
	E-commerce website
	Integration API with SEFAZ/RS (specific State treasury system)
	App for qualification and tracking of pink pepper, including front end, back end and core using cell phone photos, including an MVP.
	Filing for a software for an interactive vegetable monitoring network, a machine learning logarithm, and an Utility Model.
	Process of acquiring and processing agrometeorological data to predict the emergence of diseases.
	Property management solution that includes a marketplace, a virtual cooperative system and a basic diagnostic system for pest detection and crop maintenance.
	New process for analyzing spatial data from satellite images.
	Production of microgreens with artificial intelligence in a portable box
Industry	Development of products for 3D printing in cementitious composites with reduced cement content.
	Autonomous navigation system for a motorized wheelchair, considering the social restrictions present in the environment.
	Microscale, spatial and temporal mapping of agrometeorological variables of local interest.
	Equipment to assist medical professionals in treating people with breast cancer.
	Innovation in the separation of glass and PVB film from automotive windshields, thus contributing to recycling and reverse logistics.
	Development of a functional machine control solution with monitoring of operating and maintenance conditions
	A startup was developed that has already prospected resources form two public calls, 4 software filings and a brand filing.
	Software that operates connected to a maintenance bench.
	Innovation in the cashew nut processing process, with the use of renewable and low-cost energy sources for the cashew nut cooking (autoclaving) stage, and in the Cashew Nut Almond supply chain.
	Sustainable production of pharmaceutical formulations based on mangaba latex for healing skin ulcers and wounds, and development of a software for monitoring and evaluating healing progress.
	Application for organizing recyclable materials collection requests and route optimization for the recyclers cooperative.
	Mechanism for automatic download of bidding documents.
Services	Platform for integrating artists and the public, concentrating all types of art forms in the same place and facilitating the search for this type of service.
	Creation of an e-commerce application for small (cooperative) producers in addition to training courses.
	Application for therapy of acquired neurological speech disorders.
	Digital transformation kit for smart buildings
	Intuitive and low-cost data entry through voice command and control inventory via cell phone in a simple.
	Digital collective enterprise to increase the flow of small producers.

Source: prepared by the authors.

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