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Generativity is a Core Value of the ESJ: A Decade of Growth

Erik Erikson (1902-1994) was one of the great psychologists of the 20th century[1]. He explored the nature of personal human identity. Originally named Erik Homberger after his adoptive father, Dr. Theodore Homberger, he re-imagined his identity and re-named himself Erik Erikson (literally Erik son of Erik). Ironically, he rejected his adoptive father's wish to become a physician, never obtained a college degree, pursued independent studies under Anna Freud, and then taught at Harvard Medical School after emigrating from Germany to the United States. Erickson visualized human psychosocial development as eight successive life-cycle challenges. Each challenge was framed as a struggle between two outcomes, one desirable and one undesirable. The first two early development challenges were 'trust' versus 'mistrust' followed by 'autonomy' versus 'shame.' Importantly, he held that we face the challenge of **generativity** versus **stagnation in middle life**. This challenge concerns the desire to give back to society and leave a mark on the world. It is about the transition from acquiring and accumulating to providing and mentoring.

Founded in 2010, the European Scientific Journal is just reaching young adulthood. Nonetheless, **generativity** is one of our core values. As a Journal, we reject stagnation and continue to evolve to meet the needs of our contributors, our reviewers, and the academic community. We seek to innovate to meet the challenges of open-access academic publishing. For us,

[1] Hopkins, J. R. (1995). Erik Homburger Erikson (1902–1994). *American Psychologist*, 50(9), 796-797. doi:http://dx.doi.org/10.1037/0003-066X.50.9.796

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generativity has a special meaning. We acknowledge an obligation to give back to the academic community, which has supported us over the past decade and made our initial growth possible. As part of our commitment to generativity, we are re-doubling our efforts in several key areas. First, we are committed to keeping our article processing fees as low as possible to make the ESJ affordable to scholars from all countries. Second, we remain committed to fair and agile peer review and are making further changes to shorten the time between submission and publication of worthy contributions. Third, we are looking actively at ways to eliminate the article processing charges for scholars coming from low GDP countries through a system of subsidies. Fourth, we are examining ways to create and strengthen partnerships with various academic institutions that will mutually benefit those institutions and the ESJ. Finally, through our commitment to publishing excellence, we reaffirm our membership in an open-access academic publishing community that actively contributes to the vitality of scholarship worldwide.

Sincerely,

Daniel B. Hier, MD

European Scientific Journal (ESJ) Natural/Life/Medical Sciences

Editor in Chief

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The Strategic Role of the Third Mission in Universities: A Concrete Case Study

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Abstract

In addition to teaching and research, the goal of universities is to contribute to the development of civil society by promoting the direct application, valorization, and use of knowledge. In reality, it is a widespread and shared opinion that is no longer enough to carry out research on campus and publish subsequent works in scientific journals. It is also difficult to be fully satisfied with teaching only young people in university courses. This paper focuses on highlighting how an applied example can be taken as the best practice for future implementations. The methodology used is qualitative. The research question that initiated the study was to concretely verify how the Third Mission (TM) was integrated into the strategic choices of universities. In light of the new methods of evaluating universities, how can we highlight what they have done in terms of the third mission? Are organizational solutions possible in the approach to the TM? The objective was to verify what the impact and future development of the Third Mission (TM) in the universities will be. In light of its inclusion among the evaluation criteria of universities and teachers, the Third Mission (TM) is the new future frontier in terms of local and national openness and development, as well as their economic and financial sustainability. To this end, a case analysis was proposed as a model/best practice, and in particular the case of the Department of Business and Law of the University of Calabria was also presented. The application and implementation of rules and regulations are always difficult in

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any case and in any field. An example can be seen in public administration and universities, bureaucratically "plastered" and not very inclined to change and innovation, especially regarding performance evaluation. Therefore, seeing an application carried out relatively quickly allows the enhancement of the “DiScAG Model”, which is to be taken as an application example in the implementation of the Third Mission (TM) in universities. The study will contribute to increasing the literature and starting a discussion and a reflection on what has been done and what still needs to be done in this direction.

Keywords: Third Mission, Evaluation, Strategic Planning, Performance, Development

Introduction

Over the past few years, the Italian University, as well as other countries, has been affected by profound transformations that have influenced the improvement of the more traditional functions, such as training and research, the introduction of new missions, and characteristics to respond more directly to the needs for research, innovative services, and training expressed externally, in particular, by the territorial systems in which it operates.

Historically, the university's first mission is to transmit knowledge to new generations with the aim of training highly qualified figures. As per consolidated practice, the institutional mandate of the university is to train the ruling class of a country. Thus, the second mission involves increasing certified knowledge to respond to the different needs of social well-being.

With the process of corporatization of public administration, all the mechanisms of private companies have been adapted to the public sector and, therefore, also to universities (Comite, 2020). Addressing the topic of planning and control by referring them to the university system, it presupposes on the one hand the consideration that the university takes, at least in part, the typical connotations of the company. On the other hand, there is the need to contextualize the concepts that must be inserted into the peculiarities "of the public university company". Universities constitute a completely peculiar reality in the state sphere, primarily due to the specificity of the products offered and the management circuits implemented. Secondly, it entails a particular legal regime of autonomy they enjoy in educational and scientific terms from an organizational, financial, and accounting point of view.

In addition to Teaching and Research (Deidda Gagliardo, 2020), the aim of the universities is to contribute to the development of civil society by promoting the direct application, valorization, and use of knowledge. In reality, it is a widespread and shared opinion that it is no longer enough to carry out research on campus and publish subsequent works in scientific

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journals. Also, it is difficult to derive satisfaction only simply from teaching young people in university courses.

A historical measure of the impact factor of teachers is given by citations and patent registrations, which are not always precise indicators of all disciplines (Trombetti, 2017). Thus, there is a need to open up to the world and spread culture, disseminate knowledge, and transfer research results outside the academic environment, thereby contributing to the social growth and cultural direction of the territory (Chesbrough, 2013, 2021).

Concretely, universities must link up with the world of economy and industry to be considered both as a potential supplier of resources and as a source of demand for highly qualified labour. Furthermore, in this direction, there is a need to satisfy new requests from society, especially professional updates through continuous training.

Today, knowledge has taken on a central role in society both from an economic and political point of view and in life processes. Knowledge, research, and innovation are currently the pillars on which to leverage the growth and competitiveness of society.

The objective of this paper is to verify the impact and future development of the TM in universities. In the light of its inclusion among the evaluation criteria of universities and teachers (National Agency for the Evaluation of the University and Research System (ANVUR)), the third mission represents the new frontier of the future in terms of openness, local and national development, as well as their economic and financial sustainability. To this end, a case analysis is proposed and, in particular, the case of the Department of Business and Law of the University of Calabria was presented.

Methodology

The methodology used is qualitative in nature. Based on the theoretical framework, focused on the strategic planning process in universities, the following research question was generated: How was the Third Mission (TM) integrated into the strategic choices of universities? In light of the new methods of evaluating universities, how can one highlight what they have done in terms of the third mission? Are organizational solutions that are useful for achieving positive outcomes possible? However, the importance of the topic suggests that the study will contribute significantly to the existing literature and stimulate discussion and reflections on the future direction of third mission-related activities in universities.

After an examination of the strategic planning with a particular focus on the university context, a definition of the Third Mission (TM) was formulated in line with the strategic plan in force at the University of Calabria. Subsequently, the main aspects of the Third Mission (TM) of the University

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of Calabria were identified, with particular attention to the Department of Business and Legal Sciences.

The intent was to start the research and third mission office activities as well as verify the state of the art in terms of implementation of the department's Third Mission (TM). An online questionnaire was sent to the teachers present in the department at the time of the establishment of the Research and Third Mission (TM) Office, which took place in 2019. The purpose is to perform initial mapping and start the third mission activity, monitor the progress and improve it, and strengthen areas where there are uncertainties. Over time, the indicators identified by both the university and the department governance were analyzed to encourage the third mission and verify that it was the best practice to define a "DiScAG model".

To answer the research questions, the university's strategic plans for 2020-2022 and the one currently in force for 2023-2025 were analyzed. Also, the strategic plans of the Department of Business Sciences and Legal Science and the documents of the reviews carried out by the governance bodies were also analyzed.

Strategic Planning in Universities

Through the planning process, objectives are established and the methods for achieving them are determined. Strategic planning is the systematic process aimed at defining the organization's strategy that allows it to optimize its performance, or the formulation of strategies that identify the actions to be taken to achieve the organization's objectives. The strategy is accompanied by the concept of programming, through which an order to things is assigned, thus foreseeing possible future scenarios and organizing behavior aimed at achieving pre-established objectives over an extended time horizon. This was done to make the action itself coherent compared to the expected results. Planning is a part of the organization through which governing body exercise its political-administrative direction function, after having identified the strategic objectives, the resources, and the times needed to achieve them. However, bureaucratic bodies are empowered to decide on the concrete methods of implementing the program.

The administrative planning activity becomes strategic when analysis are carried out regarding the role that the organization intends to play in the future and the basic choices that will shape the administrative actions. Furthermore, the ability to analyze work processes, define strategies, evaluate the results, and ultimately rectify imperfections has become a source of competitive advantage. Law 43/2005 states that universities (Nardo et al., 2017), in order to pursue objectives of efficiency and effectiveness of the services offered, adopt, every year, three-year programs connected with the general guidelines defined by the decree of the former Ministry of Education,

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University and Research (MIUR), and today's Ministry of University and Research (MUR). The legislation also states that university programs are evaluated by the ministry and monitored periodically in accordance with parameters and criteria identified by the Minister, making use of the National Committee for the Evaluation of the University System (CNVSU). Furthermore, after consulting the Conference of Rectors of Italian Universities (CRUI), it was shown that university programs are taken into account in the distribution of the universities' Ordinary Financing Fund (FFO).

The three-year planning system for the activities and development of universities and the entire university system involve the following provisions:

1. The preparation of the general guidelines defined by Decree of the Minister.
2. The preparation of three-year programs by each university.
3. The evaluation of these programs by the Ministry.
4. Periodic monitoring of university programs based on parameters and criteria identified by the Minister.
5. The preparation of a three-yearly report on the results of the evaluation of the programs that the Minister presents to parliament.
6. The definition of the methods with which to take university programs into account in the distribution of the ordinary university funding fund.

With this legislation, strategic planning finds a concrete application within Italian universities (Rubino et al., 2017). Therefore, it is important to understand the phases and actions of the planning process, content of the documents, and their formalization as established by the legislation. Generally, by statute or regulation, universities require the Academic Senate to definitively approve the strategic plan, as it is the highest internal policy-making body.

Furthermore, it is essential to consider how the State Universities over the years have been affected by a regulatory overlap which has required them to draft numerous planning documents, including the three-year planning systems, the economic-financial plans, the personnel planning plans, the three-year construction plan, the performance plan, the plan for the prevention of corruption and transparency and, the integrated plan of activity and organization, which is a real novelty and concrete simplification of the bureaucracy of last year.

Provided for by Article 6 of Legislative Decree no. 80 of 2021, public administrations from 30 June 2022 must draw up a single planning and governance document called the Integrated Activity and Organization Plan (PIAO). It includes many of the plans that public administrations were

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required to prepare annually, such as performance, staff needs, gender equality, flexible working, and anti-corruption.

One of the reasons that generated the preparation of a single document is the high number of rules that regulate the system. Although each of these regulations has objectives of high social and civil significance, their combination over time has shown strong limitations. This has generated an overload of obligations without producing the desired improvement effects or severely limiting them.

Definition of Third Mission (TM)

Historically, the first mission of universities is to transmit knowledge in order to train highly qualified figures. The institutional mission of universities is precisely to train the ruling class of the future. The second mission is aimed at increasing certified knowledge with the aim of responding to the needs of social well-being.

The TM is defined as the set of all the activities through which universities dialogue and interact with society, with variable content and form that is dependent on the context.

It is therefore necessary to distinguish, according to the definition given by ANVUR, two types of interaction:

a) TM of economic valorization of knowledge.
b) Third cultural and social mission.

Based on the first point, this paper refers to the economic valorization of knowledge in the event that the TM is useful for productive purposes, including technological transfer activities aimed at evaluating, protecting, marketing, and commercializing technologies which are developed within academic research projects. It also includes the management of intellectual property in relation to these projects (such as patents, trademarks, etc.). In reference to the Third Cultural and Social Mission, the concept shows that "public goods are those that increase the wellbeing of society". Example includes cultural events, scientific dissemination, management of museum centers, public health, continuing education, public debates and controversies, scientific expertise, and adult education. Generally, there is no payment or market price for the use of these goods. In any case, these activities are numerous.

For this reason, the indicators that describe them cannot be standardized and consequently less comparable and, therefore, are less shared. ANVUR requests periodic monitoring of the **evaluation of the third mission** of a socio-cultural nature.

This second point includes all initiatives for the production and management of cultural heritage, research infrastructures, clinical trials and

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medical training, and continuous training or public engagement. By "*Public Engagement, we mean the set of non-profit activities with educational, cultural, and social development value. The business and benefits of higher education and research can be communicated and shared with the public in numerous ways.*" (ANVUR, 2015)

Presently, a distinction has been established between public and social engagement. The word "engagement" here is understood as a psychological, individual, motivational, and context-dependent involvement.

The following are considered as Public Engagement initiatives:

- Informative publications signed by the teaching staff at a national or international level.
- Participation of the teaching staff in radio and television broadcasts at a national or international level.
- Active participation in public meetings organized by other entities (e.g., scientific cafés, festivals, science fairs, etc.).
- Organization of public events (e.g., Researchers' Night, Open Day).
- Publications (paper and digital) dedicated to the external public (e.g., university magazine).
- Organized communication training days (aimed at PTA or teachers).
- Interactive and/or informative websites, blogs.
- Use by the community of museums, hospitals, sports facilities, libraries, theatres, historic university buildings.
- Organization of concerts, exhibitions, and other public events open to the community.
- Participation in the formulation of programs of public interest (policy making).
- Participation in committees for the definition of standards and technical regulations.
- Health protection initiatives (e.g., information and prevention days).
- Initiatives in collaboration with entities for urban development or territorial enhancement projects.
- Orientation and interaction initiatives with high schools.
- Information initiatives aimed at children and young people.
- Participatory democracy initiatives (e.g., consensus conferences, citizen panels).

The University of Calabria

The University of Calabria was established 12 May 1968 with Legal Science Decree no. 422. It is a strategic resource for the development of

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Calabria and is capable of creating prospects of cultural, social, and economic growth for its students and their families.

For about 10 years, the University of Calabria has started a process of improving strategic planning and operational programming processes.
The 2023-2025 strategic plans was adopted on 25 October 2022, and the first part highlighted the mission and vision of the university. Thereafter, the presentation of the university and its characterizing elements was introduced. Some peculiarities that allow Unical to be distinguished from other universities can essentially be summarized in its "Campus" University model, which introduced the Departmental Structure and the Residential Center in Italy for the first time. However, another characteristic distinctive feature was the creation of an environment, which is conducive for the promotion of close relationships among all the components of the institution (teachers, students, technical, and administrative staff). In fact, the current university's structure is characterized by an equipped "Bridge" axis, with buildings (called "Cubes") such as departments, administrative offices, laboratories, classrooms, libraries, cinemas, and theaters. The university residences, sports facilities, and canteens for student and staff catering are located in the surrounding hilly area.

Today, over 50 years after its establishment, 14 departments are active, which have employed around 800 teachers made up of professors, associate professors, and researchers. The administrative, financial, and technical activities are organized and managed by approximately 650 units of technical-administrative staff. Also, there are 5 common service centers active in the university: The Music and Entertainment Arts Center (CAMS), the Publishing and Book Center, the University ICT Center, the University Language Center (CLA), and the presence of 4 Museums, namely: the Museum of Paleontology, the Museum of Natural History and Botanical Garden (MuSNOB), the Museum of Zoology, and the Museum for the Environment/ RiMuseum, located outside the campus. The residential center, however, is responsible for the provision of services to students, providing approximately 1,800 beds and a canteen service that supplies approximately 2,377 meals a day.

At present, Unical boasts approximately 24,000 enrolled students, thus positioning itself among the main academic institutions in the country.

The University of Calabria has activated a guesthouse service with 168 apartments and a "Residenza Socrate Residence", which is a hotel structure equipped with 44 rooms ready to welcome visitors. Also, there are numerous sports facilities organized in a multifunctional university sports center (CUS) near the Youth Aggregation Centers. Interestingly, there are also spaces or centers available for students' ideas and initiatives.

Furthermore, it is important to highlight the activity of a health emergency operating station, known as a Medical Emergency Care Unit,

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which is a significant example of conurbation of the university with the surrounding area. In addition, the University Chapel has always been entrusted to the Dehonian Fathers and was joined by the Dorotee Sisters in 2006. The University Chapel welcomes various university groups and organizes thematic reflection meetings. Students can freely access the library system made up of three large libraries: the technical-scientific area library, the humanities library, and the economic and social sciences library. Furthermore, within the university perimeter is situated a banking agency, a post office, two theaters, two cinemas, two amphitheaters for outdoor events, and a nursery that welcomes over 50 children from three months of age and above. Overall, over 5,000 parking lots spaces are available, and the various structures are accessible through a public transport system which guarantees daily mobility for over 25,000 users.

The strategic areas of training and research are the two principles of the university system, which are spontaneously supported. In recent times, as stated by the TM and social commitment, it is seen as an area to systematically state one's initiatives aimed at strengthening ties with the territory and its social and cultural valorization. The University of Calabria aims to contribute to the planning of the cultural project aimed at bringing change to the social and economic growth of the regional territory, both nationally and internationally, and strengthening the international vocation and the area of student services.

The university acts as a driving force towards development and addresses the problems of the Calabria territory, particularly those connected to delay in growth compared to other areas of the country, global competition, and employment issues, especially for young people who have a high level of education. Therefore, the vision of quality of the TM sees a natural propensity to strongly support not only technological transfer initiatives and activities, but also knowledge transfer and public engagement initiatives, which is developed by adopting the principles of quality assurance as its own methodological reference.

The Department of Business and Law

The Department of Business and Law "is the structure responsible for carrying out scientific research, teaching and training activities, as well as activities related or ancillary to the previous ones which are externally directed and attributable to the scientific-disciplinary sectors of legal and business sciences within the department itself".

The Department of Business and Law was established in 2013, following the entry into force of the novel Unical Statute, pursuant to Law 240/2010, which provides for the reorganization of research and training activities previously delegated to departments and faculties, thereby relocating

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them within the new departments. DiScAG, in particular, was established from the merger of the pre-existing Departments of Business Sciences and Legal Sciences and operates in continuity with the former Faculty of Economics of the University of Calabria. The initial project envisaged the development of scientific and cultural activities essentially in two areas (Business – SSD 13B and Legal – SSD 12). Over time, the department has been further enriched and the initial SSCs have also been joined by 13A (Economic area), SSD 13 (Statistical area), and SSD 14 (Sociological area).

The objectives of DiScAG started from the awareness that the context in which universities operate is complex and variable, both from a cultural and socio-economic point of view. Therefore, the objectives are influenced by continuous changes in the labor market which has a significant impact on the employability of graduates, the growing competition in attracting students, the needs of the territory in terms of motivating companies towards innovation, the evolution of the traditional reference professional figures (accountants, managers, lawyers), and the ever new scenarios of research, TM, and competitive projects. To face these challenges, adaptation and resilience skills are needed, as well as the ability to influence and stimulate change, without undergoing it.

Its mission, therefore, is to train excellent individuals with intelligence and professionalism capable of adapting to environmental changes and, in some way, guiding them.

All DiScAG operational activities developed by the technical and administrative staff are organized into four (4) sectors:

1. Administration and Accounting
2. Teaching
3. Research and TM
4. Higher education and Masters.

It should be specified that compared to the initial division (administration, teaching and research) dating back to 2012 - when the faculties were transformed into departments following the Gelmini Decree - at the beginning of 2019, the research sector of the department was divided into research and TM sector and higher education and masters sector. This subdivision has allowed the development of more specific skills, which is necessary in these areas, to achieve the expected objectives. Above all, it has helped in generating best practices that allow the department to consolidate the set objectives.

Subsequently, the staff is structured into 14 units, as well as other 13 units with collaboration contracts.

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Starting from 2019, the Head of the Research and Third Mission (TM) Office (the author of this paper) begun mapping and monitoring the departmental research and the third mission activities carried out within the department. Nonetheless, an attempt was also made to start a process of diffusion of the culture of the Third Mission (TM). In the first instance, the Head of the Research and Third Mission (TM) sector initiated the mapping of the lines and research interests of all the teachers belonging to DiScAG (There were 57 active teachers in 2019). For the mapping or reconnaissance, which is a starting point, a questionnaire containing some questions relating to their research activity was sent to each teacher. It constitutes the description of their competition sector and the scientific disciplinary sector they belong to, the ERC (European Research Council) sector of membership, research products, and any collaborations with other departments and/or third parties, i.e., companies, public bodies, external financiers, or stakeholders.

On the basis of the information received and the legislation that establishes the scientific disciplinary sectors and the subjects included in them, 8 research groups have been outlined. The research groups are as follows:

1. Business Economy Area
2. Business and Management
3. Civil Law in Constitutional Legality
4. Commercial and Tax Law
5. Criminal Law
6. Public Law Disciplines
7. Financial Intermediaries and Corporate Finance
8. Territory, Environment, City and Tourism

Presently, there are 61 teachers in force (data updated in March 2024), and they have been added and/or eliminated as needed. The membership of the teachers is as follows:

1. Business Economics Area - 16 teachers
2. Business and Management - 10 teachers
3. Civil Law in Constitutional Legality - 5 teachers
4. Commercial and Tax Law - 6 teachers
5. Criminal Law - 2 teachers
6. Public Law Disciplines - 10 teachers
7. Financial Intermediaries and Corporate Finance - 5 teachers
8. Territory, Environment, City and Tourism - 7 teachers

By following this order, there was an understanding of what was done. Furthermore, the organizational chart of the existing organizational structure was reported in official documents, which is based among other things on a consistent and well-defined number of delegations granted to teachers. The

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auspicious wish of the governance was to confer as many delegations as possible to ensure teachers are responsible for enhancing the education of young people and contribute significantly to local, regional, and national development.

Analysis and Results

To optimally conduct a planning, monitoring, and evaluation action to guarantee development with a view to continuous improvement, it is necessary to focus on three key macro-dimensions:

- **Strategy –** This is the vertical dimension of planning, monitoring, and evaluation from which the indications that define the path to follow for the next few years derive. It goes from the strategic plan to management performance, and from the academic to the technical-administrative sphere;
- **Transparency –** This is the external dimension (or depth), which opens the organization to stakeholders with a view of real accountability;
- **Quality** – This is the horizontal dimension, which permeates all university processes, roles, resources, and structures.

Universities must, therefore, adopt internal methodologies for monitoring the achievement of the planned strategic objectives. This also involves the development of autonomous indicators, adequately harmonized with the indicators defined by ANVUR, which measures the degree of achievement of the objectives in teaching, research and organization, and individual performances.

Furthermore, the identification of indicators is an extremely complex aspect since these may not always be exhaustive or sufficiently represent the complexity of an organizational structure. Based on the upstream and downstream of this moment, it is necessary to pay attention to equally important aspects, such as the definition of the information needs that the indicators must satisfy, the possible ways to allow their real use within the decision-making process, the dangers of behavioral distortions which the use of indicators can lead to, and the identification of adequate standards and terms of comparison within organizations. Therefore, the path through which the indicator is defined (and its labelling) is certainly more important than the indicator itself as the methodological analysis activated will allow us to identify the factors that will help the healthcare company to improve and grow. According to the Department of Business and Law, the actions envisaged for the implementation of the activities contained in the third departmental mission, which is included in the strategic plan, are as follows:

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Table 1. Strategic actions to achieve the objectives included in the strategic plan (Source: Strategic Plan 23-25 of the Department of Business and Law)

Strategic actions	**TM.1 - A.1**	Incentivation of the valorization of the results of the company research
	TM.1 - A.2	Promotion of the corporate culture
	TM.1 - A.3	Reinforcement of incubation and support programs for businesses

Thus, the indicators used to achieve these strategic actions include:

- **TM.1-I.2** Number of people involved in training courses for the promotion of corporate culture
- **TM.1-I.4** Income from commissioned research, technology transfer and competitive financing
- **TM.2-I.1** Number of initiatives for the promotion and support of the civil and educational mission

Based on the reports in the DiScAG strategic plan:

TM.1- indicator I.2 Number of people involved in training courses for the promotion of corporate culture

Table 2. Indicator TM.1- I.2- Number of people involved in training courses for the promotion of business culture (Source: Strategic Plan 23-25 of the Department of Business and Law)

Weight 25%	**Baselines**	**Detection**	**Current**	**Target**	
	Dec. 31, 2019	**Dec. 31, 2020**	**Jun. 30, 2021**	**Dec. 31, 2021**	**Dec. 31, 2022**
Department	3.3	7.7	12.3	4.0	4.3
University	24.3	61.7	100.7	29.2	31.6

The data refers to the last useful survey carried out before the adoption of the strategic plan.

Table 3. Initiatives planned for the next three years (Source: Strategic Plan 23-25 of the Department of Business and Law)

Initiatives indicated in the Departmental Strategic Plan DiScAG	**Any Changes or Planning of the Initiatives Scheduled for 2023-2024-2025**
Advertising the three-year courses and master's degree courses, based on the DiScAG of the UnicaLab path, as an elective course (6 CFU), including other available initiatives, such as the StartCup Calabria.	Communication about UnicalLab and StartCup has already begun by hosting staff from the University's Innovation and Social Impact Research Area (ARIIS) as part of classroom and/or online lessons. The trial will continue in 2023-2024-2025

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Organization of corporate culture development paths through collaborations with many local, national, and international companies that already collaborate with DiScAG for internships, Masters and post-graduate higher education courses, also involving the PTA.	DiScAG currently has 565 agreements in place with companies, bodies, and organizations that host over 300 students a year for internships and training and extra-curricular internships, in Italy and abroad. Furthermore, numerous collaborations are active with credit institutions and companies for the financing of scholarships and for the support of post-graduate training courses. For 2023, there are plans to further increase the pool of collaborations until 2025, which has been constant for many years

The department takes the social, cultural, and economic development of the territory into great consideration through continuous collaboration with other university departments. This is in accordance with the educational, productive, and innovative ecosystem.

Strategic Action TM.1-A.1 - Based on the incentive for the valorization of research results, it can be seen that the indicator **TM.1-I.4** proceeds from commissioned research, technological transfer, and competitive financing as shown in the table below:

Table 4. Indicator TM.1-I.4 (Source: Strategic Plan 23-25 of the Department of Business and Law)

Weight 25%	Baselines	Detection	Current	Target	
	Dec. 31,2019	Dec. 31,2020	Jun. 30, 2021	Dec.31,2021	Dec. 31,2022
Department	€52,538	€40,000	€170,566	€54,114	€55,165
University	€12,269,488	€12,487,690	€3,490,143	€12,637,573	€12,882,962

DiScAG has already achieved excellent results in terms of the TM. In fact, when compared to the other departments, it has the most existing activities due to the vocation and specificity of the research groups. For example, in the legal field, there are several lawyers and it is normal to involve the forensic associations or in the economic accounting field, the associations of accountants and accounting experts are consulted. Thus, the department has the objective of strengthening certain activities, which are outlined below:

- Developing multidisciplinary collaboration involving transversal research areas and promoting applied research projects;
- Cooperation with the local entrepreneurial fabric and non-profit associations;
- Spreading the culture of technology transfer and active citizenship among teachers, researchers, PhD students, research fellows and the PTA;
- Organizing professional courses for researchers, businesses and, above all, public administrations such as local authorities, given that the

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PNRR is in charge of planning, organization, management, and reporting of simple and complex projects. As a result, there is a lack of suitable professionalism, especially in small local authorities. For this reason, one aspect for future intervention is the training of public administration employees. Indeed, for over 6 years, DiScAG has participated, winning an average of two/three activated courses every year, in the INPS Valore PA project[1].

Other activities to be strengthened involves supporting teachers, researchers, PhD students, and research fellows in scouting regional, national, and European opportunities and in carrying out the administrative and partnership creation aspects. Also, it aims to intensify participation in competitive funding calls, including multidisciplinary research activities that allow access to various types of calls traditionally but not central to the DiScAG.

Table 5. Initiatives planned for the next three years (Source: Strategic Plan 23-25 of the Department of Business and Law)

Initiatives Indicated in the PSD DiScAG	**Any changes or planning of the initiatives scheduled for 2023-2024-2025**
Increase in opportunities for collaboration with other Unical departments by encouraging teaching staff and researchers to participate in competitive funding calls, including multidisciplinary research activities that allow access to various types of calls traditionally but not central to DiScAG.	The process which started a few years ago will continue in 2023, until 2025, in order to increase the share of financial resources acquired.
Strengthening of personnel resources dedicated to the research and Third Mission (TM) sector of the department.	A request has been made for the university to be assigned at least one additional unit in addition to the structured PTA unit already dedicated. For now, temporary contracts are in operation. However, the requested allocation will hopefully be obtained on or before 2025.
Greater interaction with the university's Innovation and Social Impact Research Area (ISIRAARIIS) to provide support to teachers	Contacts with ARIIS staff are constant and will be intensified over the next three years.

[1]The INPS PA Value Project is dedicated to the training of public employees by issuing an annual call consisting of 3 steps: The first step is aimed at public administrations which must report their training needs. The second step is dedicated to universities which, based on the training needs expressed by public administrations, must offer training courses constructed according to INPS indications. The last step is addressed to public administration employees who have been accredited for their selection. It should be noted that the institution itself bears the per capita cost of those admitted to take the courses.

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and researchers (e.g., timely news on tenders, support in drafting projects, etc.).	

However, with regard to indicator TM.2-I.1, which indicates the number of initiatives for the promotion and support of the civil and educational mission, the strategic plan shows that the department is more focused on the following activities: consolidating and intensifying the relations with educational institutions and institutional subjects in the area, increasing public engagement initiatives aimed at student placement (due to the involvement of local economic operators and companies), orientation and interaction initiatives with schools of all levels, and proposing a large number of hackathons, bootcamps, and co-design with companies and institutions for the development of innovations.

The table below shows the values of the indicators for the year that just ended and the target for the year 2024.

Table 6. Indicator values for 2023 and proposed objectives for 2024 (Data source: Monitoring, quality and evaluation service - Statistics and reporting sector of the University of Calabria)

	Indicator Values					
Indicator	Weight	Value Dec.31,2023	TARGET Dec. 31,2023	Badger Achievement Indicator	Achievement normalized weighted	TARGET Dec. 31,2024
TM.1-I.2	25%	14	4	100%	25%	4.3
TM.1-I.4	25%	260,816 €	54,114 €	100%	25%	55,165 €
TM.2-I.1	50%	155	52	100%	50%	141

Discussion of Results: Review Report for the DiScAG

A review is an activity carried out to verify the suitability, adequacy, and effectiveness of something to achieve the established objectives (UNI ISO 9000 standard).

According to the review report for the revision of the strategic plan, it was found that DiScAG is expressed as TM_DiScAG. This indicates that the third mission had a score of 100%.

Two of the three indicators (Number of people involved in training courses for the promotion of business culture - TM.1-I.2 - Elaborated by the university (TM-20), Proceeds from commissioned research, technological transfer, and competitive financing - TM.1-I.4 - PSD (TM-21)) significantly exceeds the previous year's target.

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The indicator number of initiatives for the promotion and support of the civil and educational mission - TM.1-I.2 - PSD (TM-20) reaches a value slightly below the target (91.26%). In fact, this started from 2019, with the organization of 48 activities. In 2020, 41 initiatives were registered. However, 42 initiatives were registered in 2021, while 120 activities were registered in 2022. Lastly, in 2023, a sprint was recorded with 155 valid activities, which is attributable to the TM, and it includes public engagement initiatives, social engagement, conferences, seminars, workshops, etc. Therefore, this demonstrates the growing trend of activities, despite the health emergency in those years, with the involvement of all teachers and technical-administrative staff. This provides a great sense of belonging to the university. As shown in Table 7, a particular piece of data was detected immediately after the end of the health emergency. Thus, this denotes the exponential increase in activities that were carried out.

Table 7. The processing (Data source: Monitoring, quality, and evaluation service - Statistics and reporting sector of the University of Calabria)

Year	No of third mission activity recorded on Dec. 31 of each year
2019	48
2020	41
2021	42
2022	120
2023	155

The trend of the first indicator has grown over time. Nonetheless, it is underlined that in the two-year period 2020-2021, it slightly decreased when compared to the first year of monitoring in 2019[2]. For obvious reasons, this is linked to the health emergency caused by COVID-19.

[2]Monitoring began in 2019 in conjunction with the official adoption of the University Strategic Plan for the three-year period 2019-2021. A quick overview shows that, in terms of drafting strategic plans and performance **evaluation, it is certainly necessary to mention the** following standards:

1. L. 370/99: establishment of the CNVSU, or the National Committee for the evaluation of the university system.
2. L. 204/98: establishment of the CIVR, Steering Committee for Research Evaluation,
3. Legislative Decree 150/2009: performance and transparency, Brunetta decree entitled "Optimization of the productivity of public work and efficiency and transparency of public administrations". With the introduction of this decree, for the first time, the moment of measurement is distinguished from that of evaluation, establishing the CIVIT (Independent Commission for the Evaluation, Transparency and Integrity of Public Administration), which no longer exists today. The basic function of this authority was to guarantee, independently of the Italian government, the optimization of the productivity of public work, and the efficiency and transparency of Italian public administrations.
4. L. 240/2010 ANVUR quality assessment in universities.

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This, however, demonstrates that the objectives set and the actions implemented to achieve them have largely worked. The result was achieved due to the collaboration and involvement of the technical-administrative staff with the teaching staff. This has made it possible to obtain a significant competitive advantage given by the assembly of several people, who are nevertheless bearers of different knowledge, rationality, and experiences.
The most important actions that gave an immediate and tangible result include:

- Encouragement of the valorization of research results through dissemination workshops and seminars;
- Promotion of business culture through scheduled invitations to local and, sometimes, national entrepreneurs to hold seminars and spread their story among university classrooms;
- Strengthening and enhancing business support programs through training courses aimed primarily at entrepreneurs. A significant innovative experience to report and reproduce is undoubtedly the establishment of a dedicated research and training center aimed at entrepreneurs. In fact, the Department of Business and Legal Sciences has inaugurated the Training and Research Center for Small and Medium Enterprises, a sort of incubator within the department.

Conclusion

In the context of the economy and management of private companies, the perspective of "looking to the future" constitutes, without any shadow of doubt, one of the indispensable strength that allow the company to continue to live and thrive over time. This concept must also and above all be the perspective for public administrations.
Generally speaking, what is required today is an efficient and effective organization, even if this involves a necessary change of vision, primarily on the part of public administration operators, including those in the university

5. L. 98/13 ANVUR evaluation of the performance of administrative activities in universities.
6. Legislative Decree 25 May 2017, no. 74, hereinafter Legislative Decree 74/2017, made changes to Legislative Decree 150/2009 regarding the optimization of public labor productivity and the efficiency and transparency of public administrations, implementing the provisions of article 17, paragraph 1, letter r), of Law 7 August 2015, no. 124 (so-called “Madia reform”). Legislative Decree 74/2017 provides, among other things, that “public administrations annually evaluate organizational and individual performance. To this end, they adopt and update annually, subject to the binding opinion of the independent evaluation body, the Performance Measurement and Evaluation System (SMVP).
7. Worth mentioning is the implementing decree of Law 43/2005, or Ministerial Decree 216/2007, which defines the methods for drawing up three-year strategic plans.

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sector, called to work with greater order and with the awareness that every organizational-management choice is related to the need to achieve pre-ordained objectives.

In truth, it was necessary to introduce Legislative Decree 150/2009 (Brunetta Decree). However, the subsequent modification was introduced by means of Decree no. 74/2017, implementing the Madia law no. 124/2015. After a long period, characterized by waste and inefficiencies, it was necessary to introduce a rule that required public administrations to measure their work, thereby allowing the user/student grasp the transparency of the processes managed by public administrations and universities in a more efficient reallocation of available resources.

From this perspective, based on the opinion of the author, the direction in which the "**DiScAG model"** and the University of Calabria are headed is considered positive. This is especially in terms of performance measurement with the introduction of participation for technical-administrative staff in the operational processes that take place within the department at all levels.
The involvement of multiple individuals who do not work together results in diverse views, rationality, and experiences, and this constitutes a source of competitive advantage. Therefore, it is important to consider these 5 objectives:

- plan better;
- measure better;
- evaluate better;
- reward better;
- report better.

Evidently, a structure works better if it is based on good activity planning. Also, without everyone's cooperation and a valid reward system, things cannot effectively work. Therefore, this paper hopes to contribute actively and materially to the construction of a TM as the point of reference for DiScAG in the present and for the coming years.

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followed. This research was carried out according to the guidelines of the ethical code of the University of Calabria.

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Situación de la conciliación laboral y familiar en las PYMES de servicios de la ciudad de Escárcega

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Resumen

En la sociedad actual, la conciliación entre el trabajo y la vida familiar se ha convertido en un asunto esencial para los empleados de un establecimiento. La creciente necesidad del equilibrio entre la vida laboral y familiar ha motivado a numerosas compañías a revisar sus políticas y métodos para satisfacer las demandas de su personal. El objetivo de la investigación es evaluar las condiciones de la conciliación laboral y familiar en las PYMES de servicios en la ciudad de Escárcega buscando analizar las prácticas y políticas implementadas por las empresas para facilitar el equilibrio entre el trabajo y la vida familiar de sus empleados. Esta investigación tiene un enfoque de investigación cuantitativa de acuerdo a la aplicación de cuestionario que sirvió desde una perspectiva a la recolección de datos precisos, lo que nos permitió al análisis de variables identificables como la flexibilidad de horario de jornadas de trabajo, permisos razonables, entre otras. Aunque las encuestas fueron aplicadas de manera personal y muestran cifras alentadoras en la

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satisfacción de los empleadores y empleados se considera que aún hay mucho que hacer en cuanto al reconocimiento de derechos a los empleados en los temas de jornadas laborales bien remuneradas, flexibilidad en el horario fomenten la conciliación familiar y laboral.

Palabras clave: Empleo, horas laborales, conciliación, familia, Escárcega

Situation of work-life balance in service SMES in the city of Escárcega

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Abstract

In today's society, the balance between work and family life has become an essential issue for employees of an establishment. The growing need for work-life balance has motivated numerous companies to review their policies and methods to meet the demands of their staff. The objective of the research is to evaluate the conditions of work-life balance in service SMEs in the city of Escárcega, seeking to analyze the practices and policies implemented by companies to facilitate the balance between work and family life for their employees. This research has a quantitative research approach according to the application of a questionnaire that served from a perspective to the collection of precise data, which allowed us to analyze identifiable variables such as flexibility in working hours, reasonable leave, among others. others. Although the surveys were administered personally and show encouraging figures in the satisfaction of workers and employees, it is considered that there is still much to do in terms of the recognition of employee rights in the areas of well-paid work hours, flexibility in hours. Promote family and work conciliation.

Keywords: Employment, working hours, conciliation, family, Escárcega

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Introducción

Según López Núñez (2020) el entorno laboral desde hace décadas se ha caracterizado por largas jornadas laborales, un ejemplo de ello es México siendo el país con más horas laborales en todo el mundo con bajos salarios con la esperanza de poder adquirir la canasta básica para su familia, mientras que otros países como Japón mantienen largas jornadas con el objetivo de mantenerse competitivo en el mundo empresarial, aunado a ello la creciente participación de las mujeres en el ámbito laboral que marca la desigualdad laboral.

Según la Organización Internacional del Trabajo (OIT, 2021) se ha demostrado que, alrededor del 9% de la población global labora más de 55 horas por semana, situación que se ha comprobado que puede tener consecuencias adversas en el ámbito mental, físico y social, llegando en ocasiones a ser fatal. Por lo que exceder las 55 horas semanales de trabajo provoca un incremento en el riesgo de padecer enfermedades cardiovasculares, isquemia, estrés y depresión severa, cerebrovasculares, entre otras. De acuerdo con el estudio realizado por el Instituto Nacional de Salud Pública de México (INSP, 2020), en el ambiente laboral actual, las demandas son elevadas y el control sobre las condiciones laborales tiene ciertas limitaciones. Por lo tanto, prevenir cualquier enfermedad causada por la prestación de los servicios de los trabajadores, sea física o emocional, debe ser responsabilidad del empleador, de igual forma que los accidentes. Ramírez (2020) menciona que las enfermedades, son determinadas por la ley o la Secretaría del Trabajo y Previsión Social (STPS). Sin embargo el ritmo de trabajo ha ido en aumento, con la presencia de riesgos físicos, inseguridad laboral, salarios bajos, acoso laboral y escasa oportunidad para el desarrollo profesional. A pesar de que se ha trabajado en la legislación para conciliar el trabajo y la familia no ha sido fácil. Para Aguilar-Barceló et, al (2016) la situación que actualmente se vive entre la conciliación de la vida familiar y laboral se debe a los roles que tradicionalmente se han asignado por el hecho de ser hombre se les considera como proveedor y la mujer solo como cuidadora de la familia, la casa y el dinero que es provisto por el hombre, ya que la sociedad y los intereses creados no se han adaptado al arribo masivo de las mujeres al mercado laboral. Por otra parte el entorno familiar es un elemento esencial para el desarrollo personal. De acuerdo con Díaz Dumont et, al., (2020) dice que la familia tiene dos grandes y cruciales responsabilidades para la formación del Ser humano: educar y formar a sus integrantes para que cada uno de ellos pueda desarrollar su mayor potencial y lograr insertarse en el sistema social. De acuerdo con esto, podemos decir que la familia permite el desarrollo emocional y una autoestima, lo que ocasiona que puedan interactuar con la sociedad, así mismo es esencial para el crecimiento físico y emocional.

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Para Greenhaus y Beutell (1985) consideran tres dimensiones que detonan el conflicto en las empresas (Mypimes), tiempo, desgaste y el comportamiento. Es decir, el tiempo muchas veces no es suficientes para llevar a cabo una actividad productiva que subjetivamente considera el empleador, cabe mencionar que en las Mypimes de Escárcega no están estandarizados los procedimientos, situación que contribuye a esta forma de trabajo para los empleadores, al mismo tiempo que tampoco es suficiente para llevar a cabo la convivencia familiar, por lo que, la falta de tiempo, el desgaste físico y emocional derivado de estas actividades dificulta tener un equilibrio actividades tanto en el trabajo como en la familia. La creciente necesidad de equilibrio entre la vida laboral y familiar ha motivado a numerosas compañías a revisar sus políticas y métodos para satisfacer las demandas de su personal, por lo que el objetivo de esta investigación es conocer la Situación actual de las PyMes dedicadas a ofrecer servicios en el ámbito de conciliación laboral y familiar en la ciudad de Escárcega.

Métodos

La presente investigación se realizó en la ciudad de Escárcega, Campeche ubicada en el sur sureste de México. Misma que tiene un enfoque cuantitativo de tipo descriptivo. Según Bautista (2021) el "enfoque de investigación cuantitativa trabaja con un enfoque matemático mediante cuantificación y análisis de datos que surgen en el proceso del estudio para comprobar hipótesis o teorías". Por tal motivo, la presente investigación tiene un enfoque de investigación cuantitativa de acuerdo a la aplicación de cuestionario que sirvió desde una perspectiva a la recolección de datos precisos, lo que nos permitió al análisis de variables identificables a través de preguntas estructuradas dirigidas a los empleadores, dividiéndose en aspectos personales como la edad y sexo, jornada laboral, permisos razonables, visibilización de las mujeres a través de los permisos por embarazo y lactancia, derechos de los hombres en permisos por nacimiento de un hijo y actividades integradores para la conciliación laboral. Cabe mencionar que ninguna de las personas que trabajan en dichas empresas mencionaron no pertenecer a ningún sindicato, debido a que para pertenecer se paga la inscripción al mismo y se debe dar cuotas mensuales a lo que no están dispuestos los trabajadores.

Considerando la parte descriptiva según Pereyra (2020) el método descriptivo consiste en presentar la información lo más real a lo encontrado describiendo los elementos y la interrelación que caracterizan al objeto de estudio a partir de registros. En la investigación se emplea la técnica de la observación y la aplicación de un instrumento para la recolección de datos con el propósito de conocer la situación actual de las Mypimes dedicadas a ofrecer servicios a la ciudad de Escárcega, Campeche. Por tal motivo, el presente estudio tiene un enfoque de investigación cualitativa de acuerdo a la aplicación

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de cuestionario que sirvió desde una perspectiva a la recolección de datos precisos, lo que nos permitió al análisis de variables identificables. Para Hernández et al. (2014) considera la población de estudio al conjunto de todos los casos o situaciones que coinciden con una serie de especificaciones.

Con relación a las empresas de servicio en Escárcega, las cuales son un total de 543 empresas de servicios y proveedores, de las cuales se encuestaron 220 representando el 40 % del total de las empresas de servicio y proveedores.

Las empresas se agruparon de la siguiente manera: servicios médicos, servicios automotrices, servicios de alimentos y sector educativos, tomado como un servicio que se brinda a los estudiantes, cabe decir que esta muestra fue de manera aleatoria. Cabe aclarar que la muestra no pertenece a ningún estudio previo del Tecnológico Superior de Escárcega. Para poder obtener la información deseada; según el instrumento realizado, para Medina et al, (2023) el instrumento de investigación en este caso el cuestionario con la valoración de la escala de Likert, lo que nos permitió recopilar y analizar información en un proceso de investigación. Este instrumento permite al investigador obtener información precisa y confiable sobre el estudio en cuestión. De tal forma, que este estudio fue mediante la aplicación de un cuestionario tomando los criterios de: Totalmente de acuerdo, de acuerdo, indiferente, en desacuerdo y totalmente en desacuerdo de forma presencial, previamente diseñado y validado por tres expertos en el tema; teniendo la finalidad de mostrar la situación que presentan los empleados en relación a la conciliación laboral y familiar en las PYMES de Escárcega, Campeche.

Resultados

Dentro de los resultados obtenidos de la encuesta para conocer la situación de la conciliación laboral y familiar en las PYMES de servicios la ciudad de Escárcega fue realizada de manera personal, por lo que la toma de datos fue de manera física, en un tiempo promedio de 3 meses en el período marzo-mayo del presente año. Una vez analizados los datos se puede observar que de muestra encuestada en este caso 220 empresas de servicios y proveedores se encontró que la edad promedio de los empleadores o dueños es de 30 a 35 años, es decir se entrevistaron un empleador o dueño por empresa de las cuales 119 son mujeres representando el 54% y 101 hombres, representando un 46%.

Ya entrando en el siguiente aspecto a valorar de las 220 empresas encuestadas, que representa un 100%, respecto a la jornada laboral en las empresas un 47 % de los empleadores o dueños encuestados está totalmente de acuerdo con la jornada laboral que tienen los empleados, misma que es en promedio 8 horas diarias, y el 42 % de los empleadores o dueños de las empresas respondieron estár solo de acuerdo con la jornada laboral; mientras

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que un 6% le es indiferente la jornada laboral, el 3% está en desacuerdo y un 2% está en total desacuerdo con la jornada laboral que tiene en la empresa que labora. Es importante recordar la efectividad de la jornada laboral, debido a que es fundamental para impulsar el desarrollo económico y social de la comunidad.

Con relación a los permisos razonables que se les otorga a los trabajadores dentro de la jornada laboral un 46% de los empleadores dicen dar acceso a ello, mientras que el 48 % no le da importancia al tema de los permisos y solo un 6 % menciona no darles acceso a los permisos argumentando que los motivos son: falta de personal o no es parte de las políticas de la empresa, esta situación es un factor que influye en el ambiente laboral. Un aspecto fundamental para visibilizar a la mujer es respetar sus derechos y en este caso en específico los permisos por embarazo, incapacidad por gravidez, y por su puesto a los padres sus permisos por nacimiento de un hijo. Para este rubro se pudo observar que un 41% de los empleadores o dueños de empresas está totalmente de acuerdo en otorgar estos derechos y solo un 4% manifestó estar totalmente en desacuerdo, mientras que un 55%; de los empleadores dice no conocer los derechos que tienen los empleados o trabajadores de sus empresas en este rubro debido a que no realizan un contrato formal, si no la contratación es de manera verbal.

Es importante resaltar que esta es una práctica fundamental para garantizar el bienestar de los empleados y cumplir con las disposiciones legales. Otro de los aspectos que se consideró en la encuesta fue si las empresas realizan actividades que promuevan la convivencia familiar teniendo que las siguientes cifras según los empleadores: un 36% se encuentra de acuerdo, mientras que 40 % no está de acuerdo en realizar actividades que permitan convivencia de los trabajadores y la familia, esto puede tener relación con la falta de conocimiento y la gran necesidad del empleo por parte de los empleados. Sin embargo, estas actividades tienen un impacto positivo en el rendimiento laboral y la satisfacción en el trabajo y contribuye a fortalecer el sentido de pertinencia en el centro de trabajo.

Discusión

Para Biedma Ferrer et al (2014), las acciones de conciliación trabajo-familia son de gran importancia en la gestion de recursos humanos tanto para reducir factores negativos, como para potencializar comportamientos deseables en los trabajadores al implantar medidas de conciliación se encontrarían la reducción del ausentismo, falta de pertinencia y las mejoras en el desempeño.

Mientras que MacInnes (2005) desde principios de siglo menciona que de la noche a la mañana se pretende hacer creer que las empresas están dispuestas a realizar estos cambios, cosa que no ha sido así; por lo que aún no

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se puede medir si la productividad está asociada a la relación de la conciliación familiar y laboral.

Conclusión

Aunque las encuestas fueron aplicadas de manera personal y muestran cifras alentadoras en la satisfacción de los empleadores y empleados en relación al tema de respecto la situación de la conciliación laboral y familiar en las PYMES, se considera que aún hay mucho que hacer en cuanto al reconocimiento de derechos a los empleados por parte de los empleadores para jornadas laborales bien remuneradas, flexibilidad en el horario y poder tener una conciliación laboral y familiar verdadera, que se vea reflejada en la productividad de la misma empresa.

El instrumento fue aplicado a los empleadores o dueños de empresas y tuvo el objetivo de conocer la situación actual de las mismas; sin embargo aunque mencionan estar de acuerdo con los aspectos encuestados no quiere decir que lo estén aplicando, es ahí donde surge un área de oportunidad para conocer que tanto están implementando actividades que fomenten la conciliación familiar y laboral.

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Play-Based Learning: Conceptualization, Benefits, and Challenges of Its Implementation

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Abstract

This paper focuses on exploring the conceptualization, benefits, and challenges of implementing play-based learning (PBL) among Eritrean pre-school educators. The study was grounded on the social cognitive theory and a qualitative research approach was applied to explore the research objectives. A semi-structured interview was conducted with nine teachers, six principals, and two pre-primary education curriculum developers. Using inductive approach, interviews were thematically analyzed. The study found discrepancies between participants' views and their implementation. The findings indicate that most of the participants viewed PBL as incorporating both free play and guided play. Although free play is useful in the overall development of children, this study revealed that it cannot be used effectively as an instrument to teach lessons that have specific academic objectives such as numeracy and literacy skills. Moreover, the researchers sought to investigate the actual practices of PBL. The study found that the majority of educators were placed at the extremes of the Child Adult Involvement Continuum: free play and direct instruction. Furthermore, the results revealed that teachers faced various challenges as they tried to implement PBL, but the most common barrier discussed by interviewees was the lack of awareness of parents and principals towards PBL among others. Finally, the study

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concluded that the reason teachers lie at the two extremes of the Child Adults Involvement Continuum could be due to their views towards PBL, its benefits, and the challenges they face in implementing it. The study contributes to the ongoing research on how PBL is conceived and integrated into the pre-primary school context through the Eritrean perspective. The findings can inform future professional development for practitioners.

Keywords: Play-based learning, Free play, Guided play, Pre-school educators' perspective, Implementation

Introduction

Literature in early childhood education indicates that children's engagement in quality early childhood education (ECE) before starting compulsory education is beneficial. High-quality ECE impacts children's academic development as well as their emotional and social well-being more powerfully than any other education phase (McInnes, 2019). To ensure the quality of the early education children receive, the National Association for Education of Young Children in the United States (NAEYC) has provided a best practice framework since 1986. Developmentally Appropriate Practices (DAP) refers to the concept of providing an environment and offering content, materials, activities, and approaches that are coordinated with a child's level of development and readiness (NAEYC, 2009).

Although the term "DAP" was first used in the United States, the concept is not contained there. Many countries like Belgium, Netherlands, Italy, and New Zealand follow similar DAP ideas and principles (Walsh et al., 2010). The DAP mentioned in the position statement by NAEYC are grounded both in the research of child development, learning, and the knowledge base regarding education effectiveness. One of the twelve principles listed in the position statement for informing best practice is play. It is stated in the document that "play is an important vehicle for developing self-regulation as well as for promoting language, cognition, and social competence" (NAEYC, 2009, p. 14). Although research has repeatedly shown that play is a vital aspect of children's overall development and learning (Pyle & Danniels, 2017; McInnes, 2019), integrating play in children's learning, especially in the classroom context, has been a controversial issue (Miller & Almon, 2009). The controversy arises because of the different benefits that come as a result of the types of play-based learning (PBL) approaches that teachers use. The literature focuses on two types of PBL: free play and guided play. In free play, children are provided with the autonomy to choose the play-based activity, which arises from their motives, and the direction of the activity is also determined by the child (Lee et al., 2015; Pyle & Danniels, 2017). Guided play, however, as the name indicates, occurs when an adult structures or guides

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the PBL activity to accomplish a particular academic objective (Weisberg et al., 2013; Zosh et al., 2018). If this guidance is extreme, and only the teacher determines what is done in the classroom, then PBL would lose its meaning, and the teaching methodology will be a direct instruction method. The direct instruction method of teaching is the traditional, didactic teaching method where the teacher speaks and the learners listen passively (Miller & Almon, 2009).

These two types of playful pedagogical approaches (free play and guided play) have their pros and cons. However, the approach teachers use will depend on the views towards PBL, the challenges they face as they try to implement PBL, and the developmental and learning benefits expected from PBL. Different studies show that teachers who endorse the developmental benefits of play primarily facilitate free play in their classrooms, while teachers who endorse the academic benefits of play facilitate a broader range of play activities with active teacher involvement. Therefore, how teachers conceptualize and view PBL, as well as their challenges and the benefits they expect, can indicate how they will implement it in practice. According to Pyle et al. (2020), the fundamental reasons for the discrepancy in integrating PBL are not well understood.

Context

Eritrea is a country located in the Horn of Africa, which officially declared its independence in 1993. Since its recognition as a sovereign nation, the country has been showing noticeable Early Childhood Education progress. The Early Childhood Care and Education Unit (ECCE) within the ministry of education understood the benefits of early childhood education and worked to institutionalize and improve the quality of the education provided in early childhood years (Habtom, 2001). As a result of the effort, the ECCE, with the support of the United Nations Children's Fund (UNICEF) and other stakeholders, developed learning standards that include developmentally appropriate practices (ECCE, 2011). In congruence with the NAEYC position statement, one of the core ideas stated in the learning standards is that children should learn while playing and should play while learning (ECCE, 2011). This idea reflects on the two types of play that literature focuses on: free play and guided play. Whether it is free or guided, play has a remarkable contribution to children's learning and development. Hence, Eritrea's ECCE has been working to incorporate developmentally appropriate practices, such as play, into pre-primary education curriculum.

In Eritrea, pre-primary education prepares children for school (at the age of 4 to 5 years old) and lays a firm foundation for later education. There are three categories of pre-primary schools in Eritrea: governmental, private, and missionary pre-primary schools. Although these three follow the same

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curriculum designed by the Ministry of Education, schools possess different contextual background. Educators in those schools conceptualize and integrate play differently. Hence, PBL in these three types of pre-primary schools is expected to differ. Therefore, it would be essential to explore how educators conceptualize and integrate PBL in the Eritrean pre-primary school context to explain a gap between theory and practice. The study will contribute to the existing literature on how PBL is conceived and integrated into the pre-primary school context through the Eritrean perspective. Furthermore, it will inform educators on the different developmental and academic benefits gained from the different types of playful approaches to learning. The research was guided by the following three questions to reach its objectives.

1. How do Eritrean pre-primary school teachers, principals, and curriculum designers conceptualize PBL?
2. What are the developmental and academic benefits of PBL approaches?
3. What challenges do Eritrean pre-primary school teachers face as they try to integrate PBL into their classes?

Literature Review

It has been difficult over the years to define and conduct a study on play, because it is an intrinsically spontaneous and unpredictable phenomenon (Khalil, Aljanazrah, Hamed, & Murtagh, 2022). An important aspect that complicates the definition of play is that it is seen through different theoretical approaches or lenses (Fesseha & Pyle, 2016). When seen from a psychological perspective, for example, which is widely agreed upon (Pui-Wah & Stimpson, 2004), play is defined as a function of the individual's disposition. It is an activity that is intrinsically motivated, freely chosen by the child, and has a personal direction (Pyle & Danniels, 2017). Hence, children's behavior during play is a natural one, and they do whatever they wish in their own time and ways (Holt et al., 2015). When seen from another view, such as the neurological perspective, play is described as an activity that helps develop the sensory and neurotransmission stimulators and overall cognitive development (Rushton, Juolaa-Rushton, & Larkin, 2010). Hence, the lack of a clear and precise definition of play creates confusion for early childhood educators regarding the integration of play with learning (Fesseha & Pyle, 2016).

Play Based Learning (PBL)

An essential inquiry in the 21st century is how to best educate children and prepare them for an ever-changing, technological, and globalizing world. One important approach to learning is play-based. PBL is a pedagogical philosophy that tries to combine play and learning. PBL 'are the ways in which

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early childhood professionals make provisions for play and play-based approaches to learning and teaching, how they design the PBL environment, and all the pedagogical decisions, techniques, and strategies they use to support or enhance learning and teaching through play' (Wood, 2004, p. 27).

PBL includes two methods with contesting ideas: guided play and free play (Weisberg et al., 2015). Free play encompasses all criteria within the general concept of play. It involves the child's active engagement, is fun, directed by the child, and flexible (Holt et al., 2015). Since free play is directed by the child and driven by their own motives, it can effectively promote various domains of children's development (Gray, 2013). However, Geary (2007) argues that free play is challenging to apply in educational settings with specific curricular goals. Geary (2007) proposes that to teach children 'biological secondary' skills, which have evolved only in some cultures and require formal schooling, teachers must employ direct instruction. However, when applying direct instruction, everything is defined by the teacher, and children are passive recipients of mere information. This methodology limits children's opportunities for play, exploration, and learning, thereby hindering their development (Gray, 2013). While free play enhances children's development, its disadvantage lies in the difficulty of predicting the scientific learning outcomes, as there is no definite goal or direction set by the teacher. In learning context, however, free play is not the only type of play. As highlighted in literature, teachers can be involved in play with varying degrees of involvement, from collaboration to direction (Pyle & Danniels, 2017).

Some researchers have introduced a concept termed "guided play" to resolve the imbalances between these two methods (Weisberg, Hirsh-Pasek, & Golinkoff, 2013). Guided play combines the child-directed nature of free play with the learning goals associated with direct instruction. In guided play, the teacher gives children the autonomy to explore their environment, while also providing guidance and scaffolding (Weisberg et al., 2013).

Views and Conceptualizations of PBL

PBL is a relatively new concept and a pedagogical approach that has recently received much attention in Early Childhood Education. Due to its novelty, there have been divided views and understanding on how teachers view the concept of PBL (Bubikova-Moan et al., 2019). Teacher's views toward PBL vary along a continuum, ranging from those who advocate unrestricted free play to those who argue that children should prepare for formal education with minimal play in pre-primary school. In between these extremes, we also find teachers who are placed in the middle within the continuum (Bubikova-Moan, Næss Hjetland, & Wollscheid, 2019). A study conducted by Pyle, Prioletta, and Poliszczuk (2018) highlights discrepancies among teachers regarding the integration of play with learning. In their

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qualitative study, half of the participants believed that play can be effectively integrated with learning and is beneficial for children's academic and overall development. The remaining teachers held the opinion that while play supports children's overall development, adapting play as a pedagogy for specific academic areas would not be effective.

In another study of teacher's beliefs towards PBL, conducted in Northern England, a significant number of teachers were undecided whether PBL can be enacted, and some opposed PBL (Walsh, Glenda, & Gardner, 2006). The uncertainty and opposition among teachers towards PBL mirror findings from a study by Pyle et al. (2018). In both studies, a significant number of teachers perceived play and learning as two different entities, acknowledging that play contributes to the overall development of children but may not necessarily enhance academic achievements such as literacy and numeracy skills. Moreover, ECE teachers in different Asian, Scandinavian, and English-speaking countries almost unanimously perceive play as an activity that enhances social competence and holistic development. However, their beliefs regarding the role of play in enhancing academic learning are inconsistent (Bubikova-Moan et al., 2019).

Therefore, as Danniels and Pyle (2018) suggested, it would be helpful to identify teachers' views towards PBL as a continuum, ranging from those who entirely oppose PBL to those who are unsure about its effectiveness, and those who firmly believe that play can be integrated with learning.

Developmental and Academic Benefits of PBL

The evidence of the benefits of PBL in children's holistic development and academic achievement is not vivid. First, researchers have not yet agreed on the definition of PBL. Different researchers view PBL with different theoretical perspectives, which adds to the complication of understanding the benefits of PBL (Fesseha & Pyle, 2016). From an educational perspective of PBL, differences among educators can be identified in their perceived views toward the benefits of PBL (Fesseha & Pyle, 2016). Free play, which is initiated and directed by the child with very little interference from adults, is believed to enhance children's overall development. Overall development includes fostering personal and social skills, communication skills, physical development, and overall cognitive development (Pyle & Danniels, 2017; Fesseha & Pyle, 2016). On the other hand, research findings reveal that for academic learning, such as literacy and numeracy, to occur in a playful activity, teachers should participate in the process to some degree (Pyle & Danniels, 2017). Nevertheless, the literature does not define the extent of teachers' engagement in such play (Fesseha & Pyle, 2016).

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Challenges of PBL Implementation

It is consistently indicated in PBL literature that the pedagogy comes with various application difficulties (Bubikova-Moan et al., 2019). One of the most frequently reported challenges for teachers is balancing policy and curricular mandates with play-based activities. A study conducted by Fesseha and Pyle (2016) suggests that the play-based curriculum lacks a clear and more consistent conceptualization of play, which leaves teachers confused about implementing PBL. In other studies, teachers are challenged in applying a play-based pedagogy because of the administration's pressure to apply a more traditional direct way of teaching (Wu, 2014; Baker, 2015). Another challenge that teachers face in enacting PBL is parental attitudes. For example, Fung and Cheng (2012) describe that in the Chinese tradition, effort and willpower are considered the essence of effective learning, but parents may not perceive any efforts their children make while they play. Hence, they have ambivalent views towards PBL, which creates an obstacle for teachers to implement the approach effectively.

Teacher education and qualification present another challenge for implementing PBL in Early Childhood Education. Teachers in studies conducted by Gray and Ryan (2016) reported having a limited understanding of PBL as a concept. Hence, teachers either incline to a classroom environment where child-directed activities dominate learning or to a class where scripted teaching and didactic instruction dominates (Miller & Almon, 2009).

Theoretical Framework

The Zone of Proximal Development (ZPD), according to Vygotsky, is 'the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers' (Vygotsky, 1978), as cited in Nilsson and Ferholt (2014). According to Vygotsky, what a child can achieve alone in learning and development significantly differs from what he or she can achieve when supported by an adult.

ZPD can be created through play, which allows children try out real-life situations and circumstances. Furthermore, children have roles and rules to attend to, which makes play a form of activity that can create a proximal development zone. Play creates a situation where the child can learn and develop. However, as Vygotsky suggests, the child's potential to learn and develop within such a context must be backed up by an adult. Therefore, the adult/teacher who tries to bridge the gap between the child's actual development level and learning with his/her potential level plays a role of mediation/instruction, which Bruner called scaffolding (Brock et al., 2013).

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Scaffolding can be understood and conceived differently by different practitioners. Therefore, how they integrate learning and play in their classrooms can differ accordingly. According to Miller and Almon (2009) and Zosh et al. (2017), differences in the way practitioners integrate or scaffold play in the early childhood classroom creates a continuum of free play, guided play, and direct instruction. Free play, which allows children the freedom to explore and discover at their own initiative, is positioned at one end, while direct instruction, where children have limited opportunities to learn through play, is found at the other end. Guided play, where a teacher structures or guides play, is situated in the middle of these two extremes (Miller & Almon, 2009; Zosh et al., 2017; Weisberg et al., 2013).

Methods

Research Design

This research study was grounded on constructivism (phenomenologist) philosophical assumption and followed a qualitative research design to collect data through semi structured interviews. The researchers applied an inductive research approach (interpretive investigation of experiences from the particular to universal) from a subjective point of view (ontology). The study was conducted through a qualitative approach to see educators' practices in natural life settings. According to Yin (2016), if the study aims to identify people's practices under real world conditions through their own perceptions of reality, the qualitative approach is a preferred study design. Considering the research questions, a qualitative design was chosen. In Eritrea, while the early education curriculum promotes PBL, it is expected that the practitioners alone express salient constraints to PBL. Therefore, a qualitative approach, which studies people's opinions and perspectives in-depth, was considered a better fit for the current study.

Participants

The study participants included pre-primary school teachers, principals, and curriculum designers of ECCE unit Ministry of Education (MoE). Nine teachers and six principals from three different types of pre-primary schools were purposively selected. Two informants from the ECCE unit that had an active role in designing the ECCE curriculum participated in the study. The criterion for tenure, requiring at least three years of experience in preschool, was established to ensure that interviewees could thoroughly conceptualize PBL and understand its benefits and challenges within their context. Principals may serve as valuable sources of PBL information for this study. Curriculum developers operate from the central office and oversee the design and support all pre-schools in Eritrea. Also, researchers selected teachers from different type of pre-schools to ensure the inclusion of opinions

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from various professional backgrounds based on their experiences. The study categorized pre-primary education into three types of schools: missionary, public, and private schools. Therefore, the sample included participants from each of these school types. As indicated in Table 1, participants' ages ranged from 26 to 73 years old. Their experience in pre-primary education varied from 3 to 50 years. Participants' educational levels spanned from those with no formal training in ECCE to those holding a master's degree in the field. Table 1 summarizes the demographic information of the participants.

Name	Age	Gender	Training in ECCE	Current Position	Experience in ECCE Years)	Type of School
GT1	34	F	Diploma	Teacher	14	Public
GT2	48	F	Diploma	Teacher	6	Public
GT3	40	F	Diploma	Teacher	20	Public
MT1	45	F	Diploma	Teacher	13	Missionary
MT2	48	F	Certificate	Teacher	17	Missionary
MT3	26	F	No training	Teacher	4	Missionary
PT1	27	F	No training	Teacher	3	Private
PT2	32	F	No training	Teacher	4	Private
PT3	30	F	Diploma	Teacher	8	Private
GP1	58	F	Diploma	Principal	38	Public
GP2	47	F	No training	Principal	4	Public
MP1	73	F	B.A	Principal	50	Missionary
MP2	32	F	Diploma	Principal	7	Missionary
PP1	39	M	Diploma	Principal	17	Private
PP2	42	F	No training	Principal	7	Private
Informant 1	65	F	M.A	ECCE official	25	ECCE office
Informant 2	50	F	M.A	Supervisor	20	ECCE office

Table 1. Demographic Characteristics of the Participants

Data Collection Procedure and Analysis

The study adopted the model of Zosh et al. (2017) as a conceptual framework. The type of PBL approaches that educators use, or where they position themselves on the continuum can be influenced by their views on these approaches and their perceived benefits. Researchers focusing on the developmental benefits of PBL emphasize the importance of free play, led by the child with a passive role for the teacher. Conversely, researchers emphasizing academic benefits stress PBL directed by the teacher or mutual direction by both teacher and child (Pyle & Danniels, 2017). Therefore, the study will address four crucial issues: educators' conceptualization and views of PBL; their expectations regarding developmental and learning benefits from integrating play in their schools and classrooms; constraints in implementing PBL; and how educators practically implement PBL.

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To maintain ethical rules, the researchers requested permission from the ECCE and SN unit to collect data from different pre-primary school teachers, principals, and ECCE officials. Subsequently, written informed consent was obtained from these individuals for participation in interviews. The purpose of the research and procedure of data collection was clearly communicated to the participants. All information provided by respondents was confidential. Teachers and principals were given codes based on their school type so that their identity would be concealed. The first letter of the code represents whether the participant is a principal or a teacher, while the second letter represents whether he/she works in a private school, governmental school, or missionary school. Curriculum designers were referred to as informant one and informant two.

As mentioned above, the data for this research study was collected through semi structured interviews in 2021. After the ECCE office in Eritrea granted data collection permission, the researchers interviewed nine teachers, six principals, and two ECCE officials who had input in pre-primary curriculum development (See Table 1). There are three working languages in Eritrea namely Tigrigna, Arabic, and English. Hence, the interviews were done in Tigrigna language which is the widely spoken language in the country and particularly in the region where this study was done. Individual interviews lasted approximately 45 minutes and digital means were used to record the interviews.

Two interviews were first transcribed, translated, and analyzed to ensure that the semi-structured interview questions elicited valid information from interviewees. After the researchers were convinced that interview questions had content validity, the rest of the participants were interviewed individually. The research followed thematic analysis, specifically inductive approach or method, to analyze the interview data. A theoretical thematic analysis begins with a specific theoretical framework and research questions, analyzing recurring themes or patterns in the data based on those questions (Braun & Clarke, 2006). Hence, interview data was first transcribed and translated. Using Saldana's (2013) coding techniques, the interview data were analyzed. Subsequently, participants' responses were coded based on the study's three research questions and organized into categories. Finally, three major themes with their eight emerging subthemes were identified. A comparison was made among the responses inductively, and some direct quotations from respondents were used to verify and validate the study's report (Rodrigues, Correia, & Kozak, 2016).

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Results

Participants View Towards PBL

A. View Towards Integrating Play in Lessons

All seventeen participants asserted that play can be used as a teaching method and embedded into the teaching and learning process. Two principals (GP2 & MP2) and teacher PT1 mentioned that PBL is the approach supported by the MOE and their schools. They stated a slogan they follow, which says, *'Children should learn while playing and play while learning."* Principal PP1 also mentioned, *'in pre-primary school, a child has to learn playfully, because it enhances their concentration and makes them active.'* The two informants from the ECCE unit similarly asserted that children should learn through play. One of the informants from ECCE affirmed, *'the principle in pre-primary education is that children should learn through play.'* The informant elaborated that PBL is not just an alternative approach in Eritrean pre-primary education but a method of learning that should strictly be followed. Participants, therefore, unanimously believed that play should be integrated into the teaching and learning process in pre-primary education.

Although all participants emphasized that play should be integrated with learning, the extent and how it should be integrated were perceived differently by participants. Five teachers, three principals, and the informants from ECCE had the belief that all kinds of learning and contents in pre-primary education can be done through playful approaches. On the other hand, two teachers and three principals stated that everything could not be taught through play. According to the latter, there is a time when children should learn through play, and there is also a separate time when they should listen attentively to the teacher. Principal MP1 expressed this viewpoint clearly.

> *'I am against the concept that everything should be done through play. Play, play, play, we have to also think about the discipline of the child. Children also have to know when they should write, read, draw, and do other activities. They (people from MOE) sometimes say, 'do not make them write; they just have to play.' But I tell them, 'I am sorry, I will do it, but writing and reading I will not stop it.'*

As principal MP1 expressed, these participants believe that there is a kind of disconnection between play and learning. They viewed play as an activity that would disrupt learning. When it comes to academic learning, such as reading and writing, they had the view that play cannot be considered an effective instrument of learning. Teacher PT2 similarly mentioned that play should be given a limited time and children should receive direct lessons for most of the day. Explaining her point, she affirmed,

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> *'In our school, we try to stretch children to a certain level that they can reach. Making children play the whole day is easy, but we stretch children to do more than that'*

Some of the participants that had the belief that all lessons cannot be taught through play, such as PT2, also expressed the view that children can achieve and learn more if they learn with the traditional direct teaching approach. They believed that direct teaching approach would enhance and stretch children's academic capacities more than PBL.

B. View Towards PBL in Terms of Holistic Development and Academic Learning

Participants also shared their views on how PBL can enhance the holistic development and academic learning of children. The participants were divided into two groups in this category. Some of the participants stated that they did not view academic learning separately, but believed that it is included in children's holistic development. Holistic development included physical, cognitive, socio-emotional, language, and moral development. Other participants perceived academic learning, which included reading, writing, arithmetic, separately from holistic development. They further mentioned that playful activities that enhance this type of learning are also different.

Two third of the seventeen participants believed that PBL included different play types that enhance children's holistic development and academic learning separately. Principal GP2 clarified this by stating,

> *'The plays which promote academic learning are associated with letters and numbers. On the other hand, the ones which promote socio-emotional development, cognitive development, and language are different types of play.'*

Hence, this group of participants believed that there is a difference in the type of play tailored for holistic development and academic learning.

Contrarily, another group which consist one-third of the participants asserted that there is no specific type of play or playful activity particularly intended for academic learning. They indicated that when children play, they develop in all aspects, and academic learning is inclusive. Teacher GT1 described it in this way, *'The one that we are saying academy is included in the five domains of development. There are no specific play types that are designed for numeracy or literacy learning.'* These participants believed that as children engage in different playful activities, they are also learning academic concepts. Therefore, they consider academic concepts integral to the holistic development of children. Moreover, mostly free plays were mentioned. One principal and one teacher had an entirely different view

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regarding academic learning. They suggested that children cannot learn letters or numbers through play and can only be taught such lessons through direct teaching. Principal MP1 affirmed, *'…and in academic learning when the teacher is teaching, students have to listen attentively because the teacher is transferring knowledge.'* Teacher PT2 also had a similar view. The teacher stated,

> *'If a teacher concentrates more on play, then children would just want to play and forget learning.'*

C. Extent of Teacher Involvement

Participants had differing views regarding the extent to which a teacher should be involved in children's play. Half of the participants expressed that the teacher should be involved in guided play, but involvement in free play should be minimal. Principal GP2 explained the view in this way,

> *'Well, there are two types. One is free play. They just play as they like. Even if the teacher does not know whether they are learning or developing, it is just free. The second one is; the teacher has to be involved in the play. Here, there is supporting play, facilitating play, guiding play, and others. So, when she does supporting play, the teacher has to get involved. It means, for example, a puzzle can be difficult for the children, so she says, 'do it like this, and this is done like this'.*

These participants classified play types into two; guided play and free play. They also described that the involvement of the teacher should be more in guided play and less in free play. However, the other half of the participants indicated that there should be minimum involvement from the teacher in all play types. Explaining this, teacher GT1 stated,

> *'The children have to create plays themselves. For example, when they play blocks, the teacher does not tell them to do this or that. They should not be dependent on the teacher. The teacher should instruct them what to do once, but at the time they are playing she should not intrude.'*

Participants View on Benefits of PBL

A. Developmental Benefits of PBL

All participants described that PBL would enhance children's holistic development, which included physical, cognitive, and socio-emotional development. Teacher GT3 mentioned that even one type of play could have enormous benefits for the child in his/her development. She explained this with sand play.

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> *'When a child is playing with sand, his fingers are active, therefore his fine motor skills are developing, he/she is trying to design something in his/her mind and therefore the child is also developing cognitively, and while he/she is playing he/she is also enjoying the success of what he/she has done and is interacting with others, and hence is also developing socio-emotionally.'*

All seventeen participants, therefore, indicated that there is a definite relationship between playful learning and holistic development. Two-third of participants also affirmed that PBL creates a foundation for success in children's later lives. These participants viewed the effect of PBL as long-lasting, preparing children not only for grade school but also for their journey in life. One of the informants from ECCE clarified this aspect.

> *'Pre-primary school in Eritrea is not only preparing children for primary school; that is just a small part of the mission. We focus on holistic development so that children would better prepare for all the challenges they will face later in life.'*

Therefore, several participants, including the two informants from the ECCE unit, viewed PBL as an approach to learning that would equip children in all dimensions to tackle challenges successfully in later life. Another developmental benefit mentioned by half of the participants was that PBL enhances children's critical and creative thinking abilities. The participants believed that play provides an opportunity for children to explore and creates problems to be solved. They noted that as children attempt to solve these problems, their inventive, creative, and critical thinking abilities develop. Teacher MP1 emphasized this viewpoint, '*Leave children to play. As children play, they will have the opportunity to engage in problem-solving, which will enhance their critical thinking'.* Teacher GT3 also mentioned that PBL enhances children's creative abilities. She stated, '*When children play with blocks, mad, puzzles, and other materials, they try to create things such as cars and houses. These activities help them develop their inventive and creative abilities.'*

Few of the interviewees also mentioned that PBL enhances the confidence of children. They emphasized that because PBL provides the foundation for children to talk and interact with their peers, it can help them confidently express their ideas and opinions later in life. Principal GP1 described it thus:

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> *'In play, children interact and co-operate. They talk and ask things that they do not know. These interactions enhance their social development. Also, later in life, they would not say 'what would they say if I do this or that,' so it enhances their confidence'.*

Teacher PT2 also indicated that students who have learned through PBL would not hesitate to stand, teach, and speak in front of other people or a crowd. These participants believed that PBL creates opportunities for children to openly express their ideas, thereby fostering confidence in self-expression.

Finally, a few participants related PBL with assessing children's developmental levels. They noted that when a child engages in playful activities, the teacher can easily assess or determine what developmental aspects the child is lacking. Teacher PT1 remarked, *'If we engage children in different kinds of play, we can easily identify their physical, cognitive, and social abilities, and how they understand their environment.* These teachers suggested that PBL is the best approach for the child's development and learning, as well as an effective tool for assessing their abilities. In summary, participants mentioned numerous developmental benefits of PBL. However, the most frequently mentioned benefits were that it enhances holistic development across all domains, prepares children in all aspects for future life, enhances creative and critical thinking in children, and helps the teacher assess children's development.

Academic Benefits

Participants mentioned three crucial aspects regarding the academic benefits of PBL. One is that children would not forget what they learned; second, children would learn without becoming bored; and thirdly, children's motivation and concentration in learning would be enhanced. Half of the participants emphasized that children would not forget any concept they learned playfully. Teacher PT2 highlighted this point.

> *'Something they learn through a song, story, or other playful method remains in their mind for the rest of their life. I, for instance, remember all the things I learned in school in the form of play. Because children associate it with pleasurable activity, they cannot forget it.'*

Therefore, these participants believed that because children are active and engaged in playful learning, the chances of remembering what they learned would be high. Another academic benefit of PBL noted by half of the participants was that children learn without becoming bored. They observed

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that children learn joyfully in PBL, do not get bored in class, and their attention remain undivided. Teacher PT1 expounded on this point.

> *'when a teacher teaches children directly, children are bored, and they wonder about other things, but when they are thought through play, it is fun for them. They do not even think that they are learning.'*

Challenges of PBL Implementation

A. Lack of Parental Awareness in PBL

One of the frequently mentioned challenges in implementing PBL was the lack of awareness among parents in PBL. Almost two-thirds of the participants stated that parental lack of awareness is a significant challenge for implementing PBL. Many parents believe that their children are simply playing and not learning anything through play. This lack of awareness is particularly challenging for private schools where parents pay for education. Principal PP1 elaborated on this challenge.

> '*Parents want their kids to write and read very quickly, and we want to go according to the syllabus in a play-based way because we believe that it is a better approach and fits with the developmental level of children. However, other private schools focus on writing and reading only, and parents want to move their kids there. Hence, to satisfy parents' needs, we try to focus on direct teaching sometimes, but the MOE does not allow that. Therefore, we face a sort of triangular challenge.'*

This challenge stemming from parents is also present in governmental schools, but principals attempt to resolve it by meeting with parents and informing them about PBL. Additionally, because payments in governmental schools are subsidized, parents do not have the financial leverage to make demands on the learning approach teachers or schools should adopt. A similar challenge for teachers in implementing PBL arises from principals. Two teachers mentioned that PBL, especially free play, is not allowed in their school and is frowned upon by principals. Teacher PT1 for instance expressed that her efforts in trying to make children play outside were perceived negatively. The teacher remarked,

> *'One time when I was a novice teacher, I let the children in my class play outside with a ball, and the principal saw me and was not happy with me and told me not to do such an activity often.'*

Therefore, some principals think that play disrupts learning and this view of principals becomes a challenge for teachers to apply PBL.

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B. Lack of Qualified Teachers and Material Resources

The most mentioned challenge in the interview data was the level of creative abilities teachers have to display when teaching through play. More than two-thirds of the interviewees stated that teachers have to be highly creative and skillful in creating stories and playful activities that are in line with the lessons. Teacher GT2 expressed her concern in this way:

> *'Creating play and stories is a tough task to do; it needs skill. And though the guide book is written in detail, often teachers have to also create stories and plays as they teach'.*

The informants from the ECCE unit also asserted that because teachers lack the skill to teach playfully, they just directly teach students. The ECCE informants also mentioned that teachers receive one-year training only, and in most private sectors, they do not have training in ECCE at all. As a result, they abandon the playful learning approach, which requires a high skill level, and adopt direct instruction. One of the ECCE informants stated,

> *'Currently, almost all private pre-school teachers are untrained and emphasize reading, writing, and arithmetic; and the approach they use is drilling and reciting letters and numbers.'*

Therefore, one of the challenges that educators face is the high level of skill and creativity that they have to display as they teach in a play-based way.

C. Children's Characteristics

Participants mentioned that children also contribute to the challenges of PBL. One-third of the participants noted that children with special needs, who have learning difficulties, are particularly challenging to teach using a play-based approach. The participants emphasized that these children need special attention and the playful activities used with typically developing children are often difficult to implement with them. Teacher GT2 remarked,

> *'When children who have normal development are playing with puzzles, they try to fit the puzzles in a meaningful way. However, children with special needs do not even try to put the puzzles in the correct order; they only look at them and sometimes throw them around.'*

Hence, children with learning difficulties, such as mental retardation, challenged teachers to implement PBL because the playful activities teachers use are not specially designed for such children. One fourth of the participants also mentioned that children in a school come from different neighborhoods and upbringing. These children had different exposures to play, and this

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exposure influences how they would participate in playful learning. Teacher GT3 affirmed,

> *'There are different kinds of children; some are very active because they were raised in a neighborhood that has a collective culture. However, other children had never gone out of their homes to play with other kids before they started school. So aligning the play activities with these two different kinds of children is a hard task to do.'*

Thus, children with mental retardation faced learning challenges, while children who were raised in environments that did not encourage play posed challenges to teachers because they had to adapt playful activities to suit these children.

Discussion and Conclusion

Although all the study participants viewed play positively, the study results depict differences among educators on how they viewed the integration of play in learning. Participants were divided into two groups based on their view of what can be accomplished through PBL in the pre-primary education. The participants mentioned that all lessons can be taught in a playful manner in pre-primary education. Nevertheless, almost half of the participants expressed that everything cannot be done in a play-based way, especially in mathematics and language skills. Similarly, one-third of the participants asserted that the pre-primary education curriculum lacks some direct instructional methods. Studies also indicate that early childhood educators often have uncertainties in teaching academic lessons in playful ways (Walsh & Gardner, 2006; Pyle et al., 2018). Correspondingly, some participants in the current study also had doubts whether all lessons, especially those that had academic objectives, could really be achieved in playful pedagogical approaches.

More than half of the participants conceptualized PBL as encompassing both free play and guided play. Those who viewed PBL in this dual approach saw free play as enhancing general holistic development, while guided play was seen as beneficial for children's academic learning. In the literature, two types of playful learning approaches are identified: free play, initiated by the child with almost no involvement or guidance from the teacher, and guided play, where teachers direct activities to meet specific objectives (Pyle et al., 2018; Weisberg et al., 2015). However, one-third of the participants did not distinguish between free play and guided play within PBL. They believed that any type of play can enhance both holistic development and academic learning, favoring mostly free play types. Fesseha and Pyle (2016) and Geary (2007) argue that free play can enhance children's physical,

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socio-emotional, and cognitive abilities, though it may be challenging to measure specific learning outcomes. Furthermore, a few participants suggested that academic objectives such as mathematics and language skills in pre-primary education require direct instruction, doubting the effectiveness of playful approaches in facilitating academic learning.

Participants were also divided into two groups when asked about the role of teachers in PBL. Half of the participants indicated that teacher's involvement should vary depending on the type of PBL. They suggested minimal intervention in free play and a role in guiding and scaffolding activities in guided play. The other half, however, believed that teachers should have minimal involvement in any type of play

Vygotsky argues that there is a zone in which children have the potential to reach a particular level of development and learning, but cannot reach unless they are helped or guided by more knowledgeable adults, such as a teacher (Vygotsky, 1978). He called this zone the zone of proximal development. Nilsson and Ferholt (2014) discuss that play can create this zone by providing a challenging environment with roles to play and rules to attend to. Vygotsky also proposed that the teacher's input is vital for the child to reach the desired development and learning level. At this point, scaffolding is crucial in shaping but not dominating the learning process. In the current study, as mentioned earlier, some participants believed that the teacher should scaffold children's activities during guided play and agreed with the concept of Vygotsky. Other participants, however, believed that the input of the teacher should be minimal and children should explore things on their own.

The study revealed that educators mostly associated PBL with holistic development. All participants mentioned that play would generally enhance the development of children. Many of the participants also believed that PBL helps children to be prepared for life in general. Similar views are found in studies by Hunter and Walsh (2014) and Pui-Wah and Stimpson (2004). Participants in these studies believed that as children learn through playful ways, all domains of development would be enhanced. Additionally, participants in the current study believed that PBL is a practical learning approach that enhances children's creative and innovative abilities. Through play, children engage in practical activities such as forming blocks, creating models, and assembling materials. As Bergen (2009) highlights, these activities are the daily routines of an engineer or a scientist. Hence, when children engage in such activities at an early age, it can pave the way for them to pursue such creative careers in the future.

It appears that most of the educators in pre-primary education mostly focus on the holistic development of children rather than specific academic areas. This is partly because of the vision of the pre-primary school in Eritrea, which primarily focuses on the holistic development of children rather than

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mastery of specific academic skills. It has been discussed above that the majority of participants primarily implemented free play, which is only one aspect of PBL. The reason for this could be that educators focus on holistic development, assuming it is enhanced through free play.

The study results indicate that parents' and administrators' lack of awareness was one of the frequently reported barriers teachers face as they try to implement playful approaches to learning in pre-primary education. Teachers reported that some parents perceive PBL as a learning approach that allows children to play the whole time without any learning purpose, and hence they are usually against the approach. More than half of the participants believed that parents expect their children to excel in reading and writing skills during their pre-primary schools and demand that teachers use drilling and recitation methods to achieve these academic goals. Studies conducted by Baker (2015) and Fung and Cheng (2012) reported the same results. The studies indicate that it is challenging to implement PBL in countries where academic achievement has very high value. Similarly, in the Eritrean context, rather than seeing what children will achieve later in life through education, parents and the community focus on the short-term academic achievements such as grades and children's ranks in the class. Thus, parents usually associate the term "play" with leisure and assume that their children do not truly learning through playful ways.

Another similar challenge in implementing PBL arises from teachers working in privately funded pre-primary schools. While all principals in the study held a positive attitude towards PBL, these teachers reported challenges in implementing it because the administration did not share their enthusiasm for the approach. In agreement with these reports, Wu (2014) and Baker (2015) indicate that sometimes the administration puts pressure on teachers to follow a more teacher-directed teaching method. This pressure could be due to the lack of awareness from the administration and other factors such as achieving academic objectives and satisfying parents' demands. Moreover, the result of the study indicated that lack of material resources, including insufficient teacher skills and qualifications, inadequate play materials, limited space for activities, and deteriorated infrastructure, make PBL implementation difficult in Eritrean pre-primary schools. Similar to the findings of the current study, Fesseha and Pyle (2016) reports that class size, inadequate materials resources, and school space pose challenges for PBL implementation.

Finally, the study revealed that some teachers and principals experienced challenges when using play-based approach to teach special needs children. Teachers reported that special needs children pose an extra challenge to implementing PBL in the classroom. The types of special needs reported included children with learning disabilities who had some form of mental retardation. Movahedazarhouligh (2018) indicates that various

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physical and cognitive disabilities can limit what children can experience and gain from play. Another challenge that participants stated concerning children's characteristics is that they come from different backgrounds and vary in how they engage in activities and learn through play.

Integrating play and learning requires skill, creativity, and sound theoretical knowledge of play-based teaching approaches. According to the study results, these qualities are lacking in Eritrean pre-primary school teachers. Therefore, providing training for teachers that focuses on implementing PBL should be the responsible body's initial move. PBL necessitates creativity and flexibility in using different methods. Moreover, without the proper training, it would be impossible for teachers to exhibit these qualifications. One of the challenges that educators face in implement PBL is the lack of awareness on the part of parents and sometimes principals that children can learn through play. Therefore, schools, the ECCE unit, and the Ministry of Education should communicate the importance of PBL and raise society's awareness.

Limitations and Future Directions

The main limitation of the study is that it only viewed PBL through the lens of educators. Parent's and children's views were not included. Hence the findings are limited to the perspectives of only teachers, principals, and ECCE officers. Additionally, the study was conducted solely in the capital city of Asmara, as its focus was on urban centers. However, pre-primary schools in urban areas have different backgrounds and compositions compared to those in the rural areas of the country. Therefore, the findings discussed in this study may not apply to rural areas.

Based on the limitations of the study, the researchers suggest the following directions for future study. Prior research concerning playful approaches to learning is lacking in the Eritrean context. Hence, this qualitative study tried to explore educators' views towards PBL and the challenges they face in implementing it from scratch. Through the qualitative methods, the study explored teachers, principals, and ECCE officers' views towards PBL and the challenges to its implementation. Future research, therefore, should explore the research questions using quantitative designs. A longitudinal view would be a good suggestion for future research. Furthermore, research that includes observational studies that confirm the current study's findings should also be done. The current research did not include the view of parents as well as children. Therefore, future research should aim to include these vital sources of information.

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SME Instrument: an empirical analysis on the impact of the second phase on the performance of Italian enterprises

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Abstract

This article is part of the strand of research on evaluating the effectiveness of public funds in stimulating the growth of research and development activities in the private sector. The research focus is on the SME Instrument, in its original version born within Horizon 2020, and in particular Phase 2 of the instrument. The research question, therefore, is "Has the second phase of the SME Instrument had a positive impact on the Italian SMEs that have joined it? If yes, to what extent?" The evaluation will be based on quantitative data inherent in the innovation (and non-innovation) performance of individual firms. At the conclusion of the analysis, it can be concluded that the second phase of the SME Instrument did not produce significant additional effects on the performance of firms, approximated by the ratio of total sales to total assets. The only exception is for those enterprises aged between 6 and 15 years, for which there is a partially significant increase in the sales/assets ratio after receiving funding. Given the research results and given that public and private management share a common interest in making their investments effective and efficient by seeing a return on them, the implications for policymakers are twofold: personalization of policy and promotion of an integrated innovation model, both of which imply a rethinking of the instrument. However, like any

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research, the results obtained are never an end-point, but the starting point for new reflections from which to develop further research.

Keywords: R&D activities, public funds, enterprises, European funds, innovation, public management

Introduction

The importance of research and development as a driving force for sustainable growth in industrialized economies is widely shared among all economists, especially in the context of the structural shift from resource-based to knowledge-based economies[1]. This awareness has also spread among European policymakers, who aspire to make Europe the most competitive economy in the world. For this reason, during the European Council, held in Barcelona in 2002, the target of investing 3% of GDP in R&D by 2010 was included as a pillar of European policies, a target reconfirmed in the Europe 2020 strategy, emphasizing the need for combined public and private sector investment. However, this target has not been met either by the date set at the council or to date: in 2019 the EU's R&D intensity, calculated as gross domestic R&D expenditure over GDP, is around values of 2.1%, well below the values achieved by our competitors on the world market, and generally below the average of OECD countries (2.47%)[2].

EU member states spent around €311 billion on R&D in 2020, one billion less than in 2019, due to the pandemic crisis. The business and enterprise sector continues to be the sector where R&D spending is employed the most, with 66 percent of total R&D disbursed in 2020[3].

The average European R&D intensity value, below the average of OECD countries, is certainly affected by very poor innovation performance at the head of some member countries, which contrasts with the achievements of leading countries in the field such as Austria, Belgium, Denmark, Finland, Germany, France, the Netherlands and Sweden, all of which are above the European average in R&D intensity. In order to bridge the gap between member states so that they can move together and more quickly toward the common goal, the European Commission adopted a Communication in September 2020 suggesting that states, that are below the European average, increase their R&D investment by 50 percent within the next five years.

[1] Kris Aerts, Dirk Czaenitzki, (2004) *Using innovation survey data to evaluate R&D policy: the case of Belgium*
[2] Rakic R. et al., (2021), *Fostering R&D intensity in the European Union: Policy experiences and lessons learned*, Case study contribution to the OECD TIP project on R&D intensity.
[3] https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/ddn-20211129-2

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Of course, the Commission also aims to assist, actively and with numerous instruments that we will discuss later, these structural changes that member states will have to adopt in order to reach the target[4].

The reason for this economic commitment of governments, and of the EU in general, lies in the realization that, without state intervention, private companies would be engaged in developing a level of R&D and innovation activity well below the socially optimal threshold. The reason for this under-investment is inherent in the very character of activity of this kind: insofar as it is non-appropriable, non-divisible, and uncertain, R&D activity takes on the character of a public good that generates externalities that are unlikely to be internalized by the company implementing them, so as to cover the costs it incurs from the investment while also managing to maintain a certain profit margin[5]. A further justification for public intervention lies in market imperfections, first highlighted by Arrow[6] in the second half of the 1990s, and in particular in the information asymmetry that seems to be particularly pronounced in this area. Indeed, when the innovator does not coincide with the party providing the capital, there is a particularly large gap between the innovator's economic return and the cost of capital useful to finance the investment. It is logical to think that the inventor has much more knowledge of the technical details of the project and so also, to some extent, of the success rate of the project, details that either he may not want to share for reasons of secrecy and competitive advantage or, even if he wanted to, not understandable by his financial interlocutor. Because innovative activity is risky by nature and because the lender cannot understand the big picture of the investment, it will lend the capital but at a particularly high cost, thus disincentivizing innovators from applying for a private loan[7]. Firms, therefore, will only be willing to pursue projects that provide some profit margin despite these issues, but since not all will succeed, the level of innovation will be lower than the socially optimal level[8]. After clarifying the motivations behind public intervention, it is necessary to clarify what are the main channels through which support for research and development activities can be bestowed. The

[4] Rakic R. et al., (2021), Fostering R&D intensity in the European Union: Policy experiences and lessons learned, Case study contribution to the OECD TIP project on R&D intensity.
[5] Kris Aerts, Dirk Czaenitzki, (2004) *Using innovation survey data to evaluate R&D policy: the case of Belgium*
[6] Arrow K., (1962), *Economic welfare and the allocation of resources for Invention*. In: Groves, H.M. (Ed.), The Rate and Direction of Inventive Activity: Economic and Social Factors. National Bureau of Economic Research, pp. 609–626
[7] Dirk Czarnitzki (2002), *Research and Development: Financial Constraints and the Role of Public Funding for Small and Medium–sized Enterprises*, ZEW Discussion Paper No. 02-74
[8] Matthias Almus and Dirk Czarnitzki (2003) *The Effects of Public R&D Subsidies on Firms' Innovation Activities: The Case of Eastern Germany*, Journal of Business & Economic Statistics, Apr., 2003, Vol. 21, No. 2 (Apr., 2003), pp. 226- 236

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main instruments through which public institutions promote research and development are tax incentives, funds allocated directly by the public body, business cooperation pacts, public research done at research institutes and universities[9]. While the latter instrument is usually functional for national needs, the former is designed exclusively for the business world.

In this study, we will focus exclusively on the direct funds instrument. In general, the literature shows that the effects of tax incentives have a more immediate effect than direct subsidies, but have no effect in the long run, while direct funds act more slowly but are more effective in the long run[10], the reason probably lies in the fact that while tax incentives are a neutral instrument and are granted "windfall" to all enterprises that fall within the criteria set by the policy, public funds are granted on the basis of the project selected by the issuing entity. This dynamic ensures, to a certain extent, that the subsidized projects are activities that produce consistent value and new opportunities over time[11].

Effect of public funds on R&D activities of SMEs: literature review

The impact of public funding according to economic theory

According to economic theory, government subsidies for R&D directly and indirectly impact the activities of enterprises. The first direct effect expected is an increase in business investment in R&D since, by constituting low-cost capital, the borrowing costs that the company has to incur in order to obtain the capital are significantly lowered, and as a result, it will be possible to cover the costs incurred for the project, while also managing to carve out a certain profit margin. In this way, R&D investments, that were previously unprofitable, will become profitable and thus be implemented. Wallsten also points out another kind of direct effect whereby, even if public funding were not to generate an increase in R&D, it would certainly enable companies to keep those projects already underway constant, without having to divest resources due to possible economic impediments[12].

Public funding also acts indirectly, producing positive externalities even for projects that are not strictly part of the funding. It is safe to assume that, through the grants received, firms equip themselves in terms of structure, as well as personnel, to implement research and development projects, and

[9] Hans Loof, Alms Heshmati (2005), *The impact of public funds on private R&D Investment:new evidence from a firm level innovation study,* MTT Discussion papers 3
[10] David, P.A., Hall, B.H. and Toole, A.A. (2000) *Is public R&D a complement or substitute for private R&D? A review of the econometric evidence*. Research Policy 29: 497-52
[11] Becker B. (2015), *Public R&D Policies and Private R&D Investment: A Survey of the Empirical Evidence,* Aston Business School
[12] Wallsten, S. J. (2000), *The Effects of Government-Industry R&D Programs on Private R&D: The Case of the Small Business Innovation Research Program* RAND Journal of Economics, 31, 8

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that these endowments, presumably, will remain for the benefit of the firm, which will be able to take advantage of them in the future, to pursue further research that has already been started or is to be started. Moreover, there is clear evidence about the attraction of venture capital investments after a firm has received a public fund, as if being chosen by the funding body is a guarantee of reliability that reduces the information asymmetry between the investor and the firm[13], with the resulting consequences in terms of capital costs. Finally, the effects of public funds do not end with the activity of the individual firm: research and development produce knowledge that is likely to be commercialized and that will benefit the entire sector in which the firm operates and the community at large, helping to create diversity and thus competition and to propel economic growth[14]. However, the effects of public funds cannot be taken for granted: the relevant literature reveals a substantial difference between effects that generate additionality and substitution effects. The concept of additionality, as defined by Buiseret[15], is something that is achieved through public intervention, which would not exist without some kind of intervention, in this case, the subsidies that the company receives are complementary to private R&D expenditures, this happens when the policy in question has an effect on the management of activities in research and development and not only are expenditures increased, but a change in terms of the quality of resource management takes place. Firms receiving the subsidy are stimulated to do more, to undertake collaborations with research centers and universities[16], and to embark on riskier projects that would not otherwise be financed, committing themselves to spend, in the medium to long term, an even greater amount than they received from a given program. However, these positive effects run the risk of being displaced (*crowding out*) by the *substitution effect*: in fact, it is logical to think that a firm will always have an incentive to apply for public subsidies, even when it could invest in research and development through its own resources or through venture capital. This is a very normal reasoning of economic expediency whereby, in terms of cost and deployment of resources, it is always more cost-effective to apply for a public subsidy than to scrape together financing on the capital market. For this reason, the firm sees the subsidy as a substitute resource rather than a force

[13] Lerner J., (1999), *The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program*, The Journal of Business, Vol. 72, No. 3 pp. 285-318

[14] Fritsch, M. (2008*). How does new business formation affect regional development? Introduction to the special issue.* Small Business Economics, 30(1), 1–14

[15] Buiseret, T.; Cameron, H.; y Georgiou, L. (1995), *What Differences Does it Make? Additionality in the Public Support of R&D in Large Firms*. International Journal of Technology Management, Vol.10, p. 587- 600

[16] Bronzini R., Piselli P. (2016) *The impact of R&D subsidies on firm innovation* Bank of Italy, Directorate General for Economics, Statistics and Research, Via Nazionale 191, 00184 Rome, Italy

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that stimulates it to implement more research and development activities[17]. The problem is that this does not generate additionality, businesses simply substitute public funds for their own resources, spending what they would have invested anyway, even if they had not received the fund[18]. The implications of these considerations are not insignificant, since a complementary relationship between investments financed through public capital and further and future business investments justifies and legitimizes the use of public funds, while a substitution relationship would constitute a misallocation of resources[19] that public agencies will be required to justify. *Crowding out* is an effect that follows more or less indirectly from the decisions of the entity providing public funds: some scholars point out that it can occur, for example, due to an increase in the cost of the resources needed to implement research and development activities, resulting from an increase in demand, driven by the companies that benefit from public funding. Scholars such as Goolsbee[20] David and Hall[21] believe that one of the effects of public subsidies is precisely to increase the wages of researchers so that even if the nominal amount of investment in research and development increases, the real amount, for example of researchers, will be lower and less efficient. Another channel through which public funds could cause *crowding out* of private investment is for the company to choose to divest resources already used in other projects in order to efficiently bring the publicly funded one to completion[22]. Finally, firms that do not receive this type of aid may be disincentivized to engage in R&D because they would have less competitive advantage over subsidized firms, for which reason they may choose not to invest and indirectly enjoy the knowledge spillovers that will come from subsidized firms[23]. Sometimes, however, *crowding out* is caused by choices made intentionally by the public agencies promoting a certain funding program. As mentioned earlier, the substitution effect occurs when funds are received by those companies that would have carried out their project anyway

[17] Lach S. (2000) *Do R&D subsidies stimulate or displace private R&D? Evidence from Israel*, Working Paper 7943 Massachusetts

[18] Aerts K, Czarnitzki D. (2004), *Using Innovation Survey Data to Evaluate R&D Policy: The Case of Belgium*, Department of applied economics Research Report

[19] Czarnitzki D., Fier A., (2002), *Do Innovation Subsidies Crowd Out Private Investment? Evidence from the German Service Sector***,** Applied Economics Quarterly 48(02-04)

[20] Goolsbee, A. (1998), *Does Government R&D Policy Mainly Benefit Scientists and Engineers*, American Economic Review, 88(2), pp. 298-302.

[21] David, P.A. and B.H. Hall (1999), *Heart of Darkness: Public-private Interactions inside the R&D Black Box*, Economic Discussion Paper, No. 1999-W16, Nuffield College Oxford, June.

[22] Lach S. (2000) *Do R&D subsidies stimulate or displace private R&D? Evidence from Israel*, Working Paper 7943 Massachusetts

[23] Guellec D., Van Pottelsberghe De La Potterie B., (2003), *The impact of public R&D expenditure on business R&D*, Economics of Innovation and New Technology, 12:3, 225-243

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through internal or external resources, i.e., those companies that are equipped with substantial internal resources or have a winning project at the outset, which would also attract the interest of venture capitalists as it is associated with a high success rate. To avoid the *crowding out* effect by generating additionality, it would therefore be necessary to finance those projects that privately would not be financed because they are not profitable: as they are highly innovative and therefore risky, the financial costs to be incurred to borrow capital would in fact be too high, assuming there is interest from some venture capital. Now, given that grant-issuing entities do not have the totality of information to distinguish between projects with a high probability of success and risky projects, it is likely that out of the total amount of funding bestowed, it will be randomly allocated to projects that could easily find other funding resources. However, it is also true that this dynamic is not entirely random, but part of a precise strategy of the entities placed to fund the projects. Indeed, for the latter, special efforts are required to justify any misallocation of resources, which is why some scholars, including Stiglitz and Wallsten, believe that public agencies are inclined to focus more on projects with a high probability of success[24] (*picking the winner strategy*), thus raising the success rate percentages of a given funding program, thereby maintaining public legitimacy over it. Or again, the decision to fund certain projects might be part of a broader strategy of developing a particular technology[25], or it might respond to a desire not to create artificial advantages for firms that are less efficient than others. In light of these considerations, it is clear that the question about the effectiveness of a subsidy is largely an empirical one.

The impact of public funds according to empirical literature

Although the evaluation of the effectiveness of public funds on business R&D activities has always attracted the attention of many economists, probably because of its managerial and policy implications, contributing to a rich literature on the subject, the research world does not seem to have reached a consensus opinion on it. In fact, the empirical evidence differs greatly as the criteria according to which the research is developed change; in particular, studies differ in terms of the object of study (e.g., a particular type of funding program, European, national, regional or ministerial), the type of sample used (e.g., small, medium or large firms belonging to one sector rather than another may be observed), the geographic

[24] Stiglitz, J. E., & Wallsten, S. J. (2000). *Public-private technology partnerships—promises and pitfalls*. In P. Vaillancourt Rosenau (Ed.), Public-private policy partnerships (pp. 37–58). Cambridge, MA: The MIT Press.
[25] Cantner U., Kosters S., (2012) *Picking the winner? Empirical evidence on the targeting of R&D subsidies to start-ups* Small Bus Econ 39:921–936

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dimension (regional, national, cross-country) of the research and, finally, the type of econometric approach employed.

Although the results are indeed mixed, in general the empirical evidence on which this study is based seems to agree, to a greater or lesser degree, that public R&D subsidies produce additionality without displacing private business investment. Guellec and Van Pottelsberghe's[26] studies on the effects of R&D funding in business go in this direction. Among their various findings, the authors come to the conclusion that direct government funds, implemented by businesses, have a positive effect on private R&D investment. In particular, this type of instrument is effective when it is stable over time: companies tend not to increase investment unless they are certain about the duration of government support.

Aert and Czarnitzki[27] in their study about the impact of policies to support Research and Innovation, in Flanders, highlight how firms that received public funds would have invested significantly less if they had not received it. So do studies by Czarnitzki and Fier[28] , Duguet[29] and again Almus and Czarnitzki[30]. The latter, in particular, seek to assess the impact of certain policies aimed at stimulating innovation activities through R&D funding, focusing on the case of East Germany, and what they find is that, on average, firms that get the subsidy achieve a higher level of R&D intensity, a result also confirmed by an individual study by Czarnitzki[31] conducted on the fabric of SMEs in Germany, with a focus on comparing East and West Germany. Another empirical study conducted on the German territory is by Czarnitzki and Hussinger[32]: the authors, in this case, analyze the effects of public funding in terms of business R&D spending and patenting activity; what emerges is a positive relationship between these factors and public intervention.

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[26] Guellec D, Van Pottelsberghe B., (2003) *The impact of public R&D expenditure on business R&D,*Economics of Innovation and new technology Volume 12- Issue 3

[27] Aerts K, Czarnitzki D. (2004), *Using Innovation Survey Data to Evaluate R&D Policy: The Case of Belgium,* Department of applied economics Research Report

[28] Czarnitzki D., Fier A. (2001) *Do R&D subsidies matter? Evidence from the German service sector,* ZEW Discussion paper No. 01-19

[29] Doguet E. (2003) *Are subsidies a substitute or a complement to privately funded R&D? Evidence from France using propensity score methods for non-experimental data,* Université de Paris I, Working paper no 2003 (75)

[30] Almus M, Czarnitzki D. (2003) *The effects of public R&D subsidies on firms' innovation activities: the case of Eastern Germany,* Journal of business and Economic Statistics 21(2), 226-236

[31] Czarnitzki D. (2002) *Research and development: financial constraints and the role of public funding for small and medium-sized enterprises,* ZEW Discussion Papers No.02-74, Mannheim

[32] Czarnitzki D. e Hussinger K, (2004) *The Link between R&D Subsidies, R&D Spending and Technological Performance,* ZEW - Centre for European Economic Research Discussion Paper No. 04-056

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Görg and Strobl[33] investigate, on a sample of manufacturing firms in the Irish Republic, the relationship between government R&D supports and privately financed R&D spending, and what they find is that subsidies received by SMEs produce additionality, especially in the case of small firms, where an even greater increase in R&D spending is observed than the amount received. Carboni[34] , in a study conducted on manufacturing firms in Italy, rejects the *crowding out* hypothesis at the expense of private R&D investment, noting rather a complementary relationship between public and private investment. Finally, Aerts and Schmidt[35] question whether or not public subsidies for R&D displace private investment led by firms in the Flanders region and Germany and come to the conclusion that the *crowding out* hypothesis can be rejected: firms that receive public funds are significantly more active in R&D than those that do not receive subsidies.

Other empirical studies find partially positive results, where additionality is found only for a certain type of firm or in some cases, and so the *crowding out* hypothesis cannot be totally rejected. In particular, these partial results emerge from analyses such as those conducted by Loof and Heshamati[36] and Lach[37]; the latter analyzing the effects of a policy promoted by the Ministry of Industry and Trade, on a sample of Israeli firms in the manufacturing sector, finds positive effects on private R&D investment, but exclusively for small firms. This kind of evidence is also endorsed by studies conducted by Becker[38] who, in her systematic and critical review of the literature, highlights how the additional effect, in the studies she reviewed, is found more in small firms. However, as she points out, these types of firms are not the ones that usually receive the funding, precisely because of the *picking-the-winner strategy* implemented by the institutions placed at the funding. This obviously results in inefficient allocation of resources.

Busom[39], in a study regarding the effects of public grants on the R&D commitment of firms and on the likelihood for a firm to participate in the

[33] Görg H., Strobl E. (2005), *The effect of R&D subsidies on private R&D*, Research Paper, No. 2005/38, Leverhulme Centre for Research on Globalisation and Economic Policy, University of Nottingham, Nottingham

[34] Carboni, O.A. (2011) *R&D subsidies and private R&D expenditures: Evidence from Italian manufacturing data*, International Review of Applied Economics 25: 419-439

[35] Aerts, K. and Schmidt, T. (2008) *Two for the price of one? Additionality effects of R&D subsidies: A comparison between Flanders and Germany*. Research Policy 37: 806-822.

[36] Loof H, Heshmati A. (2005), *The impact of public funds on private R&D Investment: New evidence from firm level innovation study*, MTT Discussion Papers 3

[37] Lach, S. (2000) *Do R&D subsidies stimulate or displace Private R&D? Evidence from Israel*, NBER Working paper No.7943

[38] Becker B, (2015), *Public R&D policies and private R&D investment: a survey of the empirical evidence*, Journal of Economic Surveys Volume 29, Issue 5 p. 917-942

[39] Busom I, (2000) *An empirical evaluation of the effects of R&D subsidies*, Economic innovation and new technology, Vol 9,111-148

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funding program, finds that public funds induce greater investment by individuals, but for 30 percent of the firms participating in the funding program, the possibility of *crowding out* cannot be totally ruled out.

However, there is no lack of empirical evidence that failed, based on the results obtained, to reject the *crowding out* hypothesis. De Blasio, Fantino, and Pellegrini[40], for example, conduct an evaluation about a funding program promoted by the Italian Ministry of Economic Development and found no evidence of the effectiveness of this program.

Another Italian study, by Bronzini and Iachini[41], analyzes the effectiveness of a tool implemented in northern Italy with the aim of stimulating R&D in the business sector, and what emerges is that in general no significant additional effect was found in the sample but, in a portion of the small businesses examined, there is a slight increase in investment. Again, authors such as Catozzella and Vivarelli[42] analyze how and to what extent the innovative productivity of firms is affected by public funding: the results show that supported firms exhaust their advantage with the mere quantitative increase in innovation spending, but do not create added value through further investment in innovation. Merito et al.[43] focus, on the other hand, on the effectiveness of subsidies bestowed in the early 2000s by the Special Fund for Applied Research, promoted by the Italian Ministry of University and Research; in this case, it emerges that additionality effects are limited to a temporally circumscribed period: after four years of receiving the subsidy, the instrument in question has an extremely marginal effect in terms of various parameters, including patenting activity. Also in Italy, Fantino and Cannone[44] investigate the effectiveness of two European programs, implemented at the regional level, that were aimed at implementing and supporting the innovative activities of SMEs; again, the results from their sample of Piedmontese firms reveal very little effectiveness. In America, on the other hand, Wallsten[45] analyzes the impact of the Small Business Innovation Research Program on

[40] De Blasio G., Fantino D., Pellegrini G., (2015), *Evaluating the impact of innovation incentives: evidence from an unexpected shortage of funds*, *Industrial and Corporate Change*, Volume 24, Issue 6, December, Pages 1285–1314

[41] Bronzini R., Iachini E., (2014), *Are Incentives for R&D Effective? Evidence from a Regression Discontinuity Approach,* American Economic Journal: Economic Policy, 6 (4): 100-134.

[42] Catozzella, A., Vivarelli, M., (2011), *Beyond additionality: are innovation subsidies counterproductive?*

[43] Merito M,, Giannangeli S., Bonaccorsi A.,(2009), *L'impatto degli incentivi pubblici per la R&S sull'attività delle PMI,* dal libro La valutazione degli aiuti alle imprese, il Mulino

[44] Fantino, D.,Cannone, G., (2011), *The evaluation of the efficacy of the R&D European funds in Piedmont*, Conference Paper, 51st Congress of the European Regional Science Association

[45] Wallsten, S. J., (2000), *The Effects of Government-Industry R&D Programs on Private R&D: The Case of the Small Business Innovation Research Program*, The RAND Journal of Economics, 31(1), 82–100

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the private R&D activities of American companies. What emerges from his study is a *crowding out* effect with respect to private R&D investment, but he admits the hypothesis that the firms that received the subsidy, thanks to it, may have kept their research activity steady, without having to decrease due to economic constraints.

Herrera and Heijs[46] analyze the impact that the subsidy system guaranteed by the Spanish government has on firms' innovative activities and their R&D intensity. What emerges from their study is that firms that have a greater chance of ensuring a positive outcome to the funded project are those that are more likely to receive the funding. Whereas, the firms that have fewer possibilities but also greater constraints are the ones that are least likely to receive the subsidy. These results clearly reveal a strategy of picking the winner by the Spanish government, a strategy that causes little additional effect on the innovative activities of firms that even invest less than the amount received as a subsidy in R&D. Kaiser[47], applying two different econometric methods, finds no significant additional effect in his study on the impact that government subsidies, aimed at stimulating R&D, have on the innovative intensity of Danish firms. Finally, Suetens[48] conducts a study of Flemish firms taking into account, as a proxy for innovation, the hiring of qualified R&D personnel: the results of this research do not allow to exclude, in most cases, a total *crowding out* effect. As evident, the empirical results discussed above do not lead to unambiguous conclusions. However, we could not expect otherwise since, as already mentioned, they differ on several research criteria and, especially, on the modeling and econometric approach. As we will see in later on, the econometric method for the evaluative study of policies of this kind has been refined over time, trying to overcome the methodological criticalities inherent in this topic.

The SME Instrument: a driver of growth and innovation for European SMEs

The European Union's ambitious goal: Horizon 2020, an unprecedented response

Under the research and innovation framework program governing the Union's support for research and innovation activities Horizon 2020, a special instrument has been designed to streamline the European Commission's

[46] Heijs, J., Herrera, L., (2004) *The distribution of R&D subsidies and its effect on the final outcome of innovation policy*, Working paper Instituto de Analisis Industrial y Financiero 46, Madrid

[47] Kaiser U., (2004), *Private R&D and public R&D subsidies: Microeconometric evidence from Denmark*, CEBR Discussion Paper 2004-19.

[48] Suetens S., (2002), *R&D subsidies and production effects of R&D personnel: evidence from the Flemish region*, CESIT Discussion Paper 2002/03, Antwerp

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support for SMEs: the SME Instrument. The purpose of the instrument is to directly develop and exploit the innovation potential of SMEs by filling funding gaps in the early and high-risk stage of research and innovation, stimulating innovative research, and increasing the commercialization of results by the private sector[49] and increase economic convergence by helping regions tap their potential and providing them with the right tools for solid and lasting growth[50]. With a budget of 3 billion, representing one-fifth of that prepared by SBIR, the SME Instrument adopts the three-phase structure of its U.S. "rival," structuring its support for SMEs as follows:

- **Phase 1** finances, with a lump sum of 50,000 euros per project, a series of preliminary analyses to be implemented by the company in order to further investigate the feasibility of its idea. These analyses can include both technical-scientific assessments and evaluations about the commercial potential of the project; thus, this phase includes funding for market studies, risk analysis, managerial activities about the intellectual property of a new product, etc. The expected outcomes, after receiving the grant, are a feasibility report and a more elaborate business plan than the initial one.
- **Phase 2**, with funding of between 500,000 and 2,500,000 million (generally covering 70 percent of the costs, or 100 percent if the projects have a strong research component), assists the company in implementing a real project. Companies, in this case, must in fact submit their proposals on the basis of an already completed feasibility analysis containing a complete business plan (these documents may have been developed both through phase 1, but also independently).
- **Phase 3**, dedicated exclusively to the winners of Phase 2, does not provide economic support to the enterprise, but is designed to provide assistance in the commercialization phase of the designed innovative solutions and in the phase of dialogue with the private capital market.

These phases, as can be seen, trace the course of the innovation cycle, starting in fact from the assessment of the feasibility of the idea, to the commercialization phase, passing through the development of the prototype and an initial application in the market. Each company, which falls under the

[49] Official Journal of the European Union, (2013), Regulation (EU) No. 1291/2013 of the European Parliament and of the Council of December 11, 2013 establishing the Framework Programme for Research and Innovation (2014-2020) - Horizon 2020 and repealing Decision No. 1982/2006/EC, Brussels.

[50] De Rose P., *L'Europa per i comuni: Strumenti per la programmazione e lo sviluppo turistico delle autonomie locali*, Aloe Editore, 2019

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EU definition of small and medium-sized enterprise[51], can decide whether to apply for a single phase, for more than one, or for all three; in fact, the phases are not sequential: it is not necessary to complete phase 1 to begin phase 2.

The SME Instrument in Italy

Since the first call for proposals in June 2014, 4151.80 million euros have been allocated to date, funding 5926 projects involving 5641 participants across Europe. From the data obtained from the EIC Accelerator hub, Italy stands out among the countries with the highest number of funded projects, second only to Spain. Out of a total of 5926 coordinated projects, 673 are Italian, thus constituting more than 10 percent of the total participations. However, participation rates in the SME Instrument are not homogeneous throughout the country; on the contrary, performance differs significantly, highlighting, again, a distinction between north and south. Based on data collected from the first call for proposals to date, at the top of the participation ranking is Lombardy, with a total of 222 participations, constituting alone almost 30 percent of the total. Lombardy is followed by Emilia- Romagna with 153 participations, Latium with 68 and Piedmont with 49. In particular, the participation rate of Lombardy companies in Phase 2 of the instrument is remarkable: detached from the national average value of 16 percent, they in fact present a participation rate of 20 percent in the second phase. At the bottom of the ranking are Basilicata, with only 2 participations, and Valle d'Aosta with 3 participations. In general, there is limited adherence to the instrument by southern firms, with participation under 10 percent of the total. The best performance is that of firms in Campania with 21 participations[52] and those in Puglia with 15.

Table 1. Projects funded and grants disbursed (TEUR)

Region	ɔnomic contribution (TEUR)	Number of beneficiary projects
Lombardia	88.764.329	222
Emilia-Romagna	44.458.881	153
Lazio	16.785.330	68
Piemonte	13.143.107	49
Toscana	5.671.930	42
Veneto	8.924.237	32
Campania	8.079.561	21
Liguria	5.756.741	19

[51] According to the Recommendation of the European Commission, dated 6/05/2003 on the definition of micro, small and medium-sized enterprises, "the category of microenterprises of small and medium-sized enterprises (SMEs) consists of enterprises which employ fewer than 250 persons, and whose annual turnover does not exceed 50 million euros or whose annual balance sheet total does not exceed 43 million euros."

[52] Eic Accelerator data hub di EASME, available here: https://sme.easme-web.eu/#

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Trentino-Alto Adige	5.243.899	19
Puglia	1.915.192	15
Marche	4.736.722	13
Friuli-Venezia Giulia	3.574.177	12
Calabria	1.097.209	8
Umbria	1.693.114	7
Sardegna	250.000	6
Sicilia	1.356.204	5
Abruzzo	3.038.126	5
Valle d'Aosta	100.000	3
Basilicata	100.000	2

Source: EIC accelerator data hub

Research design: the methodology

The present study aims to fit within the research strand of policy evaluation; the research focus is on the SME Instrument, in its original version born within Horizon 2020, and in particular Phase 2 of the instrument is being attended to. The research question, therefore, is "Has the second phase of the SME Instrument had a positive impact on the Italian SMEs that have joined it? If yes, to what extent?" The approach to this topic will be quantitative and microeconomic in dimension: in fact, the evaluation will be based on quantitative data inherent in the innovation (and non-innovation) performance of individual firms.

In essence, what is of interest in this study is the causal effect of adherence to the second phase of the SME Instrument, understood according to Rubin's definition as "the difference between the likely outcome of an individual's participation in a measure and the likely outcome of an individual's non- participation in that same measure", where in our case individuals are enterprises. The latter can be divided into two groups: participating firms and non-participating firms, since we denote by S the status of a firm, by S=1 we refer to the treatment group (i.e., the one receiving funding), and by S=0 to the group of non-treatment firms. The random effect of our interest will be identified by θ_1, the formulation of which will therefore be, by virtue of Rubin's definition, as follows:

$$\theta 1\text{: } E[Y^1 - Y^0 | S = 1] = E[Y^1 | S = 1] - E[Y^0 | S = 1] \qquad (1)$$

Where Y^1 is the outcome variable and Y^0 is the potential outcome that would have been realized if the treatment group (S=1) had not been treated[53]. Now, while the first quantity E[Y^1 ┤|S=1], i.e., the expectation of the

[53] Rubin D. B., (1974), *Estimating Causal Effects of Treatments in Randomized and Non-Randomized Studies*, Journal of Educational Psychology, 66, 688-701.

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outcome of the participating firms can be directly observed, the second counterfactual quantity E[Y^0 |S=1] is by definition unobservable, for it is not possible to observe the outcome of the treated firms in the case that they had not received treatment. Since it is unobservable it must therefore be estimated, but the counterfactual situation cannot be estimated as the simple arithmetic mean of the outcome of the firms not receiving the subsidy, for a simple but fundamental reason:

$$E[Y^0|S = 1] \neq E[Y^0|S = 0] \quad (2)$$

The expected outcome of firms that do not receive the subsidy would not be the same in the case that they do receive it, this condition, in fact, would have been true only in the case of an experimental setting in which the treatment, i.e., the funding obtained through joining the second phase of the SME Instrument, was randomized[54]. Indeed, randomized treatment assignment, if done with the proper procedures, ensures that the observable and unobservable characteristics of the units assigned to the two groups are on average equal and that therefore the difference, in terms of outcome, between the two groups is due to the treatment. However, analyses over the years have shown that firms in the treatment group and firms in the control group differ substantially in several respects. This difference is due to selection bias, i.e., bias in the selection process for treatment that stems from both the funding body, in this case, the European Commission, and the participating firms. As discussed in section 1.2, public funding agencies might decide to fund some enterprises rather than others responding to different objective functions than those stated in the intentions. Motivations may vary from case to case, for example, the public agency might decide to fund based on a larger project to stimulate a particular sector, however, in most empirical studies on this issue it has been found that this selection bias is mainly dictated by a "picking the winner strategy.". In essence, the funding body would be inclined, more or less intentionally, to select those enterprises that perform better in terms of innovation and thus tend to be guarantors of a project's success, with the aim of legitimizing the allocation of resources through positive success rates of the instrument in question. But a company's participation status is also decided, to a certain extent, by the company itself: not all those that fall within the eligibility criteria automatically decide to apply to receive funding; indeed, we have seen how participation in the second phase of the SME Instrument, in Italy as in the rest of the EU, there are significantly fewer companies responding to calls for proposals.

[54] Aerts K., Czarnitzki D,(2004), *Using Innovation Survey Data to Evaluate R&D Policy: The Case of Belgium,* K.U.Leuven - Departement toegepaste economische wetenschappen

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What distinguishes companies that decide to participate in the instrument from non-participating companies? Based on what elements, is the funding body oriented in the implementation of the winner's strategy? Answering these questions is a key node for proceeding with the empirical analysis, since in the identification of these characteristics lies the problem, but also the solution, of the empirical question regarding policy evaluation.

To do so, we need to start with empirical studies on the subject: the work of Stefania P.S. Rossi[55] et al. about the effects of firm characteristics on the likelihood of using public funding sources is an excellent starting point. From the study it appears that the characteristic with the greatest estimated impact on the likelihood of firms using public financing is past experience in using subsidies: in line with Aschoff's[56] studies of German firms, the data show that firms that have already received public subsidies in the past are more likely to participate in financing instruments.

This evidence would show the existence of information asymmetries, whereby firms that have never participated in such projects have less knowledge about possible sources of funding than those that have already taken part, but it also reveals the presence of learning-by-doing effects, which allow firms to learn the dynamics and processes aimed at selection, making them more efficient at the application stage. A second interesting result is that the probability of receiving and using public funding is closely related to the innovation activities that the enterprise has already implemented or is implementing. The results obtained by the authors, largely confirmed by other contributions cited in the paper, reveal how the innovative experience of firms acts as a signal to funding agencies, which, as reiterated extensively, would tend to provide subsidies to the most innovative firms, identifying these firms as guarantors of funding effectiveness. Or again, considering self-selection on the part of the firm, it is clear that more R&D activity requires more funding and, as discussed in previous chapters, a firm will always have an incentive to turn to publicly funded capital rather than private capital markets, if only for simple cost-effectiveness. The same positive effects are found in firms that have greater export activity, probably because the fact of entering international markets makes the innovative challenge more pressing in order to gain greater competitiveness and, as a result, obtaining public financing becomes a requirement and therefore firms will be more likely to respond to calls for proposals. The variable of financial constraints also appears to be significant,

[55] Rossi, S. P. S., Chies L., Podrecca E., (2020), *Superando il guado. Innovazione, esportazioni e strategie delle imprese tra vincoli finanziari, ambientali e di capitale umano*, EUT Edizioni Università di Trieste

[56] Aschhoff, B. (2010). *Who gets the money? The dynamics of R&D projects subsidies in Germany*. Journal of Economics and Statistics (Jahrbücher für Nationalökonomie und Statistik), 230, 522-546.

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revealing that firms that experience greater financial constraints are more likely to apply for public funding, as it represents a low-cost source of capital. Finally, with regard to key firm characteristics such as industry, age, and size, the former does not appear to be a characteristic that weakly influences the likelihood of applying for and receiving subsidies (with a higher likelihood for firms operating in industry rather than services), size, on the other hand, appears to be significant, highlighting that firms with fewer than 9 employees are less likely to use subsidies than those with more employees. enterprise facilitates the circulation of information, but also the better management of the preparatory steps to apply and the project itself. Finally, the age variable is found to be more likely to receive the subsidy for firms with less than two years of operation, compared to those that have been in the market for between 2 and 4 years; the formation of a firm usually induces innovative activities and therefore younger firms are expected to be more active in research and development[57], increase the likelihood of application for this category of firms. Other studies, such as that of Cerulli and Potì[58], also focus attention on the characteristics of firms about whether or not they belong to domestic or foreign business groups. In fact, being part of an enterprise group could promote the dissemination of information and thus increase the likelihood for an enterprise to apply for public funding. Whereas, in the event that the impact of a national financing program was to be assessed, the possible membership of firms in a foreign group would have to be taken into account; this factor could in fact reduce the likelihood for a firm to apply for the subsidy because the parent firm might choose to join financing programs implemented in the nation in which it is based.

As evident, then, firms that participate in financing programs and those that do not participate differ substantially in different respects, and this has implications not only at the theoretical level, but more importantly at the empirical level. In econometric terms, in fact, selection bias implies that the treatment variable S and the outcome variable Y are stochastically dependent and including them in a simple linear regression would cause biased estimates. For this reason, we cannot rely on the
the classical inferential approach of comparing average outcome values between treated and untreated firms; this method, in fact, assumes that the treatment variable and the outcome variable are independent, so we would have that the mean of the outcome, conditional on treatment, is equal to the

[57] Almus M,, Czarnitzki D., (2003), *The Effects of Public R&D Subsidies on Firms' Innovation Activities: The Case of Eastern Germany,* Journal of Business & Economic Statistics, Vol. 21, No. 2 , pp. 226-236
[58] Cerulli G., Potì B., (2008), *Evaluating the Effect of Public Subsidies on firm R&D activity: an Application to Italy Using the Community Innovation Survey,* Ceris-Cnr, W.P. N° 9

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unconditional mean of the outcome, that is, E(Y | S)=E(Y) (3). By definition, the average treatment effect is:

$$ATE = E(Y^1 - Y^0) \quad (4)$$

While the average treatment effect on treated units is:

$$ATET = E(Y^1 - Y^0|S = 1) \quad (5)$$

We can observe that under the assumption of independence of the mean: E(Y | S=1)=E(Y^1 | S=1)=E(Y^1); similarly E(Y | S=0)=E(Y^0 | S=0)=E(Y^0). So, we will have that the average treatment effect (ATE) and the average treatment effect on treated units (ATET) coincide and are given by the difference between the expected outcome values of treated and untreated firms:

$$ATE = ATET = E(Y|S = 1) - E(Y|S = 0) \quad (6)$$

This formulation coincides with the difference-in-mean estimator of classical inference[59], and is known to be an unbiased, consistent and asymptotically normal estimator[60]. However, the possibility of applying this estimator holds entirely on the assumption of independence of the mean (3) and that therefore the outcome variable and the treatment variable are independent, a situation which, in our case, is not verified. For this reason, the difference-in-mean estimator fails to consistently estimate the treatment additionality hypothesis. A first generation of models employed for policy evaluation ignored the endogeneity problem by assuming the treatment variable as strictly exogenous. However, we have seen how this assumption is too strong in this context, inducing biased and inconsistent estimates when included in a linear regression[61]. To overcome the estimation problem econometricians have suggested several approaches under different assumptions, each model has its own advantages and disadvantages, therefore, there is no default model for estimating the causal effect, but different methods that can be implemented. For example, implementing an instrumental variables approach can solve the problem of selection on unobserved variables, which occurs when variables not observed by the researcher are correlated with the treatment variable, causing inconsistent estimates. To implement this method, the researcher needs to know a set of exogenous variables that are correlated with the treatment variable and at the same time uncorrelated with the outcome variable

[59] Cerulli G., (2010), *Modelling and Measuring the Effect of Public Subsidies on Business R&D: A Critical Review of the Econometric Literature*, The economic record, vo. 86, N.274, 421-449

[60] Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*. MIT Press, Cambridge

[61] Busom, I. (2000), *An empirical Evaluation of the Effects of R&D Subsidies*, Economics of Innovation and New Technology 9(2), 111–148.

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in order to construct a 2SLS estimate for evaluating the equation[62]. Heckman uses yet another method constructed again to account for the possibility that there are unobservable variables that nonetheless have an effect on both the outcome and the state of the firm; however, the so-called sample selection approach requires making preliminary assumptions about the distribution of the variables that other methods do not require, freeing the estimation operation from theoretical plots. In the study of the recent literature on the subject, it can be seen that the methods preferred by researchers are the difference-in-differences (DID) and the matching estimator, the reason why these methods are preferred over others lies in the fact that they are considered data-driven methods, that is, methods that with a few basic assumptions and an information-rich sample, allow the estimation operation to be carried out without too many theoretical implications and complications. Lach, for example, in his study about the impact of subsidies guaranteed by the Ministry of Industry and Trade employs the DID estimator to identify the effect on firm performance. The basic idea is that the potential selection bias vanishes in the linear model when differences between treated and untreated firms are computed over time. However, as pointed out by Görg and Strobl, the DID estimator does not guarantee that similar firms to each other are compared in the comparison between treatment and control group, and this could be problematic since the theoretical framework of the DID estimator is based on the assumption that there are common trends in the macro variables and that treated and untreated firms react the same way to these trends. This assumption would be difficult to verify if very different firms are included within the sample, which therefore, presumably, have different criteria for reacting to trends. In addition, the DID estimator is unable to control selection bias on the side of firms because it does not take into account all those factors that impact a firm's decision to take part in a public financing project[63]. Finally, part of the scientific community seems to prefer the matching estimator because of some of its very advantageous properties. Basically, the matching estimator takes its inspiration from the experimental method in which it is possible to evaluate the effects of a treatment by making the difference between the values taken by the treatment and control group if and only if the starting differences between treated and untreated units are zero, and this is almost certainly the case when the treatment is administered in a completely random fashion, guaranteeing the basic condition of randomization. However, as we have

[62] Görg H., Strobl E. (2005), *The effect of R&D subsidies on private R&D*, Research Paper, No. 2005/38, Leverhulme Centre for Research on Globalisation and Economic Policy, University of Nottingham

[63] Görg H., Strobl E. (2005), *The effect of R&D subsidies on private R&D*, Research Paper, No. 2005/38, Leverhulme Centre for Research on Globalisation and Economic Policy, University of Nottingham

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discussed extensively in previous chapters, this condition is not met in our case, and in general in the vast majority of economically studied situations analyzed outside of laboratories, because treated and untreated units are self-selecting (to some extent) and the treatment is not assigned to them in a completely random manner. Having put this in place, the strategy of applying the matching estimator aims to somehow re-establish the randomization condition of the treatment so that it is possible to evaluate the treatment effect as the difference between the outcome of treated and untreated firms; in fact, if the randomization condition is true, then the untreated firms represent the counterfactual of the treated firms, so the difference in outcome between the treatment and control group will return us the treatment effect. But how can this strategy be implemented? Basically, it starts with the assumption that treatment status is related to specific characteristics that the researcher can observe on the units that, but once controlled, it reestablishes the randomized condition of the experiment. This assumption is known in the literature as "*treatment ignorance*" and was first proposed by Rubin during the late 1970s. Based on this assumption, an attempt is made to create an ex-post control group by selecting a subset of units, from the control group, that are as similar in terms of observable characteristics as possible to the units in the treatment group. In this way, the matching estimator procedure aims to eliminate the baseline differences that the selection process generates between the two groups[64]. Once the ex-post control group is chosen, the effect estimate will be given simply between the difference between the mean of the outcome variable of the treatment group and that of the new control subgroup. As evident, the matching estimator adopts a nonparametric estimation procedure; therefore, it does not require the specification of a particular parametric relationship, a requirement for an OLS model, where a linear relationship is assumed. Because of its simplified structure, in which economic theory enters only into the choice of variables to observe in order to perform the matching between treated and untreated units, and for other reasons that will be discussed in the next section, the matching estimator is one of the most widely adopted methods in the literature in the area of policy evaluation. However, as Hackman writes, "The choice of an appropriate econometric model depends critically on the data to which it is applied,"[65] so there is no ideal model, but in the complex choice of estimation tools there is some arbitrariness.

[64] Martini A., Sisti M., (2009), *Valutare il successo delle politiche pubbliche*, Il Mulino, Bologna
[65] Heckman, J.J., H. Ichimura, J. Smith e P. Todd (1996), *Characterizing Selection Bias using Experimental Data*, mimeo, revised version is published in Econometrica 66, 1017–1098.

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The sample

The treatment sample was extracted from the interactive tool that generates information about European funding programs, developed by EISMEA (European Innovation Council and Small and Medium-sized Enterprises Executive Agency). Through the filters made available by the tool, it was possible to obtain the list of Italian companies that were beneficiaries of the SME Instrument, and in particular of Phase 2, which is the subject of interest in this study.

There are 152 Italian companies that have benefited from Phase 2 of the SME Instrument, for a total of 113 coordinated projects. The total amount of contributions equals 162.84 million, out of a total of 2531.36 billion allocated for the financing of all Phase 2 projects in the European territory, just over 6 percent of the total funded.

Of these 152 companies, the observed sample considers 113; all companies that responded to calls for proposals after the specified 2020 cut-off period were excluded. This choice was deemed appropriate for two reasons: according to the literature, funding aimed at stimulating innovation, as in the case of the SME Instrument, generates effects within two years following the receipt of the grant; and secondly, projects responding to calls last on average 12 to 24 months.

For these reasons, we wanted to select only those enterprises that were beneficiaries by 2019, so that the economic and financial data of the enterprises would be available until 2020. Firms for which there was insufficient data to process this analysis were also eliminated from the sample selection. The economic-financial data for the 113 firms in the sample were extracted from the largest database available with data on global companies, Bureau Van Dijk's Orbis. The data obtained refer to a time period of 8 years, from 2014, the date of the first call for proposal to 2020.

Table 2. Variables description

Control variables	*Measure*
sales_assets	Ratio of total sales value (TEUR) to total assets (TEUR)
SME 2	from the year indicated as the start of the EMS Phase 2 funded project, equals 0 before the start
SME 1	from the year indicated as the start of the EMS Phase 1 funded project, equals 0 before the start
inn_index	Innovation index of the region where the enterprise is located
region_	Region to which the company belongs
sme	if the enterprise has received both EMS stage 1 and stage 2, equal to 0 otherwise
ICT	Dummy equal to 1 if the enterprise belongs to the ICT sector, equal to 0 otherwise
manufacturing	Dummy equal 1 if the enterprise belongs to the manufacturing sector, equals 0 otherwise

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Control variables	*Measure*
biotech	Dummy equal to 1 if the enterprise belongs to the biotechnology sector, 0 otherwise
age	Age of the enterprise
ita	Dummy equal to 1 if the enterprise is based only in Italy, 0 if it is based abroad
debt_equity	Ratio of total debt (TEUR) to equity (TEUR)
L	Number of employees
grants	Number of published patents
IMM_imm	Total intangible assets (TEUR)
IMM_mat	Total tangible assets (TEUR)

The enterprises included in the sample are Small and Medium Enterprises, according to the definition adopted by the European Union[66]. On average, the companies selected in the sampling have 27 employees; 43.6 percent of the observations have a number of employees less than or equal to 20. Only two enterprises (Antares Vision, Co.stamp) exceed a number greater than 250 employees, but at the time of participation in the calls for proposals they met the criterion. To assess the average size of the enterprises, the average value of total assets of 10216.89 can be considered. Almost half of the observations, 45 percent, were 10 years old or younger. The age of the firm was calculated for each year as the difference between the year of incorporation and the year under consideration. On average, the age of the sample is 15 years, the highest value being 76 years. The funded enterprises are from different sectors: the most frequently found sectors are the manufacturing sector, the IT sector, and the biotechnology sector. The two sectors were summarized in two dummies, and in the descriptive phase it was found that 59 out of 113 enterprises belong to the manufacturing sector, 18 to the IT sector, and 15 to the biotechnology sector, the remaining observations belong to the service sectors, trade, etc.

[66] Microenterprises are defined as those enterprises with fewer than 10 employees and that realize annual turnover or annual balance sheet total not exceeding 2 million euros. Small enterprises are defined as enterprises with fewer than 50 employees and that realize annual turnover or an annual balance sheet total not exceeding 10 million euros. Medium- sized enterprises are defined as enterprises with fewer than 250 employees and achieving annual turnover not exceeding 50 million euros or an annual balance sheet total not exceeding 43 million euros.

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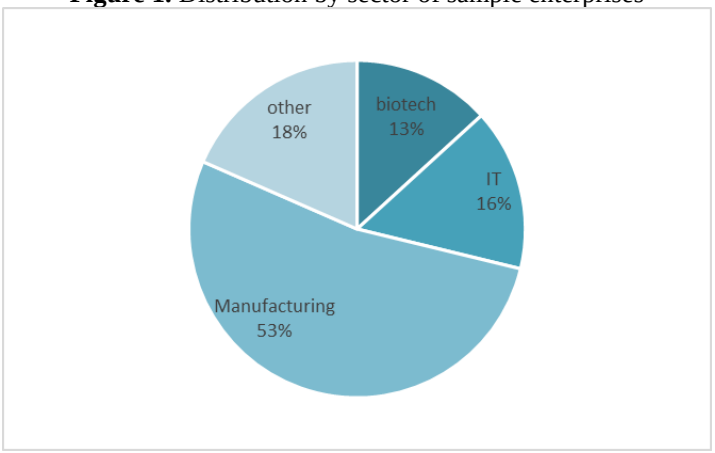
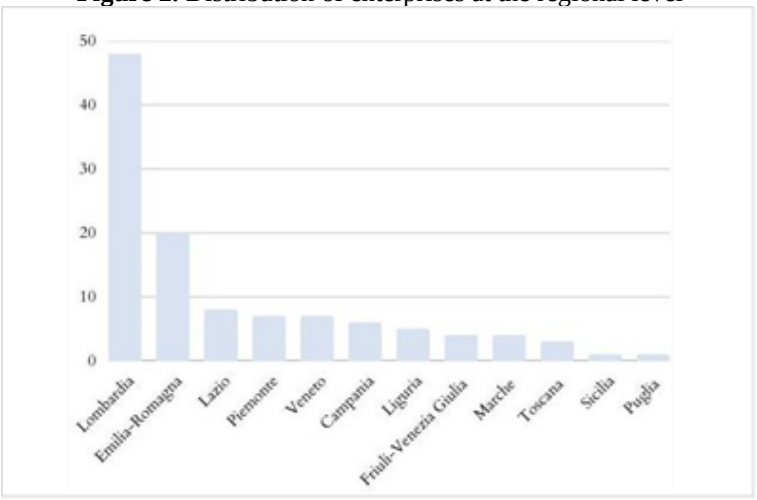
Figure 1. Distribution by sector of sample enterprises



Source: Own processing based on sample data

The companies observed in the analysis are distributed over much of Italy, with the largest presences found in Lombardy (47), Emilia-Romagna (20), Lazio (8) and Piedmont and Veneto (7), confirming the general data already discussed.

Figure 2. Distribution of enterprises at the regional level



Source: Own processing based on sample data

Wanting to summarize the innovative performance of the sample enterprises, leaving aside for the moment whether these are caused by joining Phase 2 of the SME Instrument or not, the data collected regarding patent publications(grants) and investments in intangible assets (IMM_imm) were observed, as data regarding R&D spending was not available for any sample enterprise.

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On average, the sample enterprises have the amount of intangible assets equal to the value of 1057.9 thousand euros, the highest value achieved is 229.348 thousand euros.

The enterprises considered produced an average of 8 patent publications: the highest value of patents is 129, while the lowest is 1.32 percent of the observations produced a number of 10 patent publications or less.

Companies that took part in the calls for proposals, from 2014 to 2019, for the second phase of the SME Instrument submit projects with an average scope of 2.076.170 million to the evaluation committee. The average contribution requested is 998.662 thousand euros, with almost 50 percent coverage.

Within the sample of beneficiaries of the second phase of SME2, there are also companies that received funding from phase 1 of the instrument: 48 out of 113.

Model estimation

The ratio of total sales value to total assets *(sales_assets*) was considered appropriate to use as the dependent variable. With this decision, the present study stands in contrast to the literature reviewed: for while empirical evidence about the effects of incentives on innovation inputs is copious, few papers have evaluated the effects on innovation outputs. The lack of attention with respect to the output factors of incentives would seem anomalous, considering that these are the actual goals of public management[67], yet the literature is biased toward the use of variables such as R&D Expenditure, number of researchers, human capital, rather than on output metrics such as, for example, the number of new products launched to market, profit growth, sales, etc.

This approach can be justified by a perhaps overly simplistic conception of the innovation process seen as a black box[68] in which what is entered (monetary or resource inputs) will, according to a general principle, result in an outcome (output). However, this relationship is not necessarily true in every case, which is why it is useful to look at output metrics that measure the results generated by investments in innovation, rather than input metrics that return information about the allocation of resources in innovation.

The choice of the *sales_assets* variable, based on the available data, was found to be the most useful for the present analysis for two main reasons: first, because the second stage of the SME Instrument is dedicated to

[67] Bronzini R., Piselli P., (2016), "*The impact of R&D subsidies on firm innovation",* Research Policy 442-457

[68] Meissner D., Kotsemir M., (2016), *"Conceptualizing the innovation process towards the 'active innovation paradigm'- trends and outlook",*

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commercialization of the innovative product (we are beyond stages 5-6 of the TRL), so sales is a logical proxy to use; second, because it is not necessarily the case that every input turns into an output, so observing resource allocation (e.g., R&D spending, increase in skilled employees, etc.) may not be sufficient to capture the effect.

On the other hand, in the project presentations of the beneficiary companies, among the expected results of the projects the companies explicitly mention an increase in sales due to the launch of the new innovative products; therefore, it seemed logical to use sales as a proxy for outcome of the second phase of the SME Instrument. Sales were related to total assets, so as to relate it to the size of the company, which clearly affects the size of sales. The choice was also 'forced' by the limitation of information available on the sample firms; it is believed that using targeted variables, such as new product launches in the market, would have captured additional nuances of the effect of SME2. Based on the available data, it was deemed appropriate to use a panel in which, through the construction of the SME2 step dummy equal to 1 from the year of receipt of funding, the counterfactuals for each firm are given by the firms themselves in the past. Thus, the objective is to test whether, on average, the firm had a statistically significant change in the *sales_assets* ratio as a result of participating in the second phase of the SME Instrument. The estimation technique used to build the model is backward elimination, and was structured as follows:

- After checking for possible correlations between regressors[69], we started by estimating a complete model (of all variables available in the database, which, according to the literature, affect therelationship identified as the dependent variable; the initial, complete model has such a functional form:

$$sales\_assets = \beta_0 + \beta_1 SME2 + \beta_2 SME1 + \beta_3 inn\_index + \beta_4 age + \beta_5 grants + \beta_6 L + \beta_7 IMM\_imm + \beta_8 IMM\_mat + \beta_{10} ita + \beta_{11} debt\_equity + \varepsilon \quad (1)$$

- As we proceeded, we eliminated the regressors with the highest p-value and re-estimated the model with k-1 regressors, but kept the SME2 regressor fixed to observe any changes in it and checked for fixed and time effects in each estimated model[70];
- Iterations are preceded as long as there were no insignificant regressors within the model.

[69] *Appendix 1*

[70] It was deemed appropriate to maintain control for fixed and time effects in each model because of the drastic effect that the pandemic crisis (in the year 2020) had on sales and, therefore, on the variable of interest. Since the pandemic crisis affected all firms simultaneously, by controlling for time effects we neutralize this effect.

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Interestingly, since the full model (**Model 1**) the step dummy indicating the perception of the funding of the second phase of the SME Instrument (SME2) continues to be non-significant for all iterations, while the regressors that are significant maintain their statistical significance, more or less equally until the last model (**Model 6**).

The non-significant regressors that were eliminated step by step are:

- *SME1*: the non-significance of this step dummy is consistent with the starting hypotheses; it is believed that the effect of the first step of the instrument, the output of which are feasibility studies and/or patents, cannot be captured by the evaluation of a variable such as the one used in the present study;
- *Inn_index*: the innovation index of the regions to which the firms belong does not appear to be significant, to any degree of significance, in explaining the dependent variable. The starting hypothesis was that firms located in regions with higher innovation index have a larger market in which to position their innovative products and therefore potentially have higher sales. The regression results show that this regressor is not useful in explaining the observed variable; a plausible reason may lie in the fact that the type of innovative products developed under the funded projects lend themselves as much to a regional market as to a national and international market
- *Age*: the age of the firm does not appear to be significant in explaining the dependent variable, although it is expected that a firm's seniority would positively affect the relationship of interest because, presumably, firms that have been in the market longer hold an established portfolio of customers and production system.
- *IMM_imm*: not helpful in explaining the interest ratio;
- *Debt_equity*: the ratio of total debt to equity is not statistically significant at any level of significance in explaining the dependent variable.

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Figure 3. Results of estimated regressions

Standard errors in parentheses

VARIABILI	Modello (1)	Modello (2)	Modello (3)	Modello (4)	Modello (5)	Modello (6)
SME2	0.0398	0.0401	0.0417	0.0427	0.0421	0.0432
	(0.0387)	(0.0387)	(0.0386)	(0.0386)	(0.0383)	(0.0383)
SME1	0.0228					
	(0.0483)					
inn_index	0.00570	0.00598				
	(0.00810)	(0.00807)				
age	0.0972	0.0978	0.0984			
	(0.0855)	(0.0854)	(0.0854)			
grants	0.0407**	0.0408**	0.0417**	0.0192***	0.0192***	0.0193***
	(0.0206)	(0.0206)	(0.0206)	(0.00669)	(0.00668)	(0.00669)
L	0.00397***	0.00402***	0.00400***	0.00405***	0.00409***	0.00395***
	(0.000917)	(0.000911)	(0.000910)	(0.000910)	(0.000905)	(0.000902)
IMM_imm	-4.95e-06	-4.93e-06	-5.02e-06	-5.08e-06	-5.07e-06	
	(3.21e-06)	(3.21e-06)	(3.20e-06)	(3.20e-06)	(3.20e-06)	
IMM_mat	-2.30e-05**	-2.31e-05**	-2.29e-05**	-2.26e-05**	-2.19e-05**	-2.83e-05***
	(1.01e-05)	(1.01e-05)	(1.01e-05)	(1.01e-05)	(1.00e-05)	(9.19e-06)
ita	-1.092*	-1.096*	-1.088*	-0.398***	-0.398***	-0.401***
	(0.618)	(0.618)	(0.617)	(0.153)	(0.152)	(0.153)
debt_equity	0.00668	0.00684	0.00675	0.00676		
	(0.00488)	(0.00487)	(0.00486)	(0.00486)		
Constant	0.269	0.239	0.747***	0.653***	0.662***	0.662***
	(0.704)	(0.701)	(0.139)	(0.112)	(0.112)	(0.112)
R-squared	0.778	0.778	0.778	0.778	0.777	0.776
Fixed effects	yes	yes	yes	yes	yes	yes
Time effects	yes	yes	yes	yes	yes	yes
Observations	715	715	715	715	722	722
Number of year	7	7	7	7	7	7

***p<0.01, ** p<0.05, * p<0.1

Overall, the goodness of fit of the full model (Model 1) seems positive and is approximated by the value of the' equal to 0.778. Such a value could be explained by the amount of regressors included, however, proceeding with the gradual elimination of regressors, it remains almost unchanged; in the last estimated model the' is 0.776. The consistency of this indicator, as well as the small variation in the coefficients of the regressors and their significance, is a sign of robustness of the estimates.

Model 6 is the ultimate result of this elimination process. The remaining regressors are:

- Grants: the sign and significance of the regressor, maintained throughout the elimination process, are fully consistent with expectations. A unit increase in the grants variable corresponds to an increase in the dependent variable sales_assets of 0.013.
- L: Again, the sign and consistent significance of the regressor are consistent with the hypotheses; as the number of employees in a firm increases by one unit, the ratio increases significantly by 0.004 points.
- IMM_mat: The regressor that quantifies the value of tangible assets has negative and significant sign. The negative effect on the interest ratio is consistent with expectations, since an increase in tangible

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assets leads to a growth in the value of total assets, thus reducing the total ratio. However, the effect of the ratio is totally marginal.

- Ita: Finally, the dummy summarizing membership, or not, in a foreign group is statistically significant. On average, firms that do not belong to a foreign group have a significantly lower sales_assets ratio than firms that do (-0.401). The explanation is intuitive: firms that belong to a foreign group have an easier opening to international markets to which, plausibly, corresponds greater sales opportunities and a much larger market than other firms.

The final model is as follows:

$$sales\_assets = \beta_0 + \beta_1 SME2 + \beta_2 grants + \beta_3 L + \beta_4 IMM\_mat + \beta_5 ita + \varepsilon \quad (2)$$

Net of all iterations developed, it is evident that the second stage of the SME Instrument does not assume statistical significance, to any degree and in any regression.

To test whether this is true for all firms, conditions on age were applied to the base model **(Model 6)**, constructing 3 thresholds: the first is aimed at observing firms with an age of less than 5 years, a critical threshold for the life of a firm; the second observes firms with an age between 6 and 15 years; and finally, the last observes firms with an age greater than 16 years. Imposing these conditions, **Model 7** (age < 5), Model **8** (6 < age < 15), **Model 9** (age >16) were estimated.

Figure 4. Results of estimated regressions with age conditions

VARIABLES	Modello base	Modello (7)	Modello (8)	Modello (9)
SME2	0.0432	0.0592	0.167*	-0.0265
	(0.0383)	(0.108)	(0.0918)	(0.0441)
grants	0.0193***	-0.00272	0.0290**	-0.00542**
	(0.00669)	(0.00241)	(0.0145)	(0.00237)
L	0.00395***	0.00823***	0.00429	0.000293
	(0.000902)	(0.00182)	(0.00402)	(0.00101)
IMM_mat	-2.83e-05***	-0.000185***	-3.88e-05	-3.16e-06
	(9.19e-06)	(6.08e-05)	(2.49e-05)	(9.45e-06)
ita	-0.401***	-0.0709	1.002	1.237***
	(0.153)	(0.255)	(0.647)	(0.183)
Constant	0.662***	0.562***	-0.690	
	(0.112)	(0.170)	(0.685)	
Fixed effects	yes	yes	yes	yes
Time effects	yes	yes	yes	yes
R-squared	0.776	0.811	0.781	0.847
Observations	722	146	183	280
Number of year	7	7	7	7

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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What emerges from these regressions is that SME2 continues to be non-significant for firms younger than 5 and older than 16, while, for firms between 6 and 15 years old, the effect of the second stage of EMS takes on some level of significance. On average, from the time these types of firms obtain funding to start projects under EMS2, the ratio of *sales_assets* increase by 0.167 points.

Given the low significance, it was decided to investigate the sample further: the hypothesis is that the instrument is not significant for all enterprises and that there are differences between sectors. The results show that, for manufacturing enterprises, the effect of the second stage of SME gains even more significance and power of impact. On average, manufacturing enterprises after receiving SME2 increase their sales/assets ratio by 0.288 points compared with the years before receiving it.

Table 3. SME significance matrix

sales_assets	*age<5*	*6<age<15*	*age>16*
manufacturing	SME2 statistically not significant	SME2 significant and positive	SME2 statistically not significant
ICT	SME2 statistically not significant	SME2 statistically not significant	SME2 statistically not significant
biotech	SME2 statistically not significant	SME2 statistically not significant	SME2 statistically not significant

As a result of multiple Hausman tests of the models, the null hypothesis that differences in coefficients are not systematic is rejected and models with fixed effects are preferred.

Implication for public management

The result that emerged is of extreme interest in the context of this topic. First of all, the consistent non-significance of the second phase of the SME Instrument places the present analysis in the strand of research that argues against the full effectiveness of public subsidies provided in these modes due to the *crowding out* phenomenon whereby firms intercept public financing for cost-effectiveness compared to the private financing market, which has high interest rates, but the receipt of it does not result in a systemic change that generates significant additionality.

This is true for firms older than 16 years, confirming the hypothesis shared in the literature that firms that have been in the market longer are more prone to crowding-out dynamics, and also for firms younger than 5 years. For the latter, the hypothesis is that they are not sufficiently structured to sustain the complex process that leads to product and/or process innovation.

On the other hand, firms that manage to cross the critical 5-year threshold, consolidating their structure and market presence, are able to

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conduct the innovation process more efficiently by coming to benefit from the results of it.

Now, given that public and private management share a common interest in making their investments effective and efficient by seeing a return on them, in light of the findings the implications for *policy makers* are twofold: personalization of policy and promotion of an integrated innovation model, both of which imply a rethinking of the instrument. The first solution assumes that while the SME Instrument works in the same way for all the firms that benefit from it, it cannot be said with as much certainty that the beneficiary firms work homogeneously, suffice it to say that within the sample of interest there are firms born in the period observed and firms that have been in the market for more than 50 years. Taking these two extreme cases as an example, it is logical to think that the effect of the same treatment on them differs substantially; in fact, the two enterprises will have different organizational structures, assets, customer portfolios, and resources - in general - so that the potential and resources of one are not the same for the other. For this reason, the *policy maker* should think of differentiated instruments based on certain key and structural characteristics that condition the output of the policy, regardless of the efficiency of an enterprise. However, it is a common understanding that adapting such measures to all the specifics of the case is a complex and costly process, so the second alternative, i.e., promoting an integrated innovation model, might be the one that is easiest to apply and theoretically could achieve the best results. The formula envisaged for the SME Instrument seems to suffer from an outdated view of the innovation process, imagined as a succession of black boxes from the different functions covering the stages of the process: basic research, applied research and product development. In this view, any input given to the "black box" goes through all these stages and automatically results in an output.

This perspective, in addition to not always being empirically verified, as in this case, has two main effects: on the one hand, it burdens companies with the burden of supporting the entire innovation process, with the risk that the costs-despite the financial contributions-exceed the benefits; on the other hand, it runs the risk of de-responsibilizing public management by limiting its action in the field of innovation to a shower of funding for SMEs, under the illusion that this will suffice. The ineffectiveness of such funding instruments implies a rethinking of innovation policies, starting first and foremost with the urgency of opening that "black box," scrutinizing its interior without merely observing inputs and outputs, but thinking about the entire innovation process.

With these assumptions, the *policy maker* could consider as a viable alternative the expansion of this model, moving from a linear view of the innovation process, to a more complex one that takes into account within it not only different stages but also multiple actors, including firms, partners,

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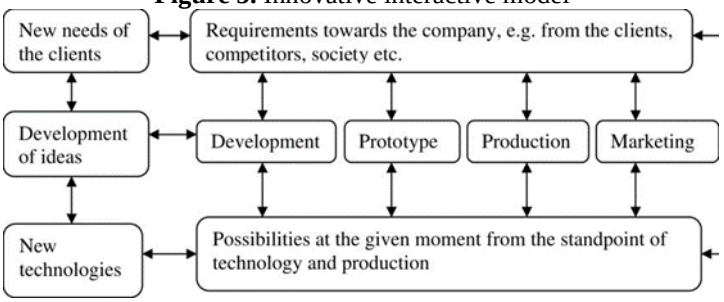
customers, universities and research centers and their continuous interactions at every moment of the innovation process, as envisioned in the interactive model.

Figure 5. Innovative interactive model



Source: Turbulence and Organizational Flexibility, Economic Printing House,2007

In this model, innovation arises from the interaction between market needs and the new technologies available at the state of the art,[71] from a collaboration between enterprises - which intercept market needs - and research institutions. In this view, the enterprise is no longer an exclusive incubator of the innovation process, but is the node of a much wider network that, due to its variety of composition and nature, can facilitate the matching of supply and demand of technologies.

Against the backdrop of today's extremely complex market environment, promoting a dynamic model such as the interactive model seems to be the optimal solution for at least two reasons: on the one hand, companies, by alienating entire stages of the innovation process to research organizations, would significantly reduce the efforts aimed at supporting the complexity of the innovation process, increasing the margin of benefit derived from innovation and generating additionality[72]; on the other hand, the collaboration between actors acting in the market and the world of research would help to give specific trajectories to technological progress, so that inventions are not left inside laboratories, but find concrete application in the market.

Conclusions

Like any research, the results obtained are never an end point, but the starting point for new reflections from which to develop further research. The question at the beginning of this study was whether the second phase of the SME Instrument had produced an impact on firms' performance and, if so, to what extent. At the conclusion of the analysis and estimation process, it can

[71] Maione A., "*Innovazione e trasferimento tecnologico dei sistemi produttivi avanzati basati sull'impiego dei materiali compositi"*

[72] This would be relevantly true for younger and smaller companies in terms of size that face, in implementing these processes, not only huge costs, but also problems in terms of organization and project management.

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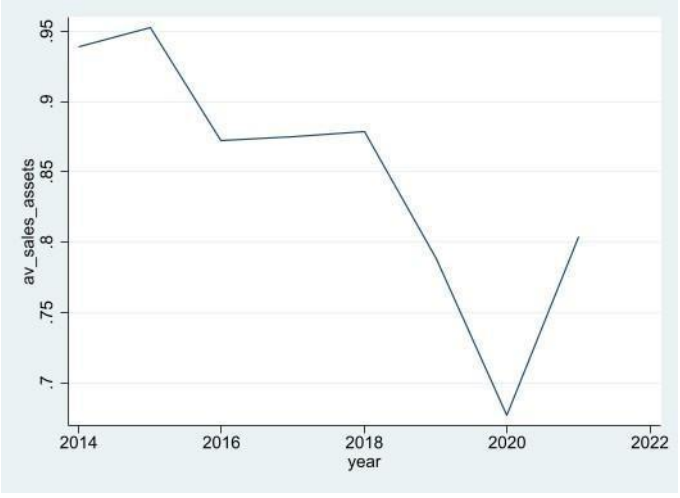
be concluded that the second phase of the SME Instrument did not produce significant additional effects on the performance of firms, approximated by the ratio of total sales to total assets. The only exception is those enterprises aged between 6 and 15 years, for which there is a partially significant increase in the sales/assets ratio after receiving funding.

The non-additionality that emerged from this analysis, contrary to initial expectations, certainly does not mean that *policy makers* should stop designing and implementing instruments to support the innovative development of SMEs that suffer from one of the most important credit market failures; rather, it leads one to question why the expected effect was not achieved and to think about what the implications of these results are. Regarding the lack of significant additionality, there are several assumptions that can be made: first, as commented in *Section 5.3*, the linear model of innovation in which resources are given to firms, entrusting them with the entire burden of the innovation process, may not be sufficient to produce additional effects; a second assumption is that the observed period from 2014 to 2020 does not span the post-pandemic economic recovery.

In fact, it is safe to assume that due to the pandemic, performance slowed down and that in the years after 2020 firms experienced enough growth to positively affect the non-significance of the SME Instrument. This hypothesis might have some basis if we look at the average trend of the sales/assets ratio by increasing the time frame under consideration by one year; in *Figure 18* we observe a collapse in the ratio coinciding with the year the pandemic began, and then starting to grow soon after. However, to ascertain this hypothesis would require the study of a longer period, extending at least a minimum of 3 years from 2020 to observe the performance of firms once they return to pre-pandemic rates.

Figure 6. Time series of sales/assets ratio



Source: Own elaboration

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In case it is not just a problem of time sample, but of criticality at the formulation level of the measure, two avenues have been identified for policy makers to pursue: customizing policies and promoting an innovative interactive model.

While the former seems a less viable route-especially in an extremely diverse context such as the European SME market-the latter is certainly an interesting tool to promote and is already in place in some regional realities in Italy (Region of Sardinia[73]) where collaboration between research institutions and clusters of companies in a process of co-designing innovative projects is promoted and financed.

Theoretically, financing innovation through these dynamic, varied and participatory models, in which the innovative process is developed within the laboratories of research organizations and not directly within companies, would relieve the latter of the costs of such a complex process, managing to obtain a larger margin of return on innovation development. However, the effectiveness of this type of tool should be verified empirically.

At the conclusion of this study, it is necessary to emphasize that the results obtained pertain exclusively to the sample of Italian companies that benefited from the second phase of the SME Instrument. Italian innovative small and medium-sized enterprises undoubtedly have different characteristics than their peers in other European countries; therefore, it is not possible to generalize the results of this analysis to the entire population of European companies benefiting from the SME2.

Finally, it is worth pointing out that these results are the result of an extreme synthesizing of much more articulated processes, the overall analysis of which - therefore - should be accompanied by a qualitative assessment that reveals the dynamics that escape quantitative schemes.

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Data Availability: All data are included in the content of the paper.

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Appendix

Table 1. Correlation table

	inn_in~x	age	grants	L	IMM_imm	IMM_mat	ita	debt_e~y
inn_index	1.0000							
age	-0.0263	1.0000						
grants	0.0444	-0.0098	1.0000					
L	0.0190	0.1461	0.3784	1.0000				
IMM_imm	0.0705	0.0014	0.2608	0.4582	1.0000			
IMM_mat	0.0127	0.1526	0.1353	0.6849	0.2834	1.0000		
ita	-0.0479	0.1304	-0.0830	0.0458	-0.0102	0.0550	1.0000	
debt_equity	-0.0105	0.0027	-0.0460	-0.0223	-0.0207	-0.0251	0.0177	1.0000

Table 2. Descriptive statistics

Variable		Mean	Std. dev.	Min	Max	Observations	
inn_in~x	overall	93.99052	9.738789	58.8	113.4	N =	791
	between		7.82561	64.57143	103.6714	n =	113
	within		5.836862	85.24766	107.6477	T =	7
age	overall	15.43995	14.11718	0	75	N =	791
	between		14.03257	.8571429	72	n =	113
	within		1.96911	12.43995	18.43995	T =	7
grants	overall	8.530973	19.27703	0	129	N =	791
	between		19.35065	0	129	n =	113
	within		0	8.530973	8.530973	T =	7
L	overall	28.43616	48.06768	0	373	N =	791
	between		41.42287	0	198.2857	n =	113
	within		24.65115	-169.8496	203.1504	T =	7
IMM_imm	overall	825.9509	4661.487	0	106307	N =	791
	between		2602.359	0	24650.86	n =	113
	within		3874.097	-23824.91	82482.09	T =	7
IMM_mat	overall	1687.37	4405.723	0	42026	N =	791
	between		3851.058	0	21781.14	n =	113
	within		2166.191	-20093.77	21932.23	T =	7
debt_e~y	overall	.685255	2.819176	0	60.92377	N =	721
	between		1.863184	0	18.44431	n =	112
	within		2.058178	-16.76136	43.16472	T-bar =	6.4375

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Table 3. Results of estimated regressions

VARIABLES	Modello (6)	Modello (7)	Modello (8)	Modello (9)
SME2	0.0432	0.0592	0.167*	-0.0265
	(0.0383)	(0.108)	(0.0918)	(0.0441)
grants	0.0193***	-0.00272	0.0290**	-0.00542**
	(0.00669)	(0.00241)	(0.0145)	(0.00237)
L	0.00395***	0.00823***	0.00429	0.000293
	(0.000902)	(0.00182)	(0.00402)	(0.00101)
IMM_mat	-2.83e-05***	-0.000185***	-3.88e-05	-3.16e-06
	(9.19e-06)	(6.08e-05)	(2.49e-05)	(9.45e-06)
ita	-0.401***	-0.0709	1.002	1.237***
	(0.153)	(0.255)	(0.647)	(0.183)
Constant	0.662***	0.562***	-0.690	
	(0.112)	(0.170)	(0.685)	
Fixed effects	yes	yes	yes	yes
Time effects	yes	yes	yes	yes
R-squared	0.776	0.811	0.781	0.847
Observations	722	146	183	280
Number of year	7	7	7	7

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Results of regressions with age conditions

Standard errors in parentheses

VARIABILI	Modello (1)	Modello (2)	Modello (3)	Modello (4)	Modello (5)	Modello (6)
SME2	0.0398	0.0401	0.0417	0.0427	0.0421	0.0432
	(0.0387)	(0.0387)	(0.0386)	(0.0386)	(0.0383)	(0.0383)
SME1	0.0228					
	(0.0483)					
inn_index	0.00570	0.00598				
	(0.00810)	(0.00807)				
age	0.0972	0.0978	0.0984			
	(0.0855)	(0.0854)	(0.0854)			
grants	0.0407**	0.0408**	0.0417**	0.0192***	0.0192***	0.0193***
	(0.0206)	(0.0206)	(0.0206)	(0.00669)	(0.00668)	(0.00669)
L	0.00397***	0.00402***	0.00400***	0.00405***	0.00409***	0.00395***
	(0.000917)	(0.000911)	(0.000910)	(0.000910)	(0.000905)	(0.000902)
IMM_imm	-4.95e-06	-4.93e-06	-5.02e-06	-5.08e-06	-5.07e-06	
	(3.21e-06)	(3.21e-06)	(3.20e-06)	(3.20e-06)	(3.20e-06)	
IMM_mat	-2.30e-05**	-2.31e-05**	-2.29e-05**	-2.26e-05**	-2.19e-05**	-2.83e-05***
	(1.01e-05)	(1.01e-05)	(1.01e-05)	(1.01e-05)	(1.00e-05)	(9.19e-06)
ita	-1.092*	-1.096*	-1.088*	-0.398***	-0.398***	-0.401***
	(0.618)	(0.618)	(0.617)	(0.153)	(0.152)	(0.153)
debt_equity	0.00668	0.00684	0.00675	0.00676		
	(0.00488)	(0.00487)	(0.00486)	(0.00486)		
Constant	0.269	0.239	0.747***	0.653***	0.662***	0.662***
	(0.704)	(0.701)	(0.139)	(0.112)	(0.112)	(0.112)
Observations	715	715	715	715	722	722
Number of year	7	7	7	7	7	7

***p<0.01, ** p<0.05, * p<0.1

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Table 5. Results of regressions with sector conditions

VARIABLES	Modello 10	Modello 11	Modello 12
SME2	0.289***	0.346	0.194
	(0.0833)	(0.314)	(0.318)
grants	-0.00401**	0.347*	0.0822*
	(0.00180)	(0.199)	(0.0437)
L	0.00132	-0.0497	0.00273
	(0.00418)	(0.0541)	(0.0275)
IMM_mat	-3.17e-05	0.00930	0.00191
	(4.04e-05)	(0.0326)	(0.00124)
ita	0.0552	0.169	
Constant	0.964***		
	(0.157)		
Fixed effects	yes	yes	yes
Time effects	yes	yes	yes
R-squared	0,889	0,925	0,661
Observations	91	29	40
Number of id	26	9	9

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Granger Causality Model of Retained Earnings and Financial Performance of Non-Financial Firms Listed on the Nairobi Securities Exchange (NSE), Kenya

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Abstract

Non-financial firms are central to economic development of nations, producing goods and services and alleviating unemployment by creating numerous job opportunities. Despite this potential inherent in non-financial firms, evidence shows that the non-financial firms listed on the Nairobi Securities Exchange (NSE) experience challenges in their financial performance, which lowers their capacity to invest. Although retained earnings have been used as a source of funding among listed non-financial firms, there is a paucity of research on the predictive power between retained earnings and the financial performance of these firms. Therefore, this paper focuses on addressing this paucity by modeling Granger causality between retained earnings and financial performance measured through Return on Assets (ROA) of non-financial firms listed on the NSE. The Wald tests revealed that the financial performance of non-financial firms Granger-causes retained earnings, but retained earnings do not Granger-cause financial performance. The conclusion drawn from these findings is that financial performance of non-financial firms listed on the NSE allows forecasting of future retained earnings. However, future research should leverage emerging advances like Network Granger causality to determine whether bidirectional Granger causality is viable between the two variables.

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Keywords: Non-financial firms, Financial performance, Granger causality, Capital structure, Wald test, Forecasting

Introduction

The financial well-being and performance of non-financial firms listed on the Nairobi Securities Exchange (NSE) in Kenya are crucial determinants that impact various stakeholders, including investors, managers, and policymakers. However, it is noted that a considerable number of non-financial firms listed on the NSE have been experiencing a decline in their financial performance and growth, which hampers investment (Shikumo et al., 2023). These scholars argue that lenders exhibit a lack of inclination to provide loans to non-financial firms. Consequently, the said firms encounter difficulties in procuring funds for their operational activities. Therefore, it is imperative to comprehend and evaluate the long-term financial health of these firms to make informed decisions regarding strategic financial management.
Retained earnings, among the principal factors determining a firm's financial well-being, play a significant role as they reflect the company's capacity to reinvest profits into its operations and sustain long-term growth. Retained earnings refer to the portion of a company's net profit after tax that is kept within the organization rather than being distributed to shareholders as dividends. These earnings are earmarked for reinvestment in the company's operations and are not distributed as dividends. Thus, they play a crucial role in enhancing stockholders' ownership of the company's net assets. According to Dahmash et al. (2023), retained profits can have a substantial impact on the overall value of the firm.

Retained earnings represent the accumulated net earnings or profits of a company after dividends have been paid out. These earnings consist of the net earnings that remain after dividends, which can be reinvested in the company or used to reduce debt. Since they signify the portion of a company's earnings that is not distributed as dividends, they are commonly referred to as retained surplus. In addition, retained earnings serve as a highly significant financial resource for firms as they do not incur additional operational costs, thereby enhancing financial performance and mitigating risks. A ratio known as the plowback ratio, also known as the retention rate in organizational contexts, can be used to measure retained earnings. However, as emphasized by Fernando (2023), there is a conflict regarding the optimal level of earnings retention. While managers often aim for a higher plowback ratio, shareholders may have different perspectives. Elevated plowback ratios introduce greater uncertainty for shareholders regarding their influence over shares and financial matters, resulting in significant trade-offs for equity shareholders (Koussis et al., 2017). Choice of retained earnings as the predictor variable

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was explained by existing literature that has leveraged the same (Nduati & Wepukhulu, 2020; Oganda et al., 2021; Pibowei et al., 2022).

Non-financial enterprises encompass a wide range of industries, including manufacturing, technology, consumer goods, healthcare, and services. Academic research indicates that these non-financial corporations engage in cross-market arbitrage by substituting one form of security for another in response to changes in relative valuations. This leads to financing flows that are negatively correlated across different markets (Ma, 2019). However, similar to other firms listed on the NSE, non-financial companies are currently facing the challenging situation of publicly traded companies suffering due to the ongoing economic crisis. Additionally, there appears to be a lack of enthusiasm among investors for stocks, which can be attributed to decreased disposable incomes and the emergence of alternative investment opportunities such as real estate and private equity (Anyanzwa, 2023). This warrants an evaluation of these firms as listed on the NSE.

Evaluating and assessing the financial performance of publicly traded non-financial firms entails scrutinizing their financial health, efficiency, and effectiveness (Verma, 2023). The analysis of the financial performance of these listed non-financial enterprises entails evaluating various financial metrics, ratios, and indicators to comprehend how effectively the company is utilizing its resources, generating profits, managing its debt, and delivering value to its shareholders. Key components of financial performance analysis may encompass profitability, liquidity, solvency, efficiency, growth, and shareholder returns (Ahsan, 2016; Fatihudin, 2018; Galant et al., 2017). However, contemporary research prominently features profitability measure ratios such as Return on Assets (ROA) and Return on Equity (ROE) (Asikin et al., 2020; Dianita, 2021; Nenobais et al., 2022; Panigrahi & Vachhani, 2021; Saputra, 2022).

Granger causality analysis, a statistical methodology devised by Clive Granger, is extensively employed to examine the causal relationship between two time-series variables (Amornbunchornvej et al., 2021; Cekic et al., 2018; Chvosteková et al., 2021; Hendry, 2017). Based on financial research, Granger causality analysis has been utilized to comprehend the temporal precedence and direction of causality between economic variables, such as retained earnings and financial performance indicators (Jackson & Orr, 2019; Josi, 2018; Yinusa & Adedokun, 2017). By investigating whether alterations in one variable occur before changes in another, Granger causality analysis provides insights into potential causal linkages that can enrich economic theory, influence policy decisions, and inform investment strategies.

Granger causality has traditionally relied on the assumption of a linear vector autoregressive (VAR) model (Shojaie & Fox, 2022) and the examination of tests on the VAR coefficients in the bivariate context.

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However, when dealing with real-world systems that involve numerous time series, studying the relationship between only two series can result in misleading conclusions (Cerqueira et al., 2020). Therefore, in using Granger causality, we took cognizance of limitations such as the assumption of (a) real-valued time series with (b) linear dynamics that depend on (c) a known number of past lagged observations, and (d) observations that are available at a fixed, discrete sampling rate, which matches the time scale of the causal structure of interest.

Scholarly research has demonstrated that comprehending the relationship between retained earnings and financial performance indicators, such as return on assets and return on equity, is crucial for making informed investment decisions and strategic management choices within the dynamic landscape of the Kenyan stock market (Thuranira, 2014). Nevertheless, it remains uncertain whether the association between retained earnings and financial performance among non-financial firms in capital markets can be sustained in the long term. While previous research has explored the interconnection between retained earnings and financial performance in various contexts (Adeniji, 2023; Mauwa, 2017; Oganda et al., 2022; Viet et al., 2020), there exists a gap in understanding the sustainability of such an association in the long term, particularly among non-financial firms listed on the NSE, Kenya. Additionally, existing studies (Lokwang et al., 2018; Purohit, 2024) often overlook the subtle distinctions in individual firm characteristics and temporal variations, which can significantly impact the dynamics between retained earnings and financial performance.

In this paper, we have addressed the aforementioned gaps by employing concise panel data analysis techniques to examine the Granger causality relationship between retained earnings and financial performance among non-financial firms that are listed on the NSE in Kenya. The utilization of panel data analysis offers a robust and comprehensive approach that takes into consideration both the time series and cross-sectional dimensions of the data, thus providing a thorough understanding of the underlying dynamics. The central research problem at hand involved determining whether retained earnings have a causal influence on changes in financial performance indicators, or vice versa, among non-financial firms in the NSE in Kenya.

The novelty of this paper is in the examination of the temporal precedence of changes in financial performance over retained earnings using Granger causality. While several studies have examined the direct effects of retained earnings on the financial performance of non-financial firms, little or no interest has been directed towards sustainability of such effects. Therefore, this study contributes valuable knowledge to existing discourse by examining how the past and present values of retained earnings can be used to predict the financial performance of non-financial firms and vice versa in the future. Such

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future causal linkages may offer valuable avenues for strategic decision-making and financial management practices within these non-financial firms. The structure of this paper is as follows: Firstly, we commence by providing an overview of the pertinent literature on retained earnings, financial performance, and Granger causality analysis. Secondly, we delineate our research methodology, encompassing data collection, panel data analysis techniques, and Granger causality tests. Thirdly, we present our empirical findings and engage in a comprehensive discussion on their implications for investors, managers, and policymakers. Lastly, we conclude by summarizing the key findings and providing suggestions for future research directions.

Literature Review

Existing empirical literature has underscored the importance of Granger causality in predictive forecasting. In a study targeting quoted firms in Ghana, Li et al. (2020) examined causation between liquidity and the financial performance of non-financial firms. Using Return on Equity (ROE) to measure financial performance, they found a negative effect of liquidity on the financial performance of the firms. On the contrary, when cash flow was used as a proxy to measure ROE, the effect was positive but non-significant. Their study did not investigate whether liquidity Granger-causes ROE. Therefore, this study aimed to fill this research gap by investigating whether retained earnings for non-financial firms trading on the NSE Granger-cause financial performance as measured by Return on Assets (ROA).

In another study conducted on commercial banks drawn from 30 countries in the Sub-Saharan Africa (SSA) region, Olarewaju et al. (2018) investigated causality between dividend policy and banks' financial performance for the period 2006 to 2015. Using pairwise Granger causality and Wald tests, they established that the retention policy Granger-causes performance when measured in terms of ROA. Despite employing the Granger causality approach, their study focused on financial institutions, thus warranting a replication of such research in non-financial firms trading on the NSE.

A prior study conducted by Mutua and Atheru (2020) investigated the association between capital structure and financial performance among manufacturing and allied sector firms listed on the NSE, Kenya. These scholars used the Ordinary Least Squares (OLS) regression approach to show that retained earnings had a negative effect on the financial performance of the manufacturing firms. The study findings left a gap as to whether the observed effects were a result of causation given the dynamic nexus between retained earnings and financial performance justifying a study on Granger causality.

Another study conducted by Abdullah and Tursoy (2021) examined the panel causality between capital structure, as measured by retained earnings

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among other proxies, and financial performance in non-financial sectors listed on the German Securities Exchange from 1993 to 2016. By using the panel regression approach, Abdullah and Tursoy (2021) confirmed that there was a significant homogeneous causality between capital structure and the financial performance of non-financial firms trading on the German Securities Exchange. However, these scholars did not put into context the cross sectional and time series aspects of the firms, justifying replication of the study by factoring in the potential for Granger causality.

A research paper authored by Gathara et al. (2019) delved into the determinants of financial performance among firms listed on the NSE, Kenya, including factors such as leverage, liquidity, and firm size. The study highlighted determinants of financial performance among firms listed on the NSE but failed to show the predictive ability of retained earnings and the financial performance of the firms. This research gap emphasizes the necessity for a dedicated analysis that scrutinizes the causal linkages between retained earnings and financial performance within the context of the Kenyan stock market.

Despite the valuable contributions made by existing empirical studies in various aspects of corporate finance and financial performance within the context of the NSE, Kenya, there remains a gap in understanding the specific panel causality between retained earnings and financial performance indicators. This study, however, addressed this research gap by employing panel data analysis techniques to investigate the Granger causality between retained earnings and financial performance among non-financial firms listed on the NSE, Kenya.

Method

Data Collection

This study targeted 51 non-financial companies listed on the Nairobi Securities Exchange (NSE) as of 2016. These firms consisted of Agricultural Firms (6), Automobiles and accessories (1), Commercial & Services (13), Construction & Allied (5), Energy & Petroleum (4), Insurance (6), Investment (5), Investment Services (1), Manufacturing & Allied (8), Telecommunication (1), and Real Estate Investment Trust (1). Data used for the study were gathered from the financial reports of these companies covering the period from 2016 to 2022 inclusive. However, the sample size included only the 42 listed non-financial companies with complete and suitable financial reports from 2016 to 2022, and it was sampled purposively using the criteria that they were non-financial firms. Hence, this means that financial firms were not considered. This decision was made due to the distinct nature of their operations and financing policies, as discussed in previous studies (Abdullah & Tursoy, 2019; Vo & Ellis, 2017). The second criterion was that they had

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complete and suitable financial reports. Therefore, companies with missing year-end financial data throughout the entire sample period were excluded from the analysis, leaving non-financial firms spread over seven years and distributed in 42 balanced panels. Balanced data allows an observation of the same units in every time period reducing errors caused by heterogeneity (Krotko & Kubinec, 2020). To meet the study's objective, secondary data from the Nairobi Securities Exchange (NSE) and the audited financial statements of companies listed on the NSE were utilized. The data collection process involved visiting the official websites of the selected companies to download their audited financial statements. From these statements, the pertinent figures were meticulously extracted and processed for in-depth analysis.

Study Variables

In this study, the independent variable employed was retained earnings, which was measured using earnings per share. Retained earnings, as described by Ball et al. (2020), represent the cumulative sum of earnings generated by the firm over its history, minus the total dividends distributed to shareholders over time. In consistency with prior research (Dahmash et al., 2023; Yemi & Seriki, 2018), earnings per share was utilized as the metric for assessing retained earnings.

Financial performance was conceptualized as the dependent variable in this study. This variable was measured through ROA. In selecting ROA as a proxy for financial performance, we took cognizant of the fact that financial performance is not only a measure of profitability but also a measure of the efficient use of assets. This measure was chosen due to its widespread adoption in similar studies (Batchimeg, 2017; Jouida, 2018; Le & Phan, 2017). Return on assets (ROA) is the ratio of the net income of a particular financial year to total assets of the same year. Investors use ROA to find good stock opportunities because the percentage shows how efficient a company is at using its assets to generate profits. Although other financial performance metrics exist, this study avoided the potential for multicollinearity by using only one measure of financial performance.

Financial Performance-Retained Earning Model

This model was based on the Panel Vector Auto Regression (PVAR) approach. The model was executed to examine the impact of financial performance on retained earnings. Earnings Per Share (EPS) served as the independent variable, representing retained earnings, while the ROA served as the dependent variable in two distinct models. We hypothesized that retained earnings could either positively (H1) or negatively (H2) affect financial performance. Based on these hypotheses, the econometric causality model can be expressed below:

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$$FP_{it} = \alpha_i + \sum_{j=1}^{p} \beta_{ij} FP_{i,t-j} + \sum_{k=0}^{q} \gamma_{ik} RE_{i,t-k} + \varepsilon_{it} \quad (1)$$

In the model, FP_{it} represents financial performance for firm i at time t; α_i represents firm specific intercepts; p and q represent the lag order for financial performance and retained earnings, respectively;
β_{ij} and $\gamma_{ik}$are coefficients to be estimated; and ε_{it} is the error term.

Financial Performance: Retained Earnings Model

This model was employed to investigate the impact of financial performance on retained earnings. Therefore, we postulated that financial performance could either have a positive (H1) or negative (H2) effect on retained earnings. Based on these postulations, the causality model can be expressed in equation 2 below.

$$RE_{it} = \mu_i + \sum_{l=1}^{r} \theta_{il} RE_{i,t-l} + \sum_{m=0}^{s} \varphi_{im} FP_{i,t-m} + \eta_{it} \quad (2)$$

Where;
RE_{it} represent retained earnings for firm i at time t; r and s represent the lag order for retained earnings and financial performance, respectively; μ_i are firm-specific intercepts; θ_{il} and φ_{im} are coefficients to be estimated; and η_{it} are error terms.

Results

Descriptive Statistics of Study Variables

The study's conceptual framework consisted of two constructs, which includes financial performance as the dependent construct and retained earnings as the independent construct. Therefore, descriptive summaries were generated for these two constructs.

Descriptive Statistics for ROA

The Return on Assets (ROA) percentage, indicating the profitability of a company in relation to its total assets, displayed an average of -2.94% (Table 1). This negative average reveals that, on average, the companies' assets were not generating profits. Moreover, the high standard deviation of 111.0 signified considerable variability among the ROA values, suggesting significant differences in asset performance among the companies. The distribution of ROA was notably skewed to the left, as indicated by the skewness value of -16.4, signifying that a majority of companies were experiencing low returns. The positive kurtosis of 276.9 implied a distribution with heavy tails, indicating a prevalence of extreme negative ROA values, contributing to the peakedness of the distribution.

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Table 1. Descriptive Statistics (ROA)

Percentiles	ROA	Smallest	Other Parameters	Value
1%	-69.3	-1875		
5%	-19.97	-122.1		
10%	-8.05	-69.3	obs	294
25%	.25	-49.7	Sum of Wgt	294
50%	2.99		Mean	-2.94
		Largest	Std. Dev.	111.0
75%	7.57	47.7		
90%	12.3	49.7	Variance	12324.3
95%	25.3	67	Skewness	-16.4
99%	49.7	185.2	kurtosis	276.9

These findings suggest that a considerable number of firms face challenges in effectively utilizing their assets to generate profits. Therefore, this research was crucial to understanding the future behavior of ROA in non-financial firms and to identifying potential areas for operational improvement.

Descriptive Statistics for Retained Earnings

Earnings Per Share (EPS), representing a company's profitability per outstanding share, had a positive mean of 6.95 (Table 2), indicating that, on average, non-financial firms were able to retain some earnings. The standard deviation of 18.3 suggests moderate variability in retained earnings. The positive skewness of 2.87 implies a distribution with a long tail on the positive side, indicating companies with high levels of retained earnings. The positive kurtosis of 12.1 suggests a distribution with heavy tails and a sharp peak, indicating common occurrences of extreme retained earnings.

Table 2. Descriptive Statistics (Retained Earnings)

Percentiles	EPS	Smallest	Other Parameters	Value
1%	-16.4	-37.4		
5%	-3.92	-30.8		
10%	-2.05	16.4	obs	294
25%	.05	-14.0	Sum of Wgt	294
50%	1.2		Mean	6.95
		Largest	Std. Dev.	18.3
75%	5.12	85.3		
90%	26.5	88.1	Variance	335.9
95%	49.1	89.9	Skewness	2.87
99%	88.1	91.3	Kurtosis	12.1

Diagnostic Tests

Prior to running the fixed effects regressions on lagged variables to estimate the PVAR model, declaration of the data to be panel data revealed a strongly balanced panel variable as required for investigating Granger causality.

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Panel Unit Root Test

Panel data unit root tests were performed using the Levin-Lin-Chu (LLC) unit root test, which is suitable for strongly balanced panels, as observed in this study. Specifically, the LLC tests were conducted in this study to evaluate the stationarity properties of financial performance and retained earnings across the 42 panels. The null hypothesis (H_0) proposed that all panels contained unit roots, indicating non-stationarity, while the alternative hypothesis (Ha) suggested that at least one panel was stationary. The LLC tests yielded compelling evidence against the null hypothesis for the two variables, as indicated by the statistically significant adjusted t* values (Table 3). Thus, this implies that there was at least one panel where financial performance and retained earnings were stationary.

Table 3. Levin-Lin-Chu unit-root test

H_0: Panels contain unit roots		Number of panes	= 42
H_a: Panels are stationary		Avg. number of periods	= 7
		Stat.	p-value
Financial Performance (ROA)	Unadjusted t	-18.3	
	Adjusted t*	-16.0	.000
Retained Earnings (RE)	Unadjusted t	-16.8	
	Adjusted t*	-13.5	.000

Estimating Panel Vector Autocorrelation Model

The STATA software Version IC 15.0 was used to generate lagged variables for financial performance and retained earnings. Hence, this was followed with an estimation of the PVAR model. Results presented in Table 4 revealed the following. A one-unit increase in the lagged ROA (L1_ROA) was associated with a decrease of 0.267 units in financial performance, holding other variables constant. The coefficient was not statistically significant at 0.05, indicating that the effect of L1_ROA on financial performance was likely due to random chance.

A one-unit increase in the lagged ROA (L2_ROA) was associated with a decrease of 0.347 units in ROA, holding other variables constant. The coefficient was statistically significant at the 0.05 level, indicating a significant effect of L2_ROA on financial performance. A one-unit increase in the lagged ROA (L3_ROA) was associated with a decrease of 0.217 units in ROA holding other variables constant. The coefficient was statistically significant at the 0.05 level, suggesting that the effect of L3_ROA on financial performance was not due to chance. Regarding retained earnings, none of the lagged retained earnings had statistically significant coefficients, an indication that lagging retained earnings at whatever level did not yield significant effects.

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Table 4. Effect of lagged variables on Financial Performance (ROA)

Financial Performance (ROA)	Coef.	Robust Std. Err	t	p>|t|
L1_ROA	-.267	.138	-1.93	0.056
L2_ROA	-.347	.127	-2.74	0.007
L3_ROA	-.217	.107	-2.02	0.045
L1_RE	.213	.126	1.69	0.093
L2_RE	.094	.135	0.70	0.488
L3_RE	.209	.135	1.55	0.123
_cons	2.33	.302	7.70	0.000

Wald test results

(1) L1_ROA = 0,	(1) L1_retained = 0
(2) L2_ROA = 0	(2) L2_retained = 0
(3) L3_ROA = 0	(3) L3_retained = 0
F(3, 119) = 6.80	F(3, 120) = 7.49
Prob > F = 0.000	Prob > F = 0.2211

Granger Causality Tests

The Wald tests were conducted to test financial performance Granger-causing retained earnings on the one hand, and retained earnings Granger-causing financial performance on the other hand. The postulation made in the predictive potential of financial performance was that the lagged ROA variables (L1_ROA, L2_ROA, and L3_ROA) had no joint significant predictive power for retained earnings. The alternative hypothesis therefore shows that at least one of the lagged ROA variables significantly predicted retained earnings. The Wald test provided evidence of Granger causality from lagged financial performance to retained earnings ($F_{3, 119} = 6.80$, $p < 0.05$). In case of the predictive power of retained earnings, the postulation was that joint lagged retained earnings variables (L1_RE, L2_RE, and L3_RE) did not significantly predict financial performance in non-financial firms. The alternative hypothesis to this was that at least one of the lagged retained earning variables predicted financial performance in non-financial firms. The Wald test results found no evidence of Granger causality from lagged retained earnings to financial performance (ROA) in the given model. Therefore, based on these test results, we inferred that financial performance Granger-causes retained earnings, and it is represented by the econometric model in equation 3.

$$RE_{it} = 2.33_i - 0.267L1\_ROA_{it} - 0.347L2\_ROA_{it} - 0.217L3\_ROA_{it} + \eta_{it} \quad (3)$$

Consequently, retained earnings represented by Equation 4, does not Granger-cause financial performance over time in the given model.

$$FP_{it} = .213L\_RE_{it} + 0.094L2\_RE_{it} + .209L3\_RE_{it} + \eta_{it} \quad (4)$$

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Discussions

The Wald test revealed that financial performance granger-causes retained earnings. This finding has implications for non-financial firms listed on the NSE. It suggests that the financial performance of these firms has a predictive effect on their retained earnings. This means that the financial performance of a non-financial firm can be used to forecast the changes in its retained earnings over time. This finding is important for managers and investors as it provides insights into the relationship between financial performance and retained earnings, which are key indicators of a firm's financial health and profitability. By understanding this relationship, managers can make informed decisions regarding resource allocation and financial planning, while investors can use it to assess the prospects and profitability of non-financial firms (Kristi & Yanto, 2020).

Furthermore, research has shown that retained earnings hold significant importance as the primary means of financing a firm's growth (Thuranira, 2014). Therefore, by showing that the financial performance of a non-financial firm can be used to forecast changes in its retained earnings over time, this research provides an avenue for non-financial firms trading on the NSE to experience growth by distributing lower dividends, reinvesting a greater portion of their earnings, and allocating a higher percentage of their overall returns towards capital gains.

The existence of unidirectional Granger causality from financial performance to retained earnings suggests that changes in financial performance can lead to changes in retained earnings. This information is valuable for decision-making and strategic planning, as it allows businesses to assess the impact of their financial performance on their retained earnings. Also, this finding regarding unidirectional Granger causality is consistent with other previous studies.

Studies by El Ammari and Terzi (2023), Lin (2021), and Muritala et al. (2020) have shown unidirectional Granger causality involving financial performance. El Ammari and Terzi (2023) found both unidirectional and bidirectional significant causal links between ownership structure, dividend policy, and financial performance in Tunisia. Lin (2021) identified a positive relationship between R&D investment and financial performance at certain quantiles. Muritala et al. (2020) found a unidirectional causal relationship between emissions intensity and equity returns, as well as a bidirectional causal relationship between emissions intensity and market value of equity deflated by sales. These studies corroborate our findings by providing evidence of the impact of various factors on financial performance and contributing to our understanding of the causality nexus in different contexts.

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Conclusions

Financial performance measured through ROA Granger-causes retained earnings in non-financial firms listed on the NSE. It implies that ROA predicts changes in retained earnings, rather than the other way around. This finding offers concrete evidence backing the theoretical connection between financial performance and retained earnings. It verifies that adjustments in financial results, as determined by ROA, impact retained earnings in non-financial companies. This backs the notion that the financial performance of companies impacts the level of earnings they retain. This finding is in line with financial management theory indicating that companies with better performance tend to hold onto more earnings. Moreover, this finding supports resource allocation theory by implying that listed non-financial firms that perform well have greater internal resources (retained earnings) at their disposal, for investing in growth and expansion initiatives in the future. This finding showing that financial performance Granger-causes retained earning underscores the significance of financial management. Policy makers and stakeholders in non-financial firms may consider mechanisms to enhance financial performance with a view to boosting retained earnings leading to improved financial stability and long-term growth opportunities. The main limitation of this research is that it contradicts accounts of retained earnings Granger-causing financial performance in other contexts. Therefore, this research reinforces the postulations that PVAR Granger causality in the temporal domain does not always reveal genuine causality. Future studies should therefore seek to replicate this research by employing recent advances, such as Network Granger causality, which can address the intricate nature of real-world systems that encompass numerous time series.

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ESJ Social Sciences Peer-reviewed

The development of Critical Thinking Skills during Practical Training: The Perspectives of Pedagogical Supervisors and Sports and Physical Education Trainees

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Abstract

In the Republic of Congo, initial teacher training has both a theoretical and a practical dimension. Theoretical training takes the form of theoretical courses within the training institution itself. Practical training, on the other hand, takes place in professional settings (secondary schools). This comparative study consisted of identifying the conceptions relating to the development of critical thinking by educational supervisors and by student-trainees. Inscribed in a qualitative methodological approach, this research was based on Eric Lavertu's (2013) conceptual approach to the development of critical thinking in internships. Eight (08) educational supervisors and nineteen (19) student-trainees voluntarily participated in the study via three focus groups. The results obtained, following a content analysis of the corpus collected, reveal several didactic-pedagogical devices for the development of student-trainees' critical thinking, both according to the perception of pedagogical supervisors, and also, according to that of student-trainees. As didactic-pedagogical devices, educational supervisors identify three: the communication strategies highlighted by the supervisor, the climate of

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exchange established by the supervisor and the attitude of the supervisor. The student-trainees, for their part, emphasize the educational supervision environment, the attitude of the supervisor and the attitude of the student-trainee. Thus, to promote the development of critical thinking among student trainees, the measures mentioned specify that the supervisor must implement a pedagogical approach to supervision anchored in a social-constructivist paradigm to support the development of the student, using a reflective approach in support. In addition, these mentioned systems emphasize the importance of placing the student at the center of their learning by making them a real actor in their development.

Keywords: Critical thinking, internship, educational supervisor, student-intern

Introduction

The development of critical thinking in formal Sports and Physical Education (SPED) teacher training is a general requirement in most training curricula (Forges *et al.*, 2013, 2018; Lui et *al.*, 2018; Yuan and Liao, 2023). However, as Soukup (1999) stipulates, it is difficult for supervisors to accurately measure the level of critical thinking development in practicum students. Although the development of critical thinking is recognized as an important goal of education, it is often difficult to assess it accurately. Supervisors may observe certain aspects of critical thinking development, but it is difficult to ascertain its precise level. This highlights the complexity of assessing critical thinking and the need to develop suitable tools to measure this important concept. Factors such as the absence of a common operational definition of critical thinking among supervisors, the lack of clear expectations regarding students' critical thinking development, and the absence of didactic-pedagogical devices to assess the level of development and mobilization of critical thinking in students, contribute to this difficulty (Soukup, 1999).

Moreover, educational supervisors are not sufficiently trained to encourage critical thinking in their student trainees, and may sometimes lack this skill themselves. They find it difficult to determine and define a minimum level of attainment. This in turn leads to variations in terms of requirements and assessment during the internship. It is therefore essential to improve the training of educational supervisors and provide them with the skills they need to encourage the development of critical thinking in their students. In addition, the lack of didactic-pedagogical devices to assess the level of development and mobilization of critical thinking is also part of the problem. Although the development of students' critical thinking skills is not mentioned in the Congo's academic goals, we note that several of the objectives mentioned are closely linked to ~~it~~ to the evolution of these skills (Nziengui *et al.*, 2022).

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Acquiring a comprehensive understanding of the student and then proposing an individualized approach based on critical judgment and the use of reflective thinking requires a level of development of critical thinking beyond a minimum threshold. In the context of current professional practice, proposing the right approach in a particular case may mean proposing quite the opposite in a slightly different situation. Educational objectives must therefore highlight the need to develop critical thinking skills during internship training. A few authors have taken a more general approach to the question of the supervisor's role in developing the trainee's critical thinking skills. Moon (2004) discusses the importance of critical thinking in professional development. She emphasizes the importance of supervisors in supporting this process by encouraging trainees to question their own beliefs and seek alternatives. Yelon (2004) explores the role of the supervisor in the development of critical thinking in psychotherapy trainees. She stresses the importance of supervisors asking open-ended questions, encouraging trainees to examine different perspectives, and helping them develop a reflective attitude. Brauer and Ferguson (2015) examine the strategies used by clinical supervisors to promote critical thinking in trainees. They emphasize the importance of encouraging them to question assumptions, analyze the evidence supporting clinical decisions, and seek perspectives. Although these authors offer an interesting discussion of the role of supervisors in the development of trainees' critical thinking, there is still a lack of information on the perspective of student-trainees with regard to the development of their critical thinking. Faced with this gap, in 2020 and 2022, Nziengui, Mandoumou and Kpazaï conducted two studies on the development of critical thinking in internship settings, in which they took into account the perspectives of the two co-present actors: the pedagogical supervisor and the student-intern.

The aim of this comparative study is to identify the conceptions of critical thinking development held by pedagogical supervisors and student interns in order to gain a better understanding of the complexity of critical thinking development in internship settings. The main question put forward in our research is as follows: how do pedagogical supervisors and trainees conceive the development of critical thinking? From this main question we have identified three sub-questions (SQ). SQ1: What didactic-pedagogical devices do pedagogical supervisors see as likely to develop trainees' critical thinking during practical teaching placements? SQ2: According to the trainees themselves, what didactic-pedagogical devices are likely to develop trainees' critical thinking during their practical teaching placements? SQ3: How can the development of critical thinking be theorized in the light of the conceptions of pedagogical supervisors and student trainees during practical teaching placements?

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1. Conceptual framework

The conceptual framework of a comparative study is an essential element that situates the study in the context of existing research and provides a sound theoretical basis for the analysis of the results. The framework for this comparative study is based on Eric Lavertu's (2013) research relating to the assessment of critical thinking in the context of nursing internships. In addition, he shows how to assess critical thinking. Firstly, he does this by identifying the assumptions underlying arguments and bringing to light new perspectives or problems. Secondly, by detecting and evaluating the relevance of assumptions, whether explicitly or implicitly formulated. Finally, for this author, thinking critically is a primarily rational activity, based on questioning and challenging prejudices and "ready-made" opinions. This requires, according to Lavertu (2013), thinking about one's own thought processes, in order to detect flaws and be able to correct them if necessary.

2. Methodology

For this study, we opted for a qualitative methodological approach, as qualitative research seeks to better understand a phenomenon, to become familiar with people and their concerns (Poupart *et al.*, 1997). According to Gohier (1998), research should be defined not so much by the instruments used to capture and interpret data, but rather by the researcher's epistemological position, which enables them to propose the interpretative and positivist approaches as subdivisions.

2.1. Data collection strategy

The comparative study was carried out in Brazzaville. Eight (08) pedagogical supervisors and nineteen (19) student trainees voluntarily participated in the study. The pedagogical supervisors had professional experience ranging from 9 to 15 years. As for the student trainees, ten (10) were in their third year of the SPED Bachelor's degree and nine (09) in their first and second year of the SPE Master's degree. Their internship experience ranged from 3 to 5 years. The focus group was used as a data collection instrument. With the supervisors, we used a focus group lasting 60 minutes. For the students, we used three focus groups: a) a declarative focus group with Bachelor's students (duration: 90 minutes), b) a declarative focus group with Master's students (duration: 90 minutes) and c) a confirmatory focus group grouping Bachelor's and Master's students (duration: 60 minutes). These focus groups were recorded using a dictaphone (See appendices for the interview guides).

These focus groups took place in a safe space where participants felt respected and stimulated. The setting was carefully designed to encourage discussion and the active participation of each member. Participants' opinions

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and ideas were listened to attentively and given fair consideration. Efforts were made to create an inclusive space where every voice was heard, and where the diversity of perspectives was valued. In fact, participants were encouraged to express their thoughts and feelings freely. Their contributions were welcomed with interest and consideration. Overall, the empowering environment of the focus group enabled productive collaboration and quality collective reflection.

2.2. Data analysis strategy

The analysis strategy for the corpus collected was based on a content analysis for a case study (Yin, 1994). It took the form of a four-stage analysis process: 1) classification according to the research axis (the development of critical thinking); 2) transcription of the group interviews; 3) coding of the units of meaning according to the frames of reference of the two studies; 4) preparation of the coding tools by reviewing the conceptual framework, research questions, and the objectives; and 5) data analysis. Each of the statements collected from focus group participants relating to the supervision actions was coded in order to bring out the informational units linked to the frames of reference of the two studies. The categorization consisted of a rigorous grouping of the different codes, constituting a kind of matrix of meaning and enabling illustrations to be made.

3. Results

3.1. The development of critical thinking in student trainees (ST) according to pedagogical supervisors (PS)

The data analysis identified the following three modalities that the pedagogical supervisor will need to put in place to develop the student trainee's critical thinking (see table 1).

Table 1: The development of critical thinking in student trainees (ST) according to pedagogical supervisors (PS)

Teaching Aids	**Device Indicators**
1. Communication strategy	Questioning that sparks dialogue,experience sharing (PS- ST), and debate Questioning that encourages the search for a solution, justification by the ST
2. Attitude of the educational supervisor	Open-mindedness Willingness to motivate ST Desire to establish a horizontal PS-ST relationship
3. Communication climate	Respectful, rewarding, motivating, and encouraging free expression Student-trainee focused

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The excerpts from the transcripts below illustrate how the development of critical thinking in student trainees (ST) varies from one pedagogical supervisor (PS) to another.

- Firstly, the critical thinking of the student trainee (ST) is developed by the communication strategies highlighted by the pedagogical supervisor (PS).

The communication strategies put forward by the pedagogical supervisor during an internship may vary according to his or her objectives and pedagogical vision. However, among the elements that can be included in these strategies we have the encouragement to ask questions where the pedagogical supervisor should encourage the trainee to ask questions and express concerns. This helps to clarify information, solve problems and maintain open, transparent communication. This is exemplified in the following statement from a student.

> *"... the pedagogical supervisor... faced with the lesson conducted by the trainee... Why did you teach this? Why did you do that? The student at that moment has the right and duty to defend himself, and the educational supervisor also has the right and duty to explain the norm, the facts..." (B6).*

With this statement, B6 demonstrates that the trainee can support his or her answers with justifications and concrete examples. This helps the supervisor to better understand the trainee's reasoning and assess their skills and understanding. The trainee can also be open to the supervisor's comments and suggestions. He or she may recognize weak points or areas for improvement and express interest in receiving further advice and guidance moving forward.

- Secondly, the critical thinking of the student trainee (ST) is developed by the attitude of the-pedagogical supervisor (PS).

The supervisor's attitude of openness, their availability, and their willingness to establish a horizontal PS-ST relationship are important tools in the development of the trainee's critical thinking. By creating an environment conducive to discussion, constructive dialogue, and questioning, the supervisor enables the trainee to deepen their thinking, explore new ideas, and develop analytical skills. The excerpt below provides an illustration.

> *"... when there's this feedback, with the supervisor, where the student starts to discuss, in relation to his form, defending his notional content, to say, if I've chosen such and such an element... I'm orienting, and, I'm demonstrating... And the supervisor says, yes, that's fine and... questions himself. Couldn't we do that? He asks for the student's point of view... we talk, we find a compromise so that tomorrow when I go back to my course, I won't make the same mistakes, because we've*

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decided together...". (B3).

When the supervisor encourages the trainee to ask questions, challenge established ideas, and seekanswers on their own, they foster their intellectual autonomy and ability to make informed decisions. Moreover, by providing constructive feedback and supporting the trainee's professional development, the supervisor offers additional tools and resources to strengthen critical thinking.

- Thirdly, the critical thinking of the student trainee is developed by the climate established by the pedagogical supervisor.

By creating an environment where mutual respect, active listening, and valuing opinions are encouraged, the supervisor fosters the trainee's confidence and open-mindedness. Trainees feel respected and valued, and are more inclined to express their ideas, ask questions, and challenge preconceptions. The respectful climate is also a tool that enables trainees to feel confident in expressing their opinions, even if they differ from those of the supervisor or other team members. The following statement testifies to this notion.

> *"...when we start the debate, we create a climate of debate, we encourage that climate; it helps the trainee to feel free...he can bring out the basic elements of his conception, his opinions...itwill create a climate of exchange, a climate of sharing and then...it will encourage the construction" (B8).*

Ultimately, the above statement exemplifies how the respectful climate promoted by the supervisor is a catalyst for the development of the trainee's critical thinking. It creates an atmosphere conducive to learning, creativity, and innovation, while fostering respect for others and valuing individual contributions. In this way, trainees are encouraged to develop their critical thinking skills independently, enabling them to become competent, reflective professionals in their field.

3.2. The development of critical thinking according to the trainees

With regard to the didactic-pedagogical devices that the student trainee must put in place to develop his or her critical thinking, the study revealed three devices (see table 2).

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Table 2: The development of critical thinking according to the trainees

Teaching Aids	**Device Indicators**
Supervision Environment	Pedagogical supervision based onsocial cooperation Pedagogical supervision based onexchanges Pedagogical supervision based onquestioning strategies
The profile of the educational supervisor	Attitude Character Cognitive skills Pedagogy and supervisoryleadership
Student trainee profile	Awareness Disposition: open-mindedness, willingness to learn, etc.

The results are supported by the following statements from the trainees.

- Firstly, we examine the pedagogical supervision environment on which the pedagogical supervisor relies to develop the critical thinking of the student trainee.

The pedagogical supervision environment is an essential tool for developing the trainee's critical thinking skills. By creating a stimulating learning climate (one that fosters the exchange of ideas), the supervisor encourages the trainee to think deeply, question preconceived ideas (questioning strategy), and develop independent critical thinking skills (social cooperation). The following statement illustrates this point.

> *"... it can happen that the advisor asks me why I did such and such an exercise. For example, in the warm-up, he asks me first to demonstrate the exercise I've done, and then he tells me that this exercise you've chosen, aren't there other, more appropriate exercises? Because the exercise I had to choose may or may not be adapted, or it may be a more difficult exercise and there may be other easier exercises that I can adapt..."* (V8).

The above statement reinforces the idea that a pedagogical supervision environment that is based on reciprocity, questioning, and cooperation fosters a positive exchange of ideas. Open, critical reflection and collaborative learning are essential for the professional development of trainees. The application of these principles enables trainees to acquire the skills and knowledge they need to become reflective, competent, and innovative teachers in their future teaching careers.

- Secondly, the profile of the pedagogical supervisor based on his/her attitude, character, cognitive skills, and adopted pedagogy, is a tool conducive to the development of critical thinking in students.

To develop a trainee's critical thinking skills, it is essential that the

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educational supervisor adopt a supportive and encouraging attitude. An educational supervisor must be open, receptive to different ideas and opinions, and ready to challenge preconceived ideas. In terms of character, it is important for the educational supervisor to be fair, equitable, and impartial in his or her assessments and feedback. He or she must also be patient and tolerant of the trainee's mistakes and shortcomings, recognizing that these are an integral part of learning and the development of critical thinking. In terms of instruction, the pedagogical supervisor must favor interactive and participative teaching methods that stimulate the trainee's critical thinking and analysis. The following sentiment expressed by a student illustrates this point.

> *"I'd say that having a soft advisor won't encourage you to work well. But having an advisor who's rigorous, in fact when you do something, he blames you and you take it seriously and not an advisor, whether you do it wrong or not, he's not going to talk to you, for me I find he doesn't help me and he won't be a good advisor"* (A2).

The attitude, character, and pedagogy of the educational supervisor are key to developing a trainee's critical thinking skills. A supportive educational supervisor who is open, rigorous, and encouraging will impel the trainee to develop critical thinking skills and make informed decisions throughout the learning process.

- Thirdly, the student-trainee's profile, reflected in their awareness and affective attitude, is a tool that encourages critical thinking.

The trainee's affective attitude - their willingness to be open, curious, and questioning - is a crucial element in fostering critical thinking. A trainee who is willing to question their own beliefs, accept constructive criticism, and actively engage in the learning process will be more likely to develop critical thinking skills in a meaningful way. Trainee self-awareness is another important tool for developing critical thinking skills. By becoming aware of their own biases, prejudices, and limitations, trainees can be more attentive to the information they receive, and be able to evaluate more objectively and critically the arguments and ideas presented to them. Awareness also enables trainees to recognize gaps in their knowledge and to actively seek to fill them, thus contributing to their critical thinking. The verbatim comments below support these assertions.

> *"For me, when the advisor gives me criticism... sometimes it... gets on my nerves, because you realize that you've also done your research and that what they're saying doesn't match up with all that. I've read three or four books, for example, and when he compares them to these three authors, for example, it doesn't match up with what I'm trying to feel myself, it really annoys me. But seeing as he's the superior to me, I act as if I've accepted to go and do some more research to try and*

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convince him...". (A7).

The above excerpt from the interviews underscores how the combination of a favorable affective attitude with an awareness of their own biases and limitations will allow trainees to develop their critical thinking in a deeper and more meaningful way. They will be able to question information, formulate sound arguments, and critically evaluate different perspectives and points of view. This will give them the skills they need to make informed decisions and contribute thoughtfully and critically to their field of study or work.

Discussion

This study reveals several didactic-pedagogical devices for developing critical thinking in student trainees, according to both the pedagogical supervisors and the student trainees themselves. These are directed at the educational supervisor, the student trainee, and the supervision environment. In this pedagogical supervision, the supervisor must take into account the professional network in which the accompaniment takes place and the interrelating resources, looking at the formal and informal learning spaces supported by the trainee. To develop student trainees' critical thinking skills in this way, the devices listed indicate that the pedagogicalsupervisor must adopt a supervisory pedagogy in line with a socio-constructivist paradigm of student development support, using reflective accompaniment (Borges and Lessard, 2005). As Campanale (2007) indicates, it must lead the student-trainee to: 1) identify "repetitive situations" and acquire automatisms to manage them; and 2) respond appropriately to a singular, unstable, or complex situation that can destabilize them when a tension arises between the situation experienced and their values. Student trainees and educational supervisors also emphasize the value of critical thinking for professional development. Their comments reinforce the need for learning strategies that support the student's reflexive process (Bocquillon & Derobertmasure, 2018). The latter must consciously and voluntarily engage in this reflexive process. Drawing on the work of Bourgeois (2013), Parent (2016), and Fredricks *et al*. (2004), this commitment can be seen in three dimensions. Firstly, affective commitment: this dimension reflects the trainee's values, interests, and motivation with regard to the type of learning offered by the educational supervisor. The trainee's affective commitment will depend on the proposed activities and what they can bring in terms of goal attainment. Their involvement is therefore influenced by a sense of belonging and by the security of the proposed support framework, so the supervisor must be conciliatory and show empathy towards the student. Secondly, behavioral commitment: this dimension is manifested in the trainee's concrete behavior,

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their desire to get involved in the internship and actively participate as well as in their level of engagement in the relationship with their pedagogical supervisor.

Thirdly, cognitive commitment: this type of commitment concerns the student-trainee's relationship with knowledge. It is linked to metacognitive strategies. Consequently, it is difficult to observe. Cognitive engagement is mobilized in particular when the student is asked to make links with the theory seen in the course in order to analyze his or her practice. However, the commitment of these two actors is not just a state, but rather a dynamic process in which the three dimensions interact with each other, and which, in a given context, manifests attachment to the profession.

Conclusion

The aim of our comparative study was to identify the conceptions of critical thinking development held by pedagogical supervisors and student interns in order to gain a betterunderstanding of the complexity of critical thinking development in the practicum environment. We discovered that the development of critical thinking in student trainees during teaching placements is a complex undertaking, requiring collaboration between two main participants and an appropriate learning environment. Although teaching supervisors and student trainees have different roles during practical placements, this research highlights that there is considerable scope for pooling their different skills. Current theories on practicum learning emphasize socio-constructivist practices, i.e. a learner who constructs their knowledge, not in isolation, but with peers and in a supportive environment where everyone participates in learning (pedagogical supervisor and student trainee). Based on our results, four points demonstrate that current theories on internship learning emphasize socio-constructivist practices. Firstly, learning through active participation: trainees are encouraged to engage in practical experiences, observe and interact with pedagogical supervisors, with supervision based on the cognitive skills of both the student trainee and the supervisor. Secondly, the encouragement of learning through reflection, a questioning-based supervision that prompts dialogue and experience sharing, motivates the trainee to reflect on their experiences, analyze their actions, and learn from the challenges encountered. Thirdly, collaboration and social interaction based on a climate of rewarding exchange. This translates into opportunities for trainees to work in teams, exchange ideas with the educational supervisor, and benefit from the knowledge and expertise of their supervisor. And fourthly, the role of the supervisor as a guide. The educational supervisor helps the trainee to make the most of their experiences, guides them in learning, provides constructive feedback, and facilitates interaction and collaboration with other students.

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If the research is based on the study of conceptions (and therefore of declared practices), future studies that examine actual practices in pedagogical supervision will be relevant to better investigate the issue of the development of critical thinking during internships.

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Appendix

Interview Guide for Pedagogical Supervisors

<table>
<tr><td colspan="2">Theme: Developing the Critical Thinking Skills of SPED Student Trainees: Comments and Actions by Pedagogical Advisors</td></tr>
<tr><td colspan="2">Goal: Better understand the conception of methods for developing critical thinking among SPED Student-Trainees</td></tr>
<tr><td colspan="2">Specific Objectives:
1) Identify and describe the conceptions of the nature and role of critical thinking among pedagogical advisors in supporting student-trainees;
2) Identify the conceptions of the modalities of development of critical thinking of student-trainees according to pedagogical advisors.</td></tr>
<tr><td colspan="2">Main Question: How, through their supervisory actions, do pedagogical advisors develop the student trainees' Critical Thinking Skills?</td></tr>
<tr><td>Sub-question 1:
What is the conception of the nature and importance of critical thinking for student-trainees according to pedagogical advisors?</td><td>Sub-question 2:
What are the methods for developing critical thinking Skills among student trainees according to pedagogical advisors?</td></tr>
<tr><td><u>Nature of critical thinking</u>
1- Have you heard of critical thinking? Yes, or no?
- If so, what is critical thinking?
- If not from the group of words "critical thinking", tell us what is it? What does this make you think of?
2- How can you define it in SPED and more specifically in the context of practical training or practical supervision? Can you give us a definition in this context, if possible?
3- What difference do you make between critical thinking and "normal" thinking/reflection?
4- In your opinion, does the initial teacher training program at HISPE promote the development of critical thinking among trainee students? Are there any concepts in their training program that make you think about critical thinking?
If yes, which ones? Justify your answer.
<u>Role of critical thinking</u>
5- According to you, what is the role of critical thinking during your discussions with student-trainees?
<u>Importance of critical thinking</u></td><td>7- According to you, is it possible to develop critical thinking skills in student-trainees?
- If yes, how? (Can you give us one or two illustrations/examples)
- If not, why not?

8- In your opinion, what methods should be implemented to develop critical thinking in students during student training internships?

9- During your discussions with student-trainees, how do you develop critical thinking in your students?

10- Give us an example of a situation or an action that a pedagogical supervisor can design or do to help develop the critical thinking or critical judgment of student-trainees.</td></tr>
</table>

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6- In your opinion, is it important to develop critical thinking in student-trainees during practical internships? Yes or no? Justify your answer.	
To conclude the interview, we would like to ask you if you have anything to add about the development of critical thinking in student-trainees.	

Focus Group Interview Guide for Student-trainees

Theme: Study of the perceptions of student-trainees with regard to didactic-pedagogical devices for developing critical thinking during teaching internships by pedagogical advisors in SPED.
Goal: Better understand the process of developing students' critical thinking during practical teaching internships according to the students' perceptions
Specific objectives: - Identify and describe the didactic-pedagogical methods for developing students' critical thinking during practical internships; - Explain the process of developing students' critical thinking during practical internships.
Main question: What is the perception of student-trainees that they have didactic-pedagogical mechanisms for developing their critical thinking by pedagogical advisors during practical teaching internships?
Sub-questions: 1. What is the perception of student trainees regarding the didactic-pedagogical systems for developing their critical thinking during SPED teaching internships? 2. How can we explain the process of developing student-trainees' critical thinking during practical teaching internships?
Didactic-pedagogical devices for developing critical thinking during internships
1. According to you, what is critical thinking or thinking critically or thinking critically? 2. In your opinion, what is the purpose of critical thinking or critical reflection in an internship? What contribution does it make to your internship training? 3. What does critical thinking mean to you in the context of a PE internship? 3.a/ Can you cite or list intellectual (or cognitive) skills specific to critical thinking in the context of internships? Which ones? Why? 3.b/ Can you cite or list affective attitudes specific to critical thinking in an internship context? Which ones? Why? 4. Do you think it is necessary for your educational advisor to develop your critical thinking during the post-teaching phase? If so, how do your academic advisors stimulate your critical thinking? Please give us examples? If not, why not? 5. Do you know of strategies that are more conducive to the development of students' critical thinking during teaching internships? If so why? 6. What are the moments when you find that your critical thinking is developed during your critical sessions or your critical exchanges with your academic advisor? Could we have some examples? 7. In your opinion, is any evaluation or moment of defense of your course an indicator of critical thinking? Can you explain your idea? 8. Do you think that during the post-teaching phase, when assessing or critiquing your teaching, pedagogical advisors seek to make you think deeply or critically about your practices? If so, what do they do? Please give us some illustrations or examples of their practices. If not, why do you think?

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9. Some pedagogical advisors think that a student who evaluates himself and seeks to find improvements in his professional actions is engaging in critical behavior. What do you think? Why? 10. Two years ago, in research that we conducted with educational advisors, they indicated 3 conditions that they use to develop the critical thinking of trainees: a) their positive attitude during educational supervision (openness, listening, kindness, etc.), b) the humanist educational climate that they create (a horizontal approach between them and the trainees) and c) the communicative strategies centered on the student-trainees (communication which starts from the needs of the trainees , the trainees speak a lot, the exchanges which start from the trainees' questions, etc.). What do you think? 11. Do you have anything to add in relation to the methods that educational advisors deploy or should deploy to develop your critical thinking during educational supervision in internships?

Confirmatory Focus Group Interview
Guide for Student-trainees

Theme: Study of student trainees' perceptions of didactic-pedagogical devices for developing critical thinking during teaching internships by SPED pedagogical advisors.
Goal: Better understand the process of developing students' critical thinking during practical teaching internships according to the students' perceptions
Specific objectives: - Identify and describe the didactic-pedagogical methods for developing students' critical thinking during practical internships; - Explain the process of developing students' critical thinking during practical internships.
Main question: What is the perception of student-trainees that they have didactic-pedagogical mechanisms for developing their critical thinking by educational advisors during practical teaching internships?
Sub-questions: 1. What is the perception of student trainees regarding the didactic-pedagogical systems for developing their critical thinking during SPED teaching internships? 2. How can we explain the process of developing student-trainees' critical thinking during practical teaching internships?

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E-training environment for developing Capstone teaching skills for STEM teachers in Egypt

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Abstract

The research investigated the efficacy of utilizing an e-training environment to enhance capstone teaching skills among STEM educators. Conducted at Obour STEM School, Cairo, Egypt, the study employed a quasi-experimental design with 27 randomly selected participants. Three instruments were utilized: a list of Capstone teaching skills, a pre-post achievement test, and an observation card assessing skill acquisition in two main fields: EDP Field and Process Management Field. These fields encompassed eight main skills, subdivided into 64 subskills. The researchers conducted pre- and post-testing, initially administering a 70-question pre-test followed by a month-long online training via Microsoft Teams. The training content aimed to address identified needs based on pre-test results. After the training, participants completed a post-test, which was repeated after another month. Results indicated a statistically significant difference ($p<=0.05$) between pre-test and post-achievement test scores, favoring the latter, suggesting improvement in Capstone teaching skills. Similarly, there was a significant difference ($p<=0.05$) between pre-test and post-observation card scores, indicating enhanced skill development. Conclusively, the study

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demonstrated the effectiveness of e-training, particularly employing the SOLE technique, in enhancing capstone teaching skills among STEM educators. Consequently, the researchers recommended the integration of e-training environments in STEM teacher development programs in Egypt.

Keywords: E-training environment, Capstone (The Applied projects), Capstone teaching skills

1. Introduction

Technology has become an essential part of our lives, and it is everywhere around us. Although it has a significant role in education in general, it is still not widely implied in our classrooms, and the traditional methods dominate our educational system, whether it is on the level of teaching in the classroom for the students or on the level of training for professional development for teachers. In the past decade, the rapid development of computer and Internet technologies in the field of education has changed the ways of teaching, learning, and training. Digital education and e-learning applications offer easy access to knowledge domains and learning processes from everywhere for everybody at any time. Furthermore, information and computer technologies are considered some of the most beneficial teaching tools supporting student learning in the classroom (Lamb, R.L., Annetta, L., Firestone, J., Etopio, 2018).

STEM education, encompassing science, technology, engineering, and mathematics, serves as the cornerstone of modern societies, driving innovation and economic growth. Stemming from the need to cultivate a skilled workforce capable of tackling complex challenges, STEM education integrates multidisciplinary curricula across all grade levels. By nurturing skills such as critical thinking, problem-solving, and collaboration, STEM education prepares students for success in diverse fields and fosters informed citizenship in an increasingly technological world.

This is due to the fact that STEM students have the ability to identify, apply, and integrate concepts from science, technology, engineering, and mathematics to understand complex problems and innovate to solve them. Meng, Idris, & Eu, 2014: 219–220.

The National Science Foundation (NSF) introduced the idea of STEM in the late 1990s in the United States. Originally, the acronym was SMET, but after various studies, it evolved into STEM (Williams & Larwin, 2016). The word S.T.E.M. is an acronym for science, technology, engineering, and mathematics. Many researchers may use this acronym to define education for science, technology, engineering, and mathematics. STEM is defined by the separate subjects that constitute it (Bybee, 2010). Education for science, technology, engineering, and mathematics should be defined as an integrated

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curriculum and education. This is excellently achieved by removing any boundaries between subjects and treating them as one subject (Morrison, 2006).

Capstone projects in secondary education play a pivotal role in preparing students for higher education and the workforce by fostering critical thinking, problem-solving skills, and project management abilities (Johnson, 2017). These culminating projects provide students with the opportunity to apply the knowledge and skills they have acquired throughout their secondary education in a real-world context. By engaging in a substantial and self-directed project, students develop research and analytical skills while also honing their ability to communicate effectively both orally and in writing (Smith & Brown, 2019). Furthermore, capstone projects often encourage interdisciplinary exploration, allowing students to integrate concepts from various subject areas and develop a holistic understanding of complex issues (Garcia & Martinez, 2020). Overall, capstone projects serve as a bridge between secondary education and future academic or professional pursuits, equipping students with the tools and experiences necessary for success in their future endeavors.

The capstone process in secondary education is used to culminate the Master of Arts in Teaching program and provides an avenue for deeper investigations of the curriculum (Brown & Benson, 2005). Capstone purposes include the synthesis and application of prior learning, developing skills related to employability, and quality assurance, with a broad range of purposes and an affective dimension (Lee & Loton, 2019). Capstone and large projects in computing education can provide students with real-world experience and support learning through creative activities and collaboration with external stakeholders (Artzt et al., 2012). Capstone effectively prepares future secondary mathematics teachers by linking college mathematics with school mathematics and pedagogy and fostering student-centered pedagogical and assessment strategies (Sherriff & Heckman, 2018).

Combining project-based learning with STEM can increase effectiveness, generate meaningful learning, and influence student attitudes toward future career pursuits (Tseng et al., 2013).

Improved Capstone (ICap) in STEM programs strengthens critical thinking, quantitative reasoning, teamwork, communications, information literacy, and the design process, enabling students to assume greater responsibility for learning experiences (Eppes et al., 2012).

Recently, there has been a growing recognition of the importance of providing effective training for STEM teachers to meet the evolving needs of STEM education. Research indicates that well-designed professional development programs can significantly impact teachers' confidence and competence in delivering STEM instruction (Czerniak et al., 2020). Effective

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STEM teacher training emphasizes hands-on, inquiry-based approaches that align with best practices in STEM education (Banilower et al., 2018). Moreover, research highlights the importance of ongoing support and collaboration among educators to sustain effective STEM teaching practices (Shernoff et al., 2017). Recent studies have also underscored the value of incorporating technology-enhanced learning experiences and real-world applications into STEM teacher training programs (Yang et al., 2021). By equipping educators with the knowledge, skills, and resources needed to engage students in meaningful STEM learning experiences, comprehensive teacher training programs play a crucial role in advancing STEM education and preparing students for success in the 21st-century workforce.

Improving capstone experiences in STEM programs requires a concerted effort to develop teachers through e-training environments. Recognizing the pivotal role of educators in facilitating capstone projects, e-training environments offer flexible and accessible platforms for professional development. Research suggests that such virtual training initiatives can enhance teachers' pedagogical skills and confidence in guiding students through complex capstone projects (Nulty et al., 2018). These e-training environments often incorporate interactive modules, collaborative forums, and multimedia resources tailored to the unique needs of STEM educators (Khan, 2019). Moreover, leveraging technology-enhanced learning methods can enable teachers to stay abreast of emerging trends and best practices in capstone design and implementation (Freeman et al., 2020). By empowering educators with the necessary tools and knowledge, e-training environments play a crucial role in ensuring the success and effectiveness of capstone experiences in STEM programs, ultimately preparing students for real-world challenges in their respective fields.

Many e-training environments and processes are based on participatory learning models in which participants share their understandings and aim to develop new insights into their workplace knowledge through discussion, questioning, mentoring, and personal reflection. Knowledge production is assumed to occur through the cumulative effect of these actions. However, equally likely outcomes include the sharing of ignorance or the development of erroneous understandings. Cognitive and social views of learning posit, however, that humans learn by thinking (not just by interacting) and that unless this is explicitly taken into account in developing training programs, optimal learning outcomes may not be achieved. This paper examines the importance of e-training environments in order to maximize the potential for optimal learning to occur and provides STEM teachers with all the tools that they need to develop their skills in teaching Capstone.

E-learning technologies have been diversified through the last decades, as many technologies have evolved, making great changes in our perception

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of learning and so our methodologies in teaching and training that supported our students and trainees. It is these technologies that the researcher will depend on in this study: -

E- training:

E-learning refers to the use of information and communication technologies (ICT) and electronic devices in education, transforming traditional systems into personalized, flexible ones. It can be referred to as distance learning, virtual education, digital education, web-based training, internet-based training, computer-based training, or technologically enhanced learning. Learning materials can be in text, images, animations, video tutorials, or computer programs. In computer-based training, students learn by executing a specific program on a computer.. Such training materials are usually embedded with computer applications, so the students can practice using the applications as they learn. (Guragain, 2016).

The Self Organized Learning Environment (SOLE): -

A Self-Organized Learning Environment (SOLE) is an environment that encourages curiosity and collaboration through the exploration of big questions using the Internet. Teachers act as facilitators, rather than transmitters of knowledge, in SOLE. Sugata Mitra and his colleagues have researched self-organized learning for over 15 years, earning him the first-ever $1-million TED Prize. At the 2013 TED conference, Mitra invited thinkers to create their own SOLEs and share their discoveries via a School in the Cloud. SOLE allows STEM teachers to deal freely with technology, enhance their search skills, and explore new experiences related to the topic.

The self-organized learning environment (SOLE) is an adaptation of a school space to facilitate inquiry-based learning. Teachers encourage students to work as a community, and answer questions using computers with internet access. Students form groups of about 4 and can change groups at any time. Applying Mitra's rules to STEM teachers can help them communicate effectively, gain new ideas, expand their search areas, and acquire problem-solving skills. Education is a self-organizing system where learning is an emergent phenomenon.

2. The problem of the Research:

Capstone (the applied projects) teaching mainly aims to provide students with different skills, which is one of the most important 21st-century skills. Being one of the researchers as a biology teacher and school general capstone leader, I have noticed that teachers use the same traditional methods in their capstone sessions that do not suit students' needs at all. Moreover, they are not aware of the 21st-century skills they must have firstly and develop

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those skills for the students to achieve all Capstone process and fulfill all stages of Engineering Design Process (EDP) effectively, although they are already trained on using the SOLE strategy in their professional development but, only in the frame of terms not practicing the strategy - this is the second observation for the researcher- being as a trainer, it has been noticed that the training not concerning to develop the needed skills for the teachers to be creative have the ability to communicate correctly with the students and also, not providing them with the searching skills that are needed as well. Therefore, there is a real need to adopt new technologies that enhance and enrich the training experience of STEM teachers. Studies found that efforts should be particularly made to increase STEM teacher supply through well-designed teacher professional development, which is a critical factor in a successful education (Jong 2019a, 2019b). Since STEM is a cross-disciplinary subject, it is expected that students are empowered to apply their disciplinary concepts and skills in integrated contexts (Kelley & Knowles, 2016; Tytler, Prain, & Hobbs, 2019). However, the majority of the current teachers who have received training in only one subject area may be unable to adopt an integrated and holistic approach to teaching STEM (Aslam, Adefila, & Bagiya, 2018). There is an obvious gap in research pertaining to teacher preparation and professional development (Al Salami et al., 2017; Cavlazoglu and Stuessy, 2017). Teachers play a crucial role in equipping students with relevant STEM knowledge and shaping their choice of a STEM career. A study by Lee et al. (2015) found that teachers' expectations of students are particularly influential, and there is a weakness in developing Capstone teaching skills among STEM teachers through training and professional development. The researchers confirmed the problem through direct observation, tracking progress, and interviews with teachers.

A pilot study on 17 STEM teachers for the academic year 2021-2022 revealed that 70% of teachers were unable to develop Capstone teaching skills and apply them in real-life situations with their students. Additionally, 80% of teachers complained about traveling during summer vacations from their countries to attend capstone training, which is costly. The researcher suggested using an e-training environment to emphasize its effectiveness in enhancing teachers' capstone teaching skills in STEM schools.

The researchers also noticed that teachers use traditional methods in their capstone sessions that do not suit students' needs, and they are not aware of 21st-century skills they must have firstly and develop those skills for the students to achieve all capstone processes and fulfill all stages of the Engineering Design Process (EDP) effectively. The training is not concerned with developing the needed skills for teachers to be creative, have the ability to communicate correctly with students, and not providing them with the searching skills that are needed.

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The identified challenges in the educational setting include a lack of foundational scientific knowledge among both teachers and students, as well as a failure to prioritize critical inquiry. Addressing these challenges requires a multifaceted approach, including targeted teacher training and fostering a culture of inquiry within the classroom.

Students often feel disappointed and bored with the capstone sessions, leading to postponing scheduled tasks or working at home. This results in a failure to achieve capstone objectives correctly, losing all anticipated benefits and skills students are supposed to gain at the end of their learning experience in STEM education.

The researcher deduced throughout many studies and research that efforts should be particularly made to increase STEM teacher supply through well-designed teacher professional development, which is a critical factor in a successful education (Jong, 2019a, 2019b). Since STEM is a cross-disciplinary subject, it is expected that students are empowered to apply their disciplinary concepts and skills in integrated contexts (Kelley & Knowles, 2016; Tytler, Prain, & Hobbs, 2019). However, the majority of the current teachers who have received training in only one subject area may be unable to adopt an integrated and holistic approach to teaching STEM (Aslam, Adefila, & Bagiya, 2018). There is an obvious gap in research pertaining to teacher preparation and professional development (Al Salami et al., 2017; Cavlazoglu and Stuessy, 2017). Teachers play a significant role in equipping students with relevant STEM knowledge and shaping their choice of STEM career. Lee et al.'s (2015) longitudinal study employing logistic regression analyses of students' choice of a STEM career indicated that teachers' expectations of students are particularly influential. While the lack of focused study on teacher professional development to foster STEM learning warrants further investigation, the situation seems unsurprising. If it is already challenging for a teacher to master the pedagogical content knowledge.

3. Theoretical Framework:

E-training, synonymous with online learning, employs digital technologies to facilitate remote educational content delivery, fostering collaboration and interactivity among learners. Its objectives span enhancing knowledge acquisition, skill development, critical thinking, motivation, accessibility, and cost-effectiveness, supporting continuous professional development, and fostering collaboration. Moreover, e-training is pivotal for compliance training, measuring learning outcomes, and fostering self-directed learning.

The concept of e-training, or electronic training, has emerged as a transformative approach to delivering educational content and facilitating learning experiences through digital platforms.

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E-training draws upon established theories such as constructivism, connectivism, and engagement theory to inform the design and delivery of effective learning experiences in digital environments, emphasizing active participation, collaboration, and knowledge construction among learners. (Clark & Mayer, 2016).

E-training, synonymous with e-learning, involves the delivery of educational content and instructional materials via the Internet or digital platforms. It enables learners to access training resources remotely, often through web-based applications, learning management systems (LMS), or virtual classrooms, allowing for flexible and self-paced learning experiences (Mesidor & Anderson, 2022).

The study by Alizadeh et al. (2021) discussed e-training and its impact on the training environment. It mentions that online training can provide efficiencies and advantages, but adjustments may be needed by adopting organizations. It offers the flexibility for learners to proceed at their own pace and engage in self-directed learning while also providing opportunities for interaction with trainers and other learners through online platforms.

E-training environments encompass various digital platforms and settings where electronic training activities take place. These environments facilitate the delivery of educational content and interactive learning experiences.

- *Learning Management Systems (LMS)***:** LMS platforms provide centralized hubs for organizing, delivering, and tracking e-training activities. They offer features such as course creation, content management, assessment tools, and learner analytics, enabling efficient management of training programs in corporate, academic, and organizational settings (Norberg et al., 2011).
- *Virtual Classrooms***:** Virtual classroom environments simulate traditional classroom settings using web conferencing tools and real-time communication technologies. They facilitate interactive lectures, discussions, group activities, and live demonstrations, allowing remote learners to engage in synchronous e-training sessions (Abrami et al., 2008).
- *Mobile Learning (M-Learning) Platforms*: M-learning platforms deliver e-training content and activities through mobile devices such as smartphones and tablets. These platforms leverage mobile apps, responsive websites, and multimedia resources to provide on-the-go access to training materials, enabling learners to engage in self-paced learning anytime, anywhere (Kukulska-Hulme & Traxler, 2007).
- *Social Learning Platforms***:** Social learning platforms integrate social networking features with e-training content, fostering collaboration, knowledge sharing, and community building among learners. These

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platforms facilitate peer interaction, mentorship, and informal learning experiences through discussion forums, blogs, wikis, and multimedia sharing (Dabbagh & Kitsantas, 2012).

An e-training environment refers to a digital platform or system that is used for delivering educational or training content to learners over the internet. It provides a virtual space where learners can access learning materials, participate in interactive activities, and engage in collaborative learning experiences (Cheng et al., 2023).

These environments can support different types of training, including language training, technical training, and professional development. They enable learners to study at their own pace, access a wide range of resources, and receive guidance and feedback from instructors. They can be particularly beneficial in situations where physical classroom attendance is not possible, such as during pandemics or for remote learners, and provide flexibility and convenience, allowing learners to access educational content anytime and anywhere with an internet connection (Kim et al., 2023).

From the previous study, the researchers concluded that e-training environments like Microsoft Teams have emerged as integral tools in modern education, offering a versatile platform for online learning (Microsoft, 2024). With features tailored for educational purposes, such as virtual classrooms, document sharing, and real-time collaboration, Microsoft Teams facilitates interactive and engaging learning experiences (Microsoft, 2024). The platform's integration with the Microsoft Office suite enhances productivity and enables seamless content creation and sharing (Microsoft, 2024). Furthermore, the chat and video conferencing functionalities allow for synchronous communication, enabling educators to provide immediate feedback and support to students (Microsoft, 2024). As a result, Microsoft Teams empowers educators to create dynamic and interactive virtual learning environments that cater to diverse learning needs (Microsoft, 2024).

A set of theories explains how learners are trained, how knowledge is introduced, and how that knowledge is processed within the learner's mind. For e-training environments to be purposeful and effective, they must be based on an underlying approach. Future progress in e-learning will come from a better understanding of training mechanisms, not just from technological improvements or their utilization (Abu Khatwa, 2010).

A capstone project is a multifaceted assignment that serves as a culminating academic and intellectual experience for students, typically at the end of their academic program. It often involves research, critical analysis, problem-solving, and the synthesis of knowledge and skills acquired throughout the course of study.

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4. Questions of the Research: The problem of the research tackled the following main question: "What is the effectiveness of E-training environment for developing Capstone teaching skills for STEM teachers in Egypt?"

The main question is branched into four subsequent questions as follows:

- What are the most important Capstone teaching skills for STEM teachers?
- What is the perspective of an E-training environment content to develop Capstone teaching skills for STEM teachers?
- What is the effect of using an E-training environment content to enhance the Capstone teaching skills of STEM teachers?
- What is the effect of using an E-training environment content to enhance the performance aspects of STEM teachers?

5. Objectives of the Research: The research aims to achieve the following objectives:

- To identify the most important Capstone teaching skills for STEM teachers
- To design an E-training environment content to develop Capstone teaching skills for STEM teachers.
- To examine the effectiveness of using an E-training environment content to enhance the Capstone teaching skills of STEM teachers.
- To examine the effectiveness of using an E-training environment content to enhance the performance aspects of STEM teachers.

6. Significance of the Research: This research is believed to be significant for the reasons described below:

This research proposes an e-training environment (SOLE) as an innovative tool for preparing STEM teachers for their Capstone project. The SOLE strategy focuses on developing 21st-century skills such as organization, analytical thinking, creativity, technology use, communication, and problem-solving. The model aims to equip teachers with sufficient STEM knowledge and instruction approaches to address students' learning needs and develop their confidence in STEM education.

The study aims to overcome low performance of capstone teachers and students by providing continuous professional development. The COVID-19 pandemic has made it difficult to provide such training, especially during social distancing. The proposed model ensures ongoing teacher training through unexpected conditions and is suitable for teachers' distancing residency, making the process of professional development more sustainable.

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The research aims to overcome low performance of capstone teachers and students by providing a model that integrates STEM subjects with their capstone project. It also offers a solution for ongoing teacher training during unexpected conditions, making the process more sustainable.

7. Research Variables: The research relied on the following variables:

- Independent Variable: An e-training environment
- Dependent Variables: Capstone teaching skills for STEM teachers

8. Hypotheses of the Research

The research relied on the following hypotheses:

H.1 There is a statistically significant difference ($p<=0.05$) between the pre-test and post-achievement test of the experimental group on developing the capstone teaching achievement of STEM teachers in favor of the post-test.

H.2 There is a statistically significant difference ($p<=0.05$) between the pre-test and post-observation cards of the experimental group on developing the capstone teaching skills of STEM teachers in favor of the post-test.

9. Method

9.1. Participants in the Research

The research targeted the capstone teachers in one of the Egypt STEM schools; 27 of the STEM teachers are all working under the same administration, rules, and work ambiance with different subject areas (Biology, Physics, Chemistry, Mechanics, Geology, Math, English, and Activities). Therefore, the researcher ensured that the target participants shared these characteristics:

1) The teachers obtained similar results in their pre-test. So, they have approximately the same level of knowledge.
2) The teachers have approximately similar rules and work conditions.
3) Teachers have good computer and online communication skills and are proficient in the Microsoft Team platform.
4) They also prefer online learning and are interested in using various techniques in their learning process.
5) All teachers have not been exposed to a capstone training experience using the e-training environment with the SOLE technique.

9.2. Research Design

A descriptive approach was used in the current research to analyze literature related to the research variables, describe and build research tools,

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and discuss and interpret the results. The research employed a quasi-experimental method. The quantitative analysis of the data allowed the researcher to make comparisons between the scores on pre- and post-tests. The research design involved one group of STEM teachers who had been trained through the e-training environment, which is the main independent variable that was applied to the experimental group. All key characteristics of a quasi-experiment were included in this study: (1) a pre- and post-achievement test to measure the cognitive aspect; (2) a pre- and post-note card to measure the skill aspect (skills of the 21st century); and (3) the assigned experimental group. Statistical analysis has been integrated into tables and figures throughout the research to provide a clearer and more accurate reflection of the research findings.

9.3. Instrumentation: The following instruments were designed and utilized by the researchers:

9.3.1. Data Collection Instrument:

The researchers conducted a pilot study on a sample of 17 STEM teachers for the academic year 2021-2022 using an electronic questionnaire divided into two sections: The first section contains 10 multiple-choice questions about the difficulties teachers encounter during capstone training, and the second section is for writing the teachers' comments and suggestions about how to improve the development of capstone teaching skills through the process of professional development. The researchers used Microsoft Forms to write the questionnaire and the Microsoft Team platform to send it.

9.3.2. Measuring Instruments:

1) Survey of the training needs to determine the capstone teaching skills that are needed by the trainees and the degree of need for each one of the main skills and also each one of the sub-skills. The survey is made up of eight main skills and 64 sub-skills.

   After conducting the survey and collecting the responses, the percentage of skill needs ranged from 90.12% to 98.77%. This was taken into consideration when designing the activities, with a focus on addressing the skills that are in higher demand.

2) Pre-post achievement test, which is formed of 70 questions. The pre-achievement test has been sent to the trainees before introducing the training content, then it was resent again after finishing the training content.

   The researchers calculated the validity of the test's internal consistency by calculating the correlation coefficients between the STEM teachers' scores on each of the test items on a random sample of 10 STEM teachers from outside the study sample and within the community. The

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correlation coefficient for the items ranged between 0.730 and 0.854 and reached the overall internal consistency correlation coefficient of 0.811, which indicates that there is internal consistency for the test questions and for the overall test, and thus the internal consistency of the test questions was confirmed.

3) The capstone teaching skills observation card is a list of eight main skills and 64 subskills, distributed over two main areas, which are the EDP field and the management field.
   The researchers calculated the reliability of the observation card and made sure that it would give similar results if it was reused again, as the researcher observed 5 trainees from the piloting sample, as well as enlisted the help of other trainers to observe the performance of the trainees. After monitoring the quantitative estimates of the performance of the trainees in the observation card, the researcher calculated the extent of agreement and disagreement between the researcher (the first observer) and the assistant (the second observer) using Cooper's equation, which states:
   The percentage of agreement = (the number of times of agreement / (the number of times of agreement + the number of times of disagreement)) x 100.
   After applying the equation to the quantitative estimates of the trainees' performance on the observation card, the researcher found an agreement rate of 89.06% for the total skills of the observation card.

9.3.3. Treatment Instrument

The researchers selected the Microsoft Team platform for building the e-training environment because of several factors listed below:

1. Microsoft Team is the official platform used by the Ministry of Education (MOE).
2. All teachers have their own Microsoft Team accounts and can easily access their Capstone channels and interact with their Capstone training content.
3. Teachers use the Microsoft Team platform daily in their teaching process and when making online meetings with their students. Therefore, the researcher explored the benefits of using Teams as an e-learning environment for delivering the training content through the Capstone channel.
4. The Microsoft Team platform can help equip teachers with 21st-century skills like critical thinking skills, communication skills, and problem-solving skills in particular by using all Microsoft Teams tools with their Capstone training content.

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5. The Microsoft Teams platform assists with classroom management and monitoring of the teachers' collaboration and works in real-time sessions.
6. The Microsoft Teams platform tracks the teachers' progress and facilitates the development of Capstone concepts and skills included in their training content.
7. Microsoft Teams can be accessed on any browser or device. Moreover, the researcher designed the E-Training content in the form of PowerPoints, PDFs, and groups of activities and assignments (questions and answers) to measure all levels of Bloom's taxonomy and enhance higher-order thinking by using images, text, animation, and videos. As a result, the training content could foster the development of Capstone concepts and skills included in the different Capstone projects since starting the STEM education project in Egypt.

In this phase, several critical steps were undertaken to create an effective electronic professional development platform. Initially, electronic tools were meticulously crafted to support the training process. This involved the identification of key tools essential for designing the training content, enabling a seamless educational experience. Subsequently, the focal activities within the training content were systematically built, ensuring alignment with the overarching objectives. The production phase also encompassed the development of interactive elements, enhancing engagement and knowledge retention. Furthermore, the content was tailored to encourage active participation among trainees as well as facilitate dynamic interaction between peers and trainers.

9.4. Delimitation of the Research:

- This research has been applied on 27 Capstone teachers from one of the Egypt STEM Schools, during the 2nd semester of the scholastic year 2022-2023 to develop the Capstone teaching skills through designing an academic portal platform (Microsoft Teams) for sharing and delivering the training content materials and applying all needed activities included in the E-training program.
- This research has been applied only for developing the Capstone teaching skills which are correlated to the 21st century skills for STEM teachers

9.5. Data Analysis:

The researchers verified the research hypotheses through the statistical analysis of the collected data that was applied using the Statistical Package for

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Social Sciences (SPSS) Version (21). The researcher analyzed and calculated data by applying the following statistical styles:

1. There is statistical significant difference at the level of ($p<=0.05$) between the pre-test and post- achievement test of the experimental group on developing Capstone teaching achievement of STEM teachers in favor of the post -test.
2. There is statistically significant difference at the level of ($p<=0.05$) between the pre-test and post- observation card of the experimental group on developing Capstone teaching skills of STEM teachers in favor of the post -test.

Learning Theories

Constructivist theory defines learning as the process of adaptation resulting from the learner's functional cognitive systems, whereby they construct their knowledge based on their previous experiences. Its function lies in adapting to organize their perceived world (Yu & Tao, 2007, p. 71).

Activity Learning Theory: Focuses on group collaboration and the Zone of Proximal Development (ZPD), where learners progress with guidance. It emphasizes real-world activities and continuous interaction as mentioned by Shafer and Moss (2010).

Social Learning Theory: Proposes that individuals learn through observation, imitation, and modeling of others' behaviors. Vicarious learning and self-efficacy play crucial roles (Bandura, 1977).

Cognitive Theory: Focuses on knowledge construction and the relationship between perception and reality. It highlights the importance of memory and organizing knowledge (Mayer, 2014). Moreover, Sweller (2010) stated that cognitive learning involves gathering and organizing knowledge.

Behaviorism Theory: Concentrates on observable behaviors learned through conditioning, reinforcement, feedback, and repetition. It also emphasizes social learning and gamification.

Capstone teaching skills

Capstone projects are pivotal in higher education, offering students a comprehensive academic experience by integrating research, critical analysis, problem-solving, and the synthesis of knowledge. These projects, occurring typically at the end of an academic program, take various forms such as research papers, case studies, or presentations, aiming to address real-world challenges relevant to the student's field of study. Interdisciplinary in nature, they require students to draw upon knowledge from multiple disciplines, collaborate with faculty or industry experts, and present their findings

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Kahn & Dell'Olio (2019) define Capstone experiences as culminating, integrative experiences in which students synthesize and apply what they have learned in the major.

STEM education refers to an interdisciplinary approach to teaching and learning that integrates concepts and principles from science, technology, engineering, and mathematics. The aim of STEM education is to prepare students for success in the rapidly evolving fields of science, technology, engineering, and mathematics by fostering critical thinking, problem-solving skills, creativity, and collaboration.

Capstone projects in education represent the culmination of students' academic experiences. They typically occur towards the end of a degree program and integrate learning from various courses and subjects. According to the National Association of Colleges and Employers (NACE), capstone projects allow students to demonstrate the application of knowledge and skills learned throughout their academic experiences (National Association of Colleges and Employers, 2024).

As described by the University of North Carolina at Chapel Hill, capstone projects involve in-depth research and critical thinking to address complex issues (UNC-Chapel Hill, 2023).

According to the University of Washington, Capstone projects allow students to demonstrate their competencies and readiness for further academic or professional endeavors (University of Washington, 2020).

Challenges of Teaching Capstone:

According to O'Reilly and McMahon (2008), accommodating diverse student backgrounds and abilities is a significant challenge in Capstone courses, as instructors must balance providing support for struggling students while challenging more advanced learners.

Capstone projects typically involve complex, open-ended problems that may not have clear-cut solutions. And guiding students while allowing them to explore the needed knowledge may be challenging for the instructors. As noted by Prince et al. (2007), designing meaningful Capstone projects that balance structure and flexibility is essential for ensuring student engagement and learning. According to Strang (2012), securing sufficient resources and support for Capstone projects remains a significant challenge for many educational institutions.

Developing valid and reliable assessment methods that capture the breadth of student learning is a challenge for instructors. As highlighted by Rhoads (2017), assessing the multifaceted outcomes of Capstone projects requires Managing time effectively to ensure that students make progress on their projects while covering essential content and meeting course objectives can be challenging. According to Johnson et al. (2005), time management is a

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common challenge faced by instructors teaching Capstone courses, as they must balance project work with other course requirements.

So that, teaching Capstone projects presents challenges related to managing diverse student backgrounds, guiding students through complex projects, providing adequate resources and support, assessing multifaceted outcomes, and managing time effectively. Addressing these challenges requires careful planning, collaboration, and ongoing reflection to ensure the success of Capstone experiences for both students and instructors.

Capstone teaching skills encompass a diverse set of competencies essential for guiding students through the Capstone project process effectively. These skills include but are not limited to research, decision-making, communication, time management, and critical analysis. Research skills are foundational, enabling students to engage in scholarly inquiry, gather relevant information, and contribute to knowledge advancement (Swanson et al., 2015). Decision-making skills are crucial for navigating complex problems, evaluating alternatives, and selecting the most appropriate course of action, which is essential for successful project outcomes (Kwon & Kim, 2014). Effective communication skills facilitate the dissemination of ideas, findings, and recommendations, fostering collaboration and knowledge sharing among project stakeholders (Wang et al., 2019).

Furthermore, time management skills are essential for students to plan, organize, and prioritize tasks effectively, ensuring the timely completion of project milestones and deliverables (Seiferth et al., 2017). Critical analysis skills enable students to evaluate data, information, and findings critically, drawing meaningful conclusions and actionable insights from their research (Brown & Rutherford, 2016). These skills collectively contribute to the successful execution of Capstone projects, preparing students for academic and professional success beyond the classroom.

STEM concept:

Gonzalez & Kuenzi (2012) pointed out that education gained through the STEM system, which includes multidisciplinary curricula in the fields of science, technology, engineering, and mathematics, holds global importance through its innovative educational approaches.

STEM education is a multidisciplinary approach that contributes to the development of workforce skills in the twenty-first century, higher-order thinking skills, and the development of nations (Erdogan et al., 2017: 614).

The methodology of STEM education emphasizes hands-on learning, inquiry-based approaches, and interdisciplinary problem-solving. Through collaborative projects and real-world challenges, students gain practical experience and develop a deeper understanding of STEM concepts. Integration of technology further enhances learning opportunities, while

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ongoing assessment and reflection support continuous improvement by engaging in practical activities such as experiments, projects, and real-world problem-solving tasks, students not only deepen their understanding of STEM subjects but also develop essential skills like collaboration and communication (Honey et al., 2014).

The objectives of STEM education are multifaceted, aiming to promote innovation, continuous curriculum renewal, and the enhancement of core skills for the twenty-first century. Additionally, STEM education seeks to prepare students for STEM careers, address global challenges, and promote equity and inclusion in education.

STEM teachers play a pivotal role in facilitating inquiry-based learning, integrating technology, promoting collaboration, fostering creativity, and addressing diversity and equity. Moreover, they collaborate with colleagues, industry partners, and community stakeholders to enhance STEM education initiatives and create diverse learning opportunities for all students (National Science Board, 2015). Through their dedication and innovative teaching methods, STEM teachers inspire the next generation of scientists, engineers, and innovators, driving forward progress and innovation in society (Bybee, 2013; Johnson et al., 2018).In Egyptian schools, STEM teachers face challenges such as limited resources and outdated curricula but remain committed to preparing students for the demands of a rapidly evolving world and driving technological advancement and economic development. Despite these challenges, dedicated STEM teachers in Egypt are working tirelessly to inspire and empower their students to pursue careers in STEM fields, driving the nation's progress towards a knowledge-based economy (El-Zeftawy & El Kordy, 2020).

In conclusion, STEM education and the dedicated efforts of STEM teachers are essential for equipping students with the skills and knowledge needed to thrive in an increasingly complex and interconnected world. Through innovative teaching methods and a commitment to excellence, STEM education empowers the next generation of leaders, innovators, and problem-solvers.

10. Findings and Discussions

The researchers utilized two instruments (the achievement test and the observation card test) to test the researchers' hypotheses. The following results were obtained and analyzed using SPSS statistical software version 21.

Findings Related to the First Question: To address the first research question, **"What are the most important Capstone teaching skills for STEM teachers?"**

The researcher answered this question in the third chapter by listing the Capstone teaching skills needed for STEM teachers to manage the applied

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projects (Capstone) that have been prepared in light of the STEM orientation by looking at literature, conference reports, and consultations of some specialists in curriculum and teaching methods, as well as experts in the STEM field. The list in its initial form consisted of two main areas: engineering design process (EDP) skills and management skills. It included eight main skills and 64 subskills for evaluating the work of applied projects in the framework of the KPI,, or Key Performance Indicators. The jury members validated the test and the needed skills, which were both used as the basis for designing the content of the e-training materials.

Findings Related to the Second Question: For the second research question, **"What is the proposed design of an e-training environment to develop capstone teaching skills for STEM teachers?"** The researcher answered this question in the third chapter by identifying the components of the e-training content required to enhance the Capstone teaching skills needed for STEM teachers to manage the applied projects. The researcher used diverse types of tools to help engage the participants and ensure their continual learning. The content has been designed in the form of eight main topics that represent the eight main skills, supported with different activities to ensure engagement of the trainees, followed by quizzes, feedback, and reflection questions as forms that impeded in the training environment. All of the training sessions started with objectives, the main open-ended question, and investigative activities, then ended with a main conclusion.

Also, the researcher developed the instructional design model for the e-training environment following the Elnaggar Model (2013). She designed the E-Training environment on Microsoft Teams as a platform that contained the E-Training content by using the tools that are provided by the Teams application to design many interactive activities, quizzes, and PowerPoint presentations, and integrated it into the Capstone team channel within the Microsoft Team platform. The validity of the E-Training content was confirmed through jury validation, which stated that the E-Training environment was valid and ready to be used by the trainees.

Findings Related to the Third Question: To answer the third research question, **"What is the effect of using an e-training environment to develop the cognitive aspects of capstone teaching skills in STEM teachers?"** The researcher verified the research hypotheses through the statistical analysis of the collected data that was applied using the Statistical Package for Social Sciences (SPSS) Version 21.. The researcher analyzed and calculated the data by applying the following statistical styles to verify the validity of the first hypothesis:

There is a statistically significant difference at the level of (a<=0.05) between the pre-test and post-achievement test of the

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experimental group on developing the capstone teaching achievement of STEM teachers in favor of the post-test.

To verify the validity of the first research hypothesis that states, "There is a statistically significant difference at the level of (a<=0.05) between the pre-test and post-achievement test of the experimental group on developing the capstone teaching achievement of STEM teachers in favor of the post-test," A paired sample t-test was used, as shown in the following table.

Table (1) Results of paired sample t-test to verify differences between mean scores of Capstone teaching skills achievement test in pre and post application

n = 27

Skill	Application	Mean	Std. Deviation	Earning		t	df	Sig.	η^2
				Mean	Std. Deviation				
Capstone teaching skills Achievement	Pre	34.67	3.174	23.407	3.029	40.157	26	0.000	0.984
	Post	58.07	2.319						

Notes from table (1) that mean scores of "Capstone teaching skills Achievement" achievement in pre application reached (34.67) with a standard deviation of (3.174), while the mean score was reached in post application (58.07) with a standard deviation of (2.319), the earned mean score in Capstone teaching skills Achievement was (23.407) with a standard deviation (3.029), the value of t-test between the two mean scores was (40.157), this value has a significance at the level of (0.05), as the calculated significance is equal to (0.000) which is less than (0.05), also the Impact factor has been extracted using Eta^2 via t value resulting from the mean difference in Capstone teaching skills Achievement test for STEM teachers in pre and post test, Where it turns out that Eta^2 value was (0.984) which indicated that the impact of E-training environment moderately achieved to develop Capstone teaching skills Achievement for STEM teachers, which means accepting the first research hypothesis.

The following figure shows differences between mean scores of the pre and post applications of Capstone teaching skills Achievement test for STEM teachers.

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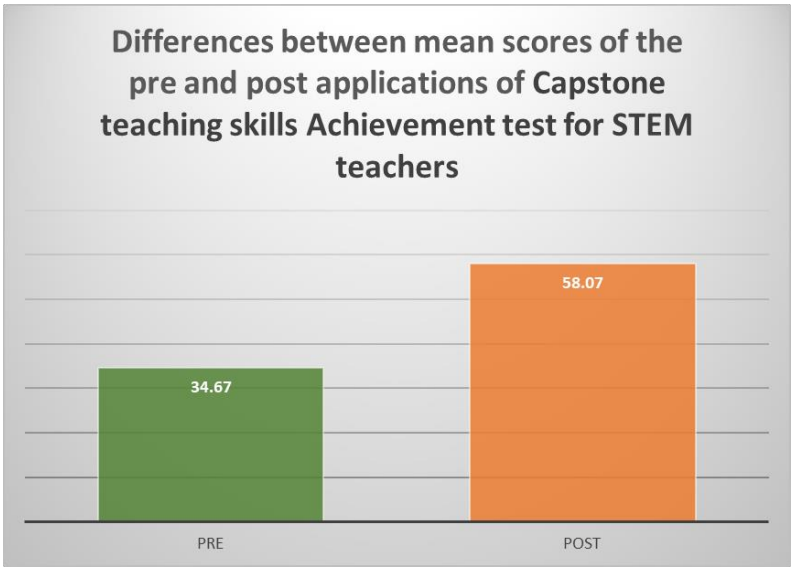

Figure (1) Differences between mean scores of the pre and post applications of Capstone teaching skills Achievement test for STEM teachers

The researcher explains the results of this research by citing the superiority of post-training scores over pre-training scores in the achievement test and the positive impact of the electronic training environment on the development of the cognitive aspects of Capstone teaching skills. This can be explained by the fact that the electronic training environment provided to STEM teachers through the Teams platform, which they are accustomed to using with their students, includes interactive activities, quizzes, PowerPoint presentations, and various interactions conducted directly among themselves and with the trainer. This familiarity led them to strive for mastery of the training content, as the electronic training environment facilitated a range of research activities and the submission of electronic work papers. It also provided training on decision-making skills by exposing them to various virtual scenarios presented through the environment, encouraging them to make decisions individually or collectively. Furthermore, the training included developing designing skills for research projects, practicing analyzing skills when dealing with scientific projects related to Capstone, mastering communication skills and performing their tasks, and training on time management skills and risk management. Additionally, the training covered budget-related skills such as budgeting, and through the various interactive activities offered by the electronic training environment, teachers were able to activate their roles when teaching their students and producing projects using Capstone skills, all of which were made possible through the Microsoft Teams platform. These results align with studies conducted by Katz (2005), Thurasamy et al. (2012), Hatwah (2013), Khatwah (2014), and Kalkan (2020),

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Wilson & Carter (2021), Johnson & Anderson (2021), Mitchell & Davis (2022), Smith & Williams (2022), Martinez (2022), Turner & Peterson (2023), Brown & Clark (2023).

The electronic training environment has been used to develop Capstone teaching skills and achievement, utilizing educational theories to build cognitive aspects. The training process should be cumulative, ensuring trainees have a cognitive and skillful reservoir for diverse educational situations. Interactivity in the environment increases information, knowledge, and skills acquired by teachers, aligning with behaviorist theory. The electronic training environment facilitates teacher interaction with educational activities, allowing for active participation and retention of learning outcomes. It also aligns with constructivist theory, building a skillful inventory based on previously acquired skills in dealing with STEM students. The study also aligns with communication theory, focusing on learning in electronic training environments and exploring how interactions within the environment influence learning through interactive media and tools. This approach views learning through networks within an effective social framework, reflecting contemporary technological advancements.

These results align with studies conducted by Smith & Brown (2021), Johnson & Wilson (2022), Martinez (2022), Brown & Anderson (2023), Wilson & Davis (2022), and Turner & Carter (2023).

There is a statistically significant difference at the level of p<=0.05 between the pre-test and post-observation card of the experimental group on developing the capstone teaching skills of STEM teachers in favor of the post-test.

Findings Related to the Fourth Question: To answer the fourth research question: **"What is the effect of using an e-training environment to develop the performance aspects of** the Capstone **teaching skills of STEM teachers?"** The researcher analyzed and calculated the data by applying the following statistical styles to verify the validity of the second hypothesis:

There is a statistically significant difference at the level of (a<=0.05) between the pre-test and post-observation card of the experimental group on developing the capstone teaching skills of STEM teachers in favor of the post-test.

To verify the validity of the second research hypothesis that states, "There is a statistically significant difference at the level of (a<=0.05) between the pre-test and post-observation card of the experimental group on developing the capstone teaching skills of STEM teachers in favor of the post-test," A paired sample t-test was used, as shown in the following table.

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Table (2) Results of paired sample t-test to verify of differences between mean scores of Capstone teaching skills observation card in pre and post application

Skill	Application	Mean	Std. Deviation	Earning		t	df	Sig.	η^2
				Mean	Std. Deviation				
The research skills	Pre	15.93	1.859	13.963	2.609	27.810	26	.000	0.967
	post	29.89	1.805						
The decision-making skill	Pre	13.44	3.250	11.259	3.265	17.918	26	.000	0.925
	post	24.70	1.031						
The designing skills	Pre	10.44	1.219	7.630	2.420	16.381	26	.000	0.912
	post	18.07	1.752						
The Analyzing skills	Pre	15.81	2.001	12.852	3.613	18.483	26	.000	0.929
	post	28.67	2.646						
Communication skills	Pre	13.93	1.730	15.370	2.976	26.835	26	.000	0.965
	post	29.30	2.091						
Time management skill	Pre	3.96	.706	3.926	1.141	17.878	26	.000	0.925
	post	7.89	.847						
Risk management	Pre	7.11	.801	6.778	1.368	25.742	26	.000	0.962
	post	13.89	1.050						
Budgeting	Pre	6.48	1.282	3.963	1.581	13.027	26	.000	0.867
	post	10.44	.892						
All Capstone teaching skills	Pre	87.65	5.010	75.296	6.330	61.814	26	.000	0.993
	post	162.85	3.581						

The mean scores of "All Capstone teaching skills" observation card in pre application reached 87.65 with a standard deviation of 5.010, while the mean score was reached in post application 162.85 with a standard deviation of 3.581, the earned mean score in The All Capstone teaching skills was 75.296 with a standard deviation 6.330, the value of t-test between the two mean scores was 61.814, this value has a significance at the level of 0.05, as the calculated significance is equal to 0.000 which is less than 0.05, also the Impact factor has been extracted using Eta2 via t value resulting from the mean difference in The All Capstone teaching skills observation card for STEM teachers in pre and post test, Where it turns out that Eta2 value was 0.993 which indicated that the impact of E-training environment moderately achieved to develop Capstone teaching skills for STEM teachers, which means accepting the second research hypothesis

The following figure shows differences between mean scores of Capstone teaching skills observation card in pre and post application.

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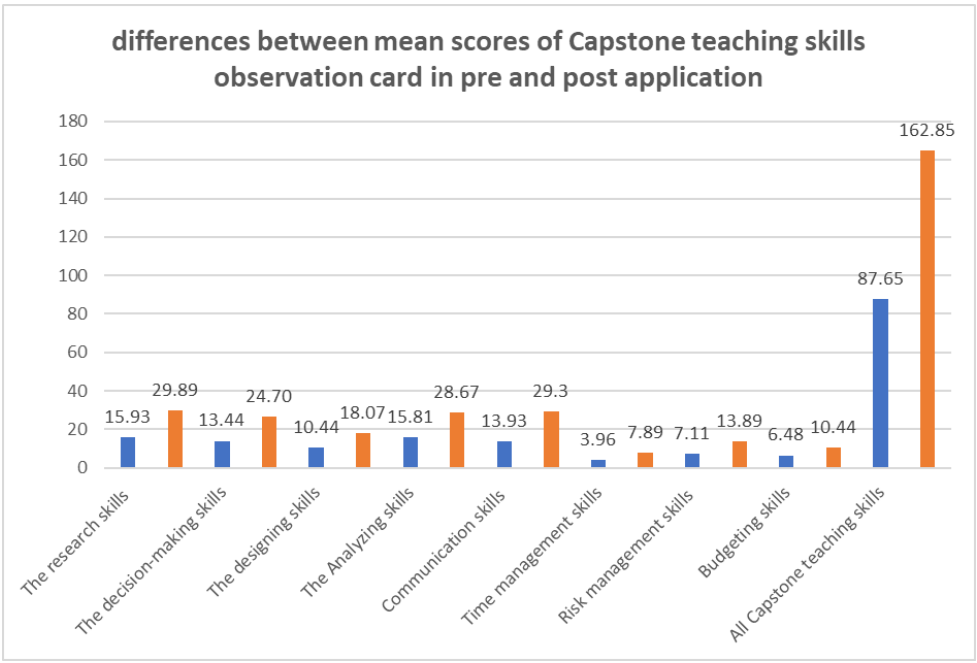

Figure (2) differences between mean scores of Capstone teaching skills observation card in pre and post application

Discussion

The research focuses on the effectiveness of using an E-training environment in developing Capstone teaching skills for STEM teachers. The results show that the proposed environment has proven effective, providing flexibility, cost-efficiency, scalability, interactive learning, resource sharing, scheduling flexibility, assessment and feedback tools, professional development tracking, customization, reduced environmental impact, integration with other tools, safety and health during public health crises like the COVID-19 pandemic, and global collaboration.

The study found that E-training environments like Microsoft Teams are highly effective in developing Capstone teaching skills for STEM teachers. They offer flexibility, accessibility, cost-efficiency, and a range of interactive and collaborative features, making them suitable for training programs involving numerous teachers or educators from different locations.

E-training platforms also allow for real-time collaboration with peers and experts, fostering global collaboration and the exchange of innovative teaching practices. This aligns with the modern approach to education and professional development, ensuring that teachers have access to the resources and support they need to excel in their roles.

In conclusion, using an E-training environment like Microsoft Teams can significantly enhance teacher training by offering flexibility, accessibility,

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cost-efficiency, and a range of interactive and collaborative features. It aligns with the modern approach to education and professional development, ensuring that teachers have access to the resources and support they need to excel in their roles.

The current research results are consistent with the previous studies providing clear evidence for the effectiveness of using E-training environment in developing the Capstone teaching skills. However, the current research added more depth than previous studies in the points outlined below:

E-training environments facilitate global collaboration and the connection with peers and experts from around the world in several ways:

The research demonstrates the effectiveness of using E-training environments in developing Capstone teaching skills. It highlights the benefits of global collaboration and connections with peers and experts from diverse locations. E-training platforms host online communities and forums, allowing participants to interact with peers and share experiences. Virtual conferences and webinars allow educators to attend presentations, workshops, and panel discussions without physical travel. Collaborative projects enable educators from different countries to collaborate on research, curriculum development, or other educational initiatives. E-training platforms also facilitate guest lectures and expert sessions, exposing participants to diverse perspectives and expertise. Peer review and feedback processes are supported by e-training platforms, allowing teachers from different countries to provide valuable insights and suggestions. Cross-cultural learning is also possible through e-training programs, enriching understanding and pedagogical approaches. Online networking features allow educators to build professional relationships with educators from around the world. Language translation features help overcome language barriers, enabling effective communication and collaboration. Overall, e-training environments break down geographical barriers, allowing educators to connect and collaborate with peers and experts from diverse locations, fostering knowledge exchange and innovative ideas in education.

Pedagogical Implications:

Using Microsoft Teams as an e-training environment for improving the Capstone teaching skills of STEM (Science, Technology, Engineering, and Mathematics) teachers has several pedagogical implications as follows:

- **i.** Blended Learning: Microsoft Teams allows for a blend of synchronous and asynchronous learning, accommodating different learning styles and schedules.
- **ii.** Group Projects: Teachers can collaborate on Capstone project development, sharing ideas, best practices, and feedback within the Teams environment.

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iii. One-on-One Coaching: Teachers can schedule one-on-one coaching sessions with trainers or experts through Teams, allowing for personalized support.
iv. Assignment Submission: Teachers can submit capstone project drafts for feedback through Teams. This process supports formative assessment and iterative improvement.
v. Peer Review: Teams can facilitate peer review of Capstone projects, fostering a culture of constructive feedback and improvement.
vi. Resource Repository: Teams can serve as a repository for educational materials, research papers, and relevant content, making it easy for teachers to access and share resources.
vii. Professional Development: Certifications and Badges: Teachers can pursue Microsoft certifications and earn badges through training modules within Teams, enhancing their professional qualifications.
viii. Progress Tracking: Teachers and administrators can monitor progress through analytics and reporting features in Teams, identifying areas where additional support is needed.
ix. Technical Support: Teams offers technical support resources to troubleshoot any platform-related issues, ensuring a smooth learning experience.
x. Data-Driven Decision-Making through Data Analytics: Teams provides data analytics tools to assess teacher engagement and performance, enabling data-driven decisions to improve the training program continually.
xi. Professional Learning Communities: Teachers can join Teams-based professional learning communities focused on specific STEM disciplines or capstone project themes, fostering collaboration and knowledge sharing.
xii. Feedback Loops: Continuous Improvement: Regular feedback mechanisms within Teams allow for ongoing refinement of training content and delivery methods based on teacher input.

Incorporating Microsoft Teams as an e-training environment for capstone teaching skills enhances pedagogical practices by promoting flexibility, collaboration, access to experts, effective assessment, and continuous improvement. These pedagogical implications contribute to the professional growth and effectiveness of STEM teachers involved in capstone education.

Recommendations

The results of the research highlighted several recommendations, including:

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The research suggests that an e-training environment can be used to develop the Capstone teaching skills of STEM teachers. This involves creating customized training programs, implementing a blended learning approach, creating interactive and engaging content, promoting collaborative learning opportunities, providing access to experts and resources, incorporating formative assessment methods, offering structured professional development pathways, establishing mentorship and coaching programs, ensuring inclusivity and accessibility, collecting feedback from participating teachers, using data analytics tools, providing technical support, fostering professional learning communities, aligning with educational objectives, continuously evaluating the effectiveness of the e-training environment, considering scalability and accessibility, keeping training content and resources up-to-date with the latest developments in STEM education, and empowering teachers to take ownership of their professional development.

These recommendations can contribute to the successful development of Capstone teaching skills for STEM teachers, supporting their professional growth and ultimately enhancing the quality of Capstone education in STEM disciplines. The e-training environment should be accessible to all teachers, ensuring that the content and objectives align with broader educational goals and the specific needs of STEM teachers.

Suggestions for Further Studies and Research

The research suggests several studies to improve the Capstone teaching skills of STEM teachers using E-Training environments. These studies should investigate the effectiveness of E-Training environments in improving teachers' trainings, assessing teachers from different types of education, training science teachers, and assessing administrative tasks in STEM schools. Additionally, the research should explore the impact of E-Training environments on academic achievement, attitudes, problem-solving skills, and creativity for teachers and students in STEM schools. The pedagogical benefits of different E-Training environments implementations should also be investigated. The implementation of chatbots in E-training systems and virtual environments with text-to-speech technology should also be explored.

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Data Availability: All data are included in the content of the paper.

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Declaration for Human Participants: This study has been approved by: Obour STEM School of outstanding students in science, technology, engineering and mathematics, and the principles of the Helsinki Declaration were followed.

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Theoretical Background of Input-Output Analysis and its Application in Albania

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Abstract

The input-output (IO) method is widely used in economic analysis to understand the relationship between sectors of the economy. One of the major advantages of the IO method is its ability to capture the direct and indirect effects of different policies in one sector on other sectors of the economy. The IO table system is a crucial component of the European System of Accounts, a standardized framework for the production of European Union statistics on economic activities. Utilizing various mathematical techniques and methods, the IO analysis shows adaptability as a tool of analysis. In comparison to alternative methods, one of the primary benefits of the IO method is its flexibility in incorporating aggregate data. This enables researchers and policymakers to gain a more comprehensive understanding of the interrelationships between different sectors of the economy as well as the effects of different policies on multiple sectors of the economy. This paper examines several studies by different authors related to IO analysis, which use official data from IO tables across various countries to analyze the economy of a country, region, and global impact. This paper evaluates the limitations of the application of the IO method in Albania, considering the techniques of constructing symmetrical IO tables and the types of analyses conducted through these data.

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Keywords: Supply Use Table, Symmetric Input-Output Table, IO analyses, Application of IO analysis in Albania

1. Introduction

The majority of works using the IO method pay attention to current issues and concerns such as environmental pollution, income distribution, investments, employment, financial indicators, and international trade relations. The System of Input-Output table is an integral part of the European System of Accounts (ESA 2010). The IO method is commonly used to assess the effects of policies and economic cycles. The IO method has become a common analytical tool for resource allocation and income distribution, and its application is not limited only to the national level but also to the regional level. The tables consist of rows and columns that quantify cross-sector supply chains. The top of each row and column lists the industries, and the data in each column shows the level of inputs used in an industry's production function. The system of supply-use tables (SUT) reconciles national accounts by adjusting and equalizing statistical data from production, expenditure, or income sources. The foundation of the IO system is the compilation and balancing of SUT using current prices. The final product of the balancing process should be a set of fully balanced accounts with a single GDP result.

Baumol (2021) described the IO method as one of the greatest contributions to economics in the 20th century. In 1968, the United Nations published "System of National Accounts, Studies, and Methods," which integrated input-output tables into the system of national accounts and greatly improved empirical analysis of the economy. The System of National Accounts was further updated in 1993 and 2008 (SNA 1993 and 2008) to international standards. The concept of input-output tables was treated as a separate part in the European System of Accounts, 1995 ESA 1995, consisting of three main tables, with greater importance given to source-use tables. The European System of National Accounts, 2010, contains the most recent theoretical treatment related to these tables. Like every model, the I-O model has its advantages and disadvantages. The disadvantage could be considered the lack of links between primary factors, limitations, and final demand. At the same time, the conceptual simplicity of the matrix presentation makes it easy to analyze and describe the circulation of products and services between different industries. Also, the production of a branch of the economy is interdependent with the output of other sectors that use this product as a raw material in production processes, or this product uses products of other branches as raw material.

Using input-output analysis, changes in these linkages can be analyzed by examining how modifications in the demand or output of one industry affect the production and demand of other industries in the economy. This

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analysis helps to understand the effects throughout the economy caused by changes in a specific industry or sector. Studying changes in backward and forward linkages through input-output methods provides a comprehensive understanding of the interconnected nature of the economy, helping policymakers in decision-making, businesses identify opportunities for growth, and researchers analyze the overall economic structure and dynamics. In developed countries Environmental changes can be analyzed using input-output tables through the application of environmental input-output analysis. This approach focuses on assessing the environmental impact of economic activities and provides insights into resource use, energy consumption, emissions, and other environmental indicators associated with different sectors and final demand categories.

A linear equation should be used to describe the interdependence between sectors and countries, expressing the balance between total inputs and outputs for each good and service produced in a country's economy or in the input-output analysis of the global, regional, or national economy. Empirical studies have revealed that the evolution of technical coefficients is consistent with a stable information structure in the form of tables. The technical coefficients describe the production structure of each sector, quantifying the relationship between inputs and outputs. In analyzing sectoral links, the input-output table for domestic production is used, with attention given to the interdependence between domestically produced and imported inputs. This division allows for a more accurate assessment of economic effects, as locally produced inputs have a greater impact (Midcore et al., 2006).

The development of supply and use tables and symmetric input-output tables is a recent task for Albania's statistical practices, and INSTAT has taken up it under the IPA 2007 project. The first tables for supply, which use SUT at current prices for the years 2009–2011, and the derived symmetric input-output table (TSIO) for the year 2011 were published in February 2015. The source, uses, and input-output tables for the years 2012–2014 were compiled and published in 2016 and 2017. In accordance with Eurostat's methodology and requirements, the compilation and publication of these tables take place three years after the reference year (t+3) (Eurostat 2013).

2. Literature Review

According to the OECD guidelines, the input-output matrix is constructed based on the simple principle that goods and services produced by different sectors of the economy should be recorded in a table according to their origin and destination. When one sector purchases agricultural production from another sector, it is considered an input for the purchasing sector. This is known as intermediate demand, which refers to inter-industry transactions where goods and services are purchased from other firms and

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used in production (Yamano et al., 2006). On the other hand, products delivered for final consumption include purchases made by individuals for personal use, firms for investment (in fixed capital such as buildings, cars, etc., which is known as gross capital formation), the government, and foreign countries through exports. The use of the term "final demand" indicates that purchases made from this sector are not intended for use in production (Kodderitzsch, S. 1999).

Besides the intermediate inputs mentioned earlier, firms also use primary inputs, which are services not bought by other firms but by individuals. These services are known as factors of production and include wages and payments for labor services, interest paid for borrowing, rent paid for the use of equipment, buildings, and land, and profits paid for entrepreneurship, which is a function of organization and risk-taking (Common and Stagl, 2005). Furthermore, the matrix of imported intermediate products is also referred to as the imported input matrix (Sönmez, H. A. K. A. N. 2023).

The input-output method examines the relationships between industries and final demand in an economy. The static input-output system, which is based on the linear Leontief production function, was developed by Wassily Leontief and serves as the foundation for input-output analysis. As previously noted, input-output models are consistency models that are capable of assessing the primary aspects of interdependence between economic sectors and the effects of economic changes and external shocks. However, despite their longstanding use, analytical techniques that rely on input-output models have limitations that have been documented in research within this field.

The production functions of the industry are simple linear models that are based on final demand, and they do not consider changes in consumption patterns that may occur due to income changes. Furthermore, these models have limitations in their treatment of international trade, as they consider exports and final demand to be exogenous variables, and imports are not treated as being competitive. However, the analysis methodology of TIOs has evolved to the point where it has the potential to identify new modes of operation and physical variables that can be useful in solving a range of problems. This approach can also provide insights into physical processes that have not been analyzed extensively. As a result, methodological evolution can be employed to address problems that may not yet be fully understood (Ramsden, 1956).

The process of technical coefficient evolution is characterized by a gradual and consistent pace. While the coefficients may fluctuate based on specific factors, their transformation is so gradual that it will not have a significant impact on the fundamental structural models of input-output tables.

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As a result, the structural patterns that define the economy will remain relatively stable over extended periods of time (Szyrmer et.al., 1985).

Input-output analysts aim to achieve the highest degree of separation when constructing a fundamental transaction table. The demand-driven nature of these models disregards supply constraints, assuming that an increase in demand for a product will result in increased output, regardless of resource availability (Norbu, 2021). This suggests that the industry resource curve is perfectly elastic. These models exogenously determine prices and do not consider the impact of economic policies or external shocks on prices. The fixed coefficient assumption and fixed input structure assumption of I-O models are unrealistic as they do not account for technological advancements in various industries. Another limitation of these models is the lack of connection between primary factor constraints and final demand (Hellgate, (2008).

3. Theoretical Description of the Methodology

An input-output table is not an economic model in and of itself. Rather, it is an analytical representation intended to be as comprehensive as possible regarding the flows of goods and services that occur between actors within an economic system. When we begin from the premise that the economic system presented in the table is stationary, reproducing itself in the same manner year after year, and we assume that the labor force employed by each sector is fixed, as is the technical knowledge or technology that determines the necessary quantities of other goods to produce a certain good, we refer to it as a Leontief model, Parra, F (2020). The linear equation describes the balance between total inputs and outputs.

$$\begin{aligned} a_{11}X_1 + a_{12}X_2 + \ldots\ldots + a_{1n}X_n + Y_1 &= X_1 \\ a_{21}X_1 + a_{22}X_2 + \ldots\ldots + a_{2n}X_n + Y_2 &= X_2 \\ a_{n1}X_1 + a_{n2}X_2 + \ldots\ldots + a_{nn}X_n + Y_n &= X_n \end{aligned} \tag{1}$$

The underlying assumption of this model is that inputs are used in fixed proportions relative to output, and that changes in the prices of production factors do not affect the technical coefficients of inputs. The computation of the input matrix coefficients is expressed mathematically as follows:

$$a_{ij} = \frac{x_{ij}}{x_j} \tag{2}$$

as:

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a_{im} = correlation coefficients,
$xI\ j$ = output of branch "I" used in branch "j",
x_j = branch output.

Another method for calculating the coefficients is the matrix transformation of equation 2:

$$AX + Y = X \tag{3}$$

Matrix A is called matrix of input-output coefficients, vector X is the vector of output and vector Y is the vector of final demand.

$$X - AX = X$$
$$(I - A)\ X = Y$$
$$X = (I - A)\text{-}1\ Y \tag{4}$$

Where I is the unit matrix and $(I - A)\text{-}1$ is the inverse matrix of $(I - A)$ which is known as the Leontief matrix:

$$(I-A)^{-1} = \begin{bmatrix} 1 - a_{11} & -a_{12} \\ a_{21} & 1 - a_{22} \end{bmatrix} \tag{5}$$

Input-output models are based on the structure of inputs, which is represented by the matrix A and the inverse matrix $(I\text{-}A)^{-1}$. These matrixes form the foundation upon which input-output models are constructed. The input-output models are based on two matrices, matrix A and its inverse matrix $(I\text{-}A)^{-1}$, which reveal the inter-industry relationships and the impact of changes in final demand on production. Apart from Leontief demand-side models, another family of I-O models exists, which is based on production coefficients and was developed by Ghosh in 1958 (Ghosh, A. (1958).

The Leontief model is an analytical representation of an input-output table (IOT), which includes a symmetric input-output table, an internal intermediate consumption matrix (r), an inventory demand matrix, and a primary input matrix. The intermediate consumption matrix calculates the terms of trade between different branches of production, while the final demand matrix records the portion of goods and services produced that is intended for final users. The primary input matrix records the payments made by companies and administrations for the use of factors originating in production, such as labor income and business surplus (Wixted et al., 2006).

The matrix of primary inputs provides the added value of each branch, which is obtained by subtracting the total intermediate consumption from the value of production. Each element of the intermediate consumption matrix

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($xi_{,j}$) represents the consumption of the products of branch i that branch j makes. If this consumption comes from resident companies in the territorial reference area of the input-output table, it is referred to as "r," while those imported by non-resident units are referred to as "m." The output of a branch (X_j) is the sum of the elements appearing in each column, including intermediate consumption of resident units, imports, and value-added (V). The rows show the destinations of domestic production (X_j) and imports (M_j), which are intermediate demand (purchases made by other sectors) and final demand.

The I-O model aims to determine the production levels of each industry in order to meet a change in final demand, assuming that the structure of the economy does not change. The analysis of inter-industrial linkages is a crucial macroeconomic analysis that demonstrates the weight of each sector producing goods and services. This analysis is one of the central methods of macroeconomic modeling.

In addition to the link between industries and the matrix of coefficients, the input-output table analysis can calculate and analyze the following multipliers:

The production multipliers for a particular sector, denoted as "j," can be expressed as the aggregate value of the changes in production across all sectors of the economy required to produce a single unit of product j for final consumption. These multipliers, denoted as "Oj," are calculated as the sum of the coefficients in the inverse Leontief matrix. In other words, the production multipliers represent the indirect effects of changes in the production of a given sector on the wider economy.

$$O_j = \sum_1^n a_{ij}$$

Income multipliers, like output multipliers, are used to evaluate the effect of alterations in final demand on the income earned by households from employment. The equation that measures the direct and indirect demand for wages in one unit of output for final use is:

$$Z = B\,(I - A)^{-1}$$

B = vector of imputation coefficients for wages, I = unit matrix,
A = The matrix of coefficients for intermediate consumption imputation
Z = vector with direct and indirect results of wage demand.

Employment multipliers are calculated using coefficients of physical labor inputs. They show direct and indirect labor demand as a result of changes in final demand. Employment multipliers are calculated using the following equation:

$$Z = E(I - A)^{-1}$$

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E = matrix of input coefficients of work (physical number of people per million ALL output),
Z = matrix with direct and indirect results of labor demand (physical number of employees).
Forward and Backward Links are two very important indicators. In the input-output analysis and system, increasing output from a given industry has two effects on

$$BL^{CW}{}_{j} = \sum_{1}^{n} a_{ij}$$

$BL^{CW}{}_{j}$ means the attractive links of the sector *j*,

$$O_j = \sum_{1}^{n} a_{ij} \qquad BL^{CW}{}_{j} = \sum_{1}^{n} a_{ij}$$

where:
a_{im} is the matrix of input coefficients is represented by the symbol A.
The CW thrust connections are equal to the row-wise sum of the matrix of output coefficients, matrix B. The CW thrust connections for sector I are defined as:

$$FL^{CW} i = \sum_{1}^{n} b_{ij} \qquad (10)$$

where:
$FL^{CW}{}_{i}$ means the sector's driving ties I,
b_{ij} means the output coefficients of sector I in the sector j.
To analyze key sectors of the economy, are used normalized forward and backward linkages, which are calculated using the following formulas: when industry j increases production, it requires more inputs from both itself and other related industries.

4. Limitations and results of the Input Output method (case of Albania)

One of the limitations of IO analysis has been its static nature. Regarding reference years 2012 and 2015, for these years we had the IO table and static technical coefficients. This inconvenience was solved by elaborating the IO table every year to make dynamic modeling possible. However, in Albania, this inconvenience continues to exist because of the type of model used to construct symmetric input and output tables. The construction of input-output tables necessitates the classification of economic activities into sectors. This process involves aggregating economic activities into sectors in order to facilitate analysis. However, this aggregation procedure may introduce a trade-off by sacrificing detailed information, which can impede the comprehension of specific sub-sectors or industries. Furthermore,

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constructing input-output tables is a time-intensive undertaking that demands periodic updates to account for evolving economic conditions. Limitations arise from the assumptions made during the construction process, such as the adoption of constant technical coefficients or fixed relationships between sectors. These assumptions may fail to accurately represent the dynamic nature of the economy, thereby imposing restrictions on the analysis and policy implications derived from the input-output tables (Humbatova, & Hajiyev, 2020).

Environmental measures with insignificant economic impact may not be effectively captured by input-output (I-O) analysis. Therefore, I-O analysis is usually most applicable to actions that have a significant economic influence, such as constructing large infrastructures, altering port activities, or enacting environmental policies that target complete sectors, sub-sectors, or branches of economic activities (Alsamawi et al., 2017).

However, I-O analysis can also be useful for evaluating the collective impact of several policies, each of which may have a relatively small impact but whose combined effect could significantly impact the economy of a country or region. In addition to these limitations (Pearson, 1989).

The incorporation of demand changes resulting from price fluctuations should be included in I-O models, but this may increase the complexity of the model due to the presence of multiple products and/or different response functions. I-O matrices offer a static representation of the economy, making projections challenging. Nevertheless, dynamic I-O matrices can be developed, although this requires more advanced techniques (Christ, 1955). Additionally, I-O tables are typically released by national and regional authorities with a considerable time lag, sometimes spanning several years. The use of absolute data for I-O analysis is likely to yield erroneous findings for subsequent years. Nonetheless, techniques for updating dated I-O matrices do exist. Additionally, in situations where regional analysis is deemed necessary, the absence of regional I-O tables and solely national I-O tables poses yet another limitation, requiring the implementation of regionalization techniques. This requirement adds a layer of complexity to the analysis, warranting further attention (Lenzen et al., 2013).

Proper interpretation and utilization of input-output tables require a comprehensive understanding of their inherent limitations and assumptions. Users must exercise caution when drawing conclusions and formulating policy decisions based on the results obtained from input-output analysis, taking into consideration the constraints associated with the construction process. Despite these limitations, it is important to acknowledge the enduring value of input-output tables as an analytical tool that facilitates the comprehension of interconnections within an economy and informs policy discussions (Joghee, 2020).

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Regarding the Albanian case, I-O analysis is limited because of the data provided by INSTAT. The employment database should be in a vector matrix divided by 35 industries, just like the input-output symmetric table. In this case, we cannot calculate the employment multiplier, and so we are not able to identify the impact of the change in employment in one sector on the other sectors and the impact on the economy.

Recommendation for INSTAT should implement different databases for employment and gas emissions regarding the classification of national accounts to expand the level of analysis that researchers could do with the data provided by this institution by using input-output analysis. At this level, even Albania has the possibility of taking an approach with EU countries using input-output analysis for better implementing policies and economic growth. Emission of O2 from different industries is another missing piece of information regarding the interindustry impact of pollution when demand or production changes. Also, because the because the Albanian economy is small and highly dependent on imports, the multiplier effect for a given sector may be overestimated.

There are still missing analyses for the case of Albania related to the input-output tables. In relation to other countries, these analyses are also related to the indicators of employment and the environment, giving a clearer and more complete picture of the impacts that the sectors give on each other and on the economy. In Albania, this analysis is limited to only five basic analyses related to backward and forward linkages, Le Masne, simulations, vertical integration of products, and graphs (Duarte et al., 2011).

Conclusions

This paper presents a literature review on the use of the IO symmetric tables for the inter-branch connections of the different economies.

Empirical studies have revealed that the evolution of technical coefficients is consistent with a stable information structure in the form of tables. Recent developments in the field of IO analysis involve empirical analyses that address various issues related to globalization phenomena.

When examining the relationships between different industries, analysts utilize the domestic production input-output table, which focuses on the interconnectedness between domestically produced inputs and those that are imported. Input-output matrices provide a useful solution to different problems, as they take into account both direct and indirect effects. This is particularly valuable when assessing the economic impact of policy changes, both ex-ante and ex-post. Furthermore, the impact on the environment can also be analyzed by incorporating environmental data into the classic input-output tables, thus creating green I-O tables. By analyzing the tables, it is possible to determine how the production of goods and services affects carbon emissions,

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water consumption, and waste generation. Additionally, it can be used to identify the sectors that have the most significant environmental impact and target environmental policies accordingly. Input-output (I-O) analysis is not only beneficial in assessing the economic effects of individual policies but also in evaluating the cumulative impact of multiple policies. While individual policies may have minimal effects, the collective impact of several policies could substantially influence the economy of a country or region. By using I-O analysis to model the impacts of these policies, researchers and policymakers can gain insights into how they could interact to affect the economy's performance. Furthermore, I-O analysis can be useful in determining the optimal combination of policies that would yield the greatest economic benefit. By analyzing the interactions between different policies, I-O analysis can identify policies that complement one another and those that could lead to unintended consequences. Moreover, I-O analysis can be used to forecast the long-term economic impact of policy changes. By simulating different scenarios and analyzing their economic effects, policymakers can make informed decisions on which policies to adopt, modify, or discard. In summary, I-O analysis is a powerful tool for evaluating the collective impact of policies and predicting their economic effects. By providing insights into how different policies interact, I-O analysis can inform policymaking and help promote sustainable economic growth. The author summarizes various uses of I-O analysis.

INSTAT should implement different databases for employment and gas emissions regarding the classification of national accounts to expand the level of analysis that researchers could do with the data provided by this institution by using input-output analysis. At this level, even Albania has the possibility of taking an approach with EU countries using input-output analysis for better implementing policies and economic growth.

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Balanced Scorecard : Optimisation de la Performance dans le Secteur Public Marocain

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Résumé

L'article analyse l'introduction de la Nouvelle Gestion Publique (NGP) au Maroc, en mettant l'accent sur la mise en œuvre du Balanced Scorecard (BSC) pour relever les défis du secteur public. Malgré les critiques sur sa standardisation, le BSC a été adopté dans le but d'instaurer une culture de la performance ; l'étude montre que le BSC a permis d'améliorer la gestion performante des organisations publiques marocaines. Grâce à une évaluation globale liant indicateurs financiers et non financiers, le BSC a favorisé une prise de décision plus éclairée. Cependant, des défis persistent, notamment la résistance au changement de la part des acteurs publics et la difficulté à définir des indicateurs de performance pertinents, l'introduction du BSC a renforcé la transparence, la responsabilisation et l'orientation stratégique, mais nécessite une formation continue du personnel et des ressources dédiées pour sa mise en œuvre. Enfin, les résultats suggèrent d'étendre l'utilisation du BSC à d'autres entités du secteur public en adoptant une approche adaptative et personnalisée afin de maximiser les bénéfices à long terme.

Mots-clés: Balanced Scorecard ; Nouveau Management Public; Secteur Public Marocain ; Performance organisationnelle ; contrôle de gestion

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Balanced Scorecard: Performance Optimization in the Moroccan Public Sector

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Abstract

The article analyzes the introduction of the New Public Management (NPM) in Morocco, focusing on the implementation of the Balanced Scorecard (BSC) to meet the challenges of the public sector. Despite criticism of its standardization, the BSC was adopted with the aim of establishing a performance culture; the study shows that the BSC has helped to improve the performance management of Moroccan public organizations. Thanks to a global assessment linking financial and non-financial indicators, the BSC has fostered more informed decision-making. However, challenges remain, notably resistance to change on the part of public players and the difficulty of defining relevant performance indicators. The introduction of the BSC has strengthened transparency, accountability, and strategic orientation, but requires ongoing staff training and dedicated resources for its implementation. Finally, the results suggest extending the use of BSC to other public sector entities, adopting an adaptive and customized approach to maximize long-term benefits.

Keywords: Balanced Scorecard; New Public Management; Moroccan Public Sector; Organizational performance; management control

1. Introduction

L'avènement de la nouvelle gestion publique représente l'une des avancées les plus significatives dans le domaine public. Au début des années 1980, plusieurs problèmes ont amené à réfléchir à la modernisation du secteur public. Ces problèmes incluaient des lacunes en performance, des failles du modèle bureaucratique wébérien, et une gestion axée sur les moyens. De plus, les citoyens étaient de plus en plus insatisfaits des services publics, qui ne répondaient plus à leurs attentes. Gerald Caiden (1991) souligne que "les systèmes administratifs hérités se montraient lents, inflexibles et insensibles à l'évolution des besoins humains et des circonstances." De même, ils sont critiqués pour leur inefficacité inhérente liée à une bureaucratie excessive,

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rigide, coûteuse, non innovante, et une hiérarchie excessivement centralisée, entraînant des perturbations profondes, notamment en termes d'endettement et de déficit (Albouy & Obeid, 2009). Ainsi, le Nouveau Management Public (NPM) est intervenu pour remédier à ces problèmes, cherchant à améliorer l'efficacité, l'efficience et la pertinence, en particulier en matière de performance, une notion complexe à appréhender dans le contexte public (Thomas, 2005). Le renforcement et l'amélioration de la performance des organismes publics sont devenus un enjeu crucial, initialement initié par les réformes au Royaume-Uni et aux États-Unis, avant de se répandre à l'échelle mondiale. Cette évolution se présente comme une nouvelle approche inspirée du secteur privé, visant à démocratiser l'organisation publique et à introduire des systèmes de management de la performance ainsi que des outils de management de la qualité (Maesschalck, 2004).

Kaplan et Norton (1992) ont confirmé que pour évaluer et piloter la performance, il est nécessaire d'introduire des outils récents de gestion de la performance multidimensionnelle, tels que le tableau de bord prospectif.

Ces auteurs ont précisé que cet outil peut être implanté avec succès dans le secteur public à condition de l'adapter aux spécificités de la sphère de l'entreprise publique (Kaplan & Norton, 2001, p. 100). Étant donné que toutes les activités gouvernementales ((Kaoutar Lahjouji, Kaoutar El Menzhi. (2018), p 10)) peuvent être transférées difficilement au secteur privé, la meilleure solution consiste à transférer les pratiques de gestion issues du secteur privé au secteur public. Comme le montre Andrew Dunsire (1995) pour le Royaume-Uni, l'objectif est de remplacer les « cultures administratives, hiérarchiques et professionnelles » par une « culture commerciale et managériale ». De nombreuses organisations publiques ont déjà une expérience sur la mise en place du BSC. Le modèle générique de la performance associé à la structure de la Balanced Scorecard (Manel BENZERAFA. (2007), p14)) a fait l'objet de nombreuses critiques de la part de certains auteurs. Ces derniers dénoncent le caractère standard voire normatif de l'outil développé par Kaplan et Norton. Ainsi, ces organisations ont dégagé de nombreux facteurs qui influencent sa mise en place et par conséquent le pilotage de la performance. Nous allons nous baser sur ces études en les considérant comme une revue de littérature qui nous permette~~nt~~ de regrouper l'ensemble des facteurs précités et par la suite enchainer notre recherche en mettant un pont entre la théorie et la pratique.

En outre, plusieurs tenants de ce courant tels que (Hood 1991, 1995, Pollit et Boukaert, 2004) ciblent de faire transférer les outils de gestion des entreprises privées et les faire intégrer dans l'organisation publique pour bien créer une culture de la performance au sein de ladite organisation. Ce transfert reçoit de nombreux facteurs qui influencent sa mise en place et par conséquent le pilotage de la performance en aval. De même le Maroc a pris connaissance

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de l'inefficacité de l'administration ancienne comme les autres pays. Les références telles que les livres, études, sites Internet sont très rares quand il s'agit de la mise en place de la BSC dans le secteur public (Gibert, 2000 ; Rochet, 2002).

Dans quelle mesure l'implémentation d'une Balanced Scorecard dans les organisations publiques favorise-t-elle la gestion performante à l'ère de la modernisation ?

Tout d'abord, nous plongeons dans la contextualisation de l'émergence de la balanced scorecard, éclairant ainsi les fondements qui ont conduit à son développement. En deuxième lieu, notre méthodologie repose sur une revue de littérature, assurant une approche rigoureuse pour appréhender les connaissances existantes. Le troisième expose les résultats obtenus au cours de cette investigation, dévoilant les déterminants essentiels de notre objectif principal. Enfin, notre exploration trouve sa conclusion dans une discussion approfondie, apportant une clarté supplémentaire aux découvertes présentées. Cette structure méthodique vise à offrir une compréhension approfondie du sujet, alignée avec les sections définies de notre article : Contexte et justification de la recherche, Revue de littérature, Méthodologie de recherche, et Résultats attendus.

Odyssée Conceptuelle : Élucider les Enjeux Fondamentaux de notre Recherche

À la lumière des appels croissants à une meilleure gestion du secteur public, les institutions publiques marocaines se trouvent obligées de répondre aux aspirations des citoyens marocains. Néanmoins, le Maroc est confronté à certains obstacles et limites en matière de gouvernance, nécessitant ainsi le renforcement de cette dernière comme catalyseur de transformation et de gestion efficace du secteur public.

Le Maroc s'est engagé dans une transformation visant à améliorer la gouvernance et renforcer la transparence de la gestion publique. Les organisations publiques marocaines doivent intégrer des méthodes modernes axées sur l'efficacité, l'efficience et des performances exceptionnelles. Cela nécessite la mise en œuvre d'un système complet de contrôle de gestion pour encourager un dialogue constructif sur l'administration publique.

La question centrale concerne le rôle crucial du contrôle de gestion dans la gestion efficace de la performance. En participant activement à l'établissement d'objectifs et de systèmes de mesure de la performance, et en orchestrant le processus de réponse à travers divers outils de contrôle, le contrôle de gestion se révèle indispensable. Parmi les outils de gestion de la performance, les tableaux de bord de gestion et les tableaux de bord prospectifs se distinguent. Le tableau de bord prospectif, en particulier, intègre

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des indicateurs financiers et non financiers, le rendant particulièrement adapté au secteur public.

Les entités publiques, en quête d'efficacité et d'efficience accrues, visent à remédier aux insuffisances existantes grâce à la mise en œuvre de cet outil innovant, sans être motivées par des impératifs concurrentiels.

2. Revue de littérature : Décryptage des Tendances Actuelles et Perspectives Futures

2.1. Le New Public Management : Vers une Gouvernance Publique Innovante

Dans de nombreux pays développés, les organisations publiques remettent en question le fonctionnement bureaucratique jugé inadapté au contexte actuel, favorisant ainsi l'adoption croissante de pratiques du secteur privé ; le Nouveau Management Public (NMP) est devenu un concept dominant dans la réforme des organisations publiques, connaissant une diffusion mondiale depuis la fin des années 1970. Malgré des variations locales et l'émergence de concepts tels que la nouvelle gouvernance publique et l'État néo-wébérien, le NMP continue de se répandre, surtout dans les pays nouvellement impliqués. Inspiré par les théories du choix public mettant l'accent sur les effets pervers de l'intervention publique, le NMP prend des formes diverses selon les pays.

Cependant, des composantes majeures du NMP, liées à la recherche de performance, se retrouvent de manière systématique dans les réformes publiques, telle que :

Composantes	Utilité
Managérialisme	Met l'accent sur l'importance de prioriser la performance en gérant avec diligence les coûts associés aux actions publiques. Même si l'objectif initial du NPM était de rationaliser les dépenses, le contrôle des coûts continue d'être un élément essentiel de ce mouvement.
Responsabilité	Cet axe combine la recherche de performance et la responsabilisation, où l'attention est portée aux acteurs. Elle conduit à la mise en place de structures indépendantes, responsables de leurs actions et de leurs résultats. La responsabilisation manifeste donc la volonté d'inculquer une culture de la performance dans les organisations publiques et d'introduire des pratiques de management pertinentes.
Contractualisation	Vise à favoriser l'intégration harmonieuse des organisations publiques dans des réseaux diversifiés d'acteurs, notamment des partenariats public/privé. Cette approche facilite l'inclusion de l'action et du travail publics au sein d'un large éventail de parties prenantes.

Tableau 1 : Réalisé par nos soins

2.2. Définition et signification du concept New Public Management

Faire référence à la « nouvelle gestion publique » plutôt qu'à une simple nouvelle gestion publique, implique une rupture nette avec les pratiques

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traditionnelles de gestion publique. Comme le souligne A. Bartoli (1997), la gestion publique englobe l'ensemble du processus de direction, d'organisation, de motivation et de supervision des organisations publiques dans le but d'améliorer leur performance globale et d'orienter leur progrès tout en respectant leur finalité inhérente. Cependant, même dans le domaine de la gestion publique, un débat existe depuis longtemps autour du remplacement de l'approche « administrative », jugée dépassée en raison de sa nature bureaucratique, par une approche plus managériale du fonctionnement des administrations publiques. Cet accent mis sur les principes de gestion était déjà évident dans l'exploration de concepts tels que le système de planification, de programmation et de budgétisation (PPBS) et la rationalisation des choix budgétaires (RCB).

La recherche de l'efficacité est un objectif fondamental de la gestion publique, qu'elle soit considérée comme conventionnelle ou innovante. Les administrations publiques adhèrent à des règles organisationnelles qui contrecarrent les actions contraires à l'organisation, garantissant ainsi sa stabilité et sa continuité. Ces réglementations visent à trouver un équilibre entre la dimension institutionnelle de l'administration, engagée à remplir des missions essentielles et durables de service public, et une dimension managériale qui privilégie la flexibilité et les conditions de travail au sein des services publics. Ce débat en cours est influencé par l'introduction d'une dynamique concurrentielle dans les services administratifs, alimentée par des systèmes d'évaluation et d'incitation des fonctionnaires. En conséquence, l'autonomie accordée aux services publics peut parfois éclipser les objectifs politiques du fonctionnement administratif, soulignant l'importance de formuler explicitement une approche stratégique ; dans le domaine de l'administration publique, il est essentiel de donner la priorité à la fois à l'efficacité opérationnelle et à l'intérêt public. Cela nécessite le respect de critères spécifiques, tels que la définition d'objectifs mesurables qui correspondent à la vision et à l'objectif à long terme du service concerné. En outre, il est crucial d'assurer la cohérence des méthodes employées, d'évaluer la satisfaction des citoyens et d'identifier toute conséquence négative involontaire. En favorisant la coordination entre les différentes agences gouvernementales, nous pouvons adopter les principes de la nouvelle gestion publique et obtenir des résultats optimaux.

3. Méthodologie

Nous nous engageons dans une analyse approfondie des répercussions du Balanced Scorecard sur la performance opérationnelle des organismes publics au Maroc. Cela englobe une évaluation des modifications dans les dynamiques du travail, la clarté des opérations, et l'efficacité globale des processus internes selon la structure suivante :

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- **Revue Approfondie de la Littérature :**

Une investigation approfondie de la littérature existante sur l'application du Balanced Scorecard dans le secteur public, mettant en lumière les principes théoriques, les meilleures pratiques, et les défis spécifiques au contexte marocain.

- **Collecte et Analyse de Données Pluridimensionnelles :**

La collecte et l'analyse de données diverses, allant des témoignages des auteurs aux niveau des articles sur la bibliographie, pour obtenir une compréhension complète des impacts du Balanced Scorecard sur la performance des organismes publics au Maroc.

- **Analyse des Stratégies d'Adaptation :**

L'évaluation des stratégies d'adaptation mises en œuvre par les entités du secteur public marocain suite à l'intégration du Balanced Scorecard. Cette analyse vise à comprendre les ajustements opérés dans les processus, les politiques, et les structures organisationnelles.

- **Exploration des Changements dans les Dynamiques du Travail :**

Une exploration approfondie des modifications induites par le Balanced Scorecard dans les relations de travail au sein des organismes publics marocains. Cela inclut une évaluation des ajustements dans la collaboration, la communication, et la productivité.

- **Clarté des Opérations :**

L'examen de l'impact du Balanced Scorecard sur la transparence des opérations au sein du secteur public marocain, mettant en lumière les changements dans la visibilité des processus et des résultats.

- **Efficacité Globale des Processus Internes :**

Une analyse approfondie de l'efficacité globale des processus internes des organismes publics, en tenant compte des ajustements opérés suite à l'adoption du Balanced Scorecard.

- **Approche Documentaire Axée sur la Transparence :**

Notre méthodologie repose sur une approche documentaire, combinant la revue de la littérature, la consultation d'articles, et l'analyse de documents officiels. Cette approche garantit une analyse objective et transparente des dynamiques en jeu.

- **Reconnaissance des Limites Potentielles :**

Identification proactive des contraintes liées au temps et à la disponibilité des données. Cette transparence totale vise à situer notre étude dans son contexte, en reconnaissant les limites potentielles de notre démarche.

En adoptant cette méthodologie, notre objectif est de fournir une compréhension approfondie des impacts opérationnels du Balanced Scorecard dans le secteur public marocain, offrant des perspectives significatives pour les praticiens, les chercheurs et les décideurs.

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4. Clarté des Opérations :

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Efficacité Globale des Processus Internes :

Une analyse approfondie de l'efficacité globale des processus internes des organismes publics, en tenant compte des ajustements opérés suite à l'adoption du Balanced Scorecard.

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5. Les Fondations du Secteur Public : Un Examen Approfondi de ses Composantes

Selon le premier article de la loi N° 69-00 relative au contrôle financier de l'Etat sur les entreprises publiques et autres organismes, un secteur public comprend :

Catégories	Description	Exemples
État	Personne morale de droit public comprenant institutions et services pour gouverner et administrer le pays.	- Ministères, services, directions, Préfectures, délégations, Administrations déconcentrées ou décentralisées
Établissement publics	Personne morale de droit public, financée par fonds publics, avec autonomie financière et administrative pour mission d'intérêt général.	- Agence nationale de la promotion de l'emploi et des compétences (ANAPEC), Agence nationale de l'assurance maladie (ANAM), Agences urbaines, Chambres d'agriculture

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Les collectivités locales ou territoriales	Entités concentrées sur territoire spécifique, distinctes de l'administration de l'État.	Communes, avec personnalité morale et capacité d'agir en justice
Les sociétés d'état	Entreprises publiques influencées par l'État ou collectivités territoriales en raison de la propriété, participation financière, ou règles.	- SNRT - Barid AL Maghreb
Les filiales publiques	Sociétés avec plus de la moitié du capital détenu par des organismes publics.	LA RAM, SIE, SONACOS, etc.
Les sociétés mixtes	Sociétés avec un capital détenu jusqu'à 50% par des organismes publics.	DIYAR AL MADINA, FONCIERE UIR, NWM, SMAEX, SOTADEC, etc.
Entreprises Concessionnaires	Entreprises chargées de services publics par contrat de concession, avec l'État comme autorité contractante.	Auto hall

6. Exploration des Enjeux et Perspectives de la Performance dans le Secteur Public

La définition de la performance dans le secteur public reste complexe et controversée. Certains chercheurs, comme Thomas (2005), soulignent la difficulté de cerner la performance dans la sphère publique. Certains affirment que l'évaluation basée sur la conformité aux lois et règlements ne permet pas un véritable bilan de performance, mais est plutôt enracinée dans la logique bureaucratique ancienne. Le nouveau management public, orienté vers le contrôle des résultats, imite les pratiques du secteur privé, en mettant l'accent sur l'efficacité, l'efficience et la pertinence, au-delà de la simple conformité légale (Gilbert, 1980). Traditionnellement centrée sur la performance sociale, la conception de la performance dans le secteur public a évolué avec les attentes croissantes des citoyens, les déficits budgétaires et la compétitivité internationale. La gestion efficace des ressources publiques est devenue cruciale, nécessitant une réponse adaptée aux nouvelles exigences du contexte actuel (Boyne et Walker, 2005).

La littérature sur les réformes administratives, amorcées par les pays de l'OCDE dans les années 1980, se concentre sur des notions clés telles que l'efficacité, l'efficience, la pertinence et l'équité. Les définitions de la performance convergent souvent vers les trois notions fondamentales : résultats, moyens et objectifs. Gibert (1980) positionne la performance au centre d'un triangle regroupant efficacité, efficience et pertinence, représenté par le triptyque Objectifs-Moyens-Résultats.

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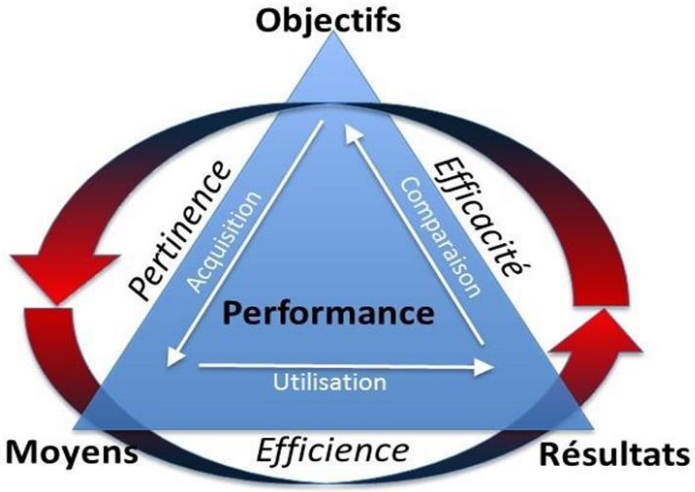
Figure 1 : Triangle de la performance



Éclairage sur les Axes d'Efficacité, Efficience et Pertinence

Efficacité : L'efficacité se mesure par la réalisation des objectifs définis. Cependant, cette notion peut être ambiguë, se demandant si elle concerne l'impact global sur les objectifs de la société (efficacité "macro") ou les opérations locales par rapport à la stratégie de l'unité (efficacité "micro"). Le défi pour le secteur public est double, nécessitant la capacité à atteindre des résultats définis préalablement et à passer d'une logique de consommation des ressources à une culture axée sur les résultats et la responsabilisation.

Efficience : L'efficience se concentre sur le rapport entre les résultats obtenus et les ressources engagées. Bien que ce concept ait parfois été négligé, les gestionnaires publics ont souvent privilégié le suivi budgétaire plutôt qu'une évaluation réelle des performances. Il s'agit d'une mesure distincte de l'efficacité, se basant sur la relation entre les extrants (output) et les intrants (input) en termes économiques.

Pertinence : La pertinence implique la programmation des ressources en fonction des objectifs et le suivi de leur application. Actuellement, la frontière entre les secteurs public et privé s'estompe, avec une orientation croissante de l'État vers la réduction des déficits et une montée de la responsabilité sociale et environnementale dans le secteur privé. Ce rapprochement est renforcé par la concurrence croissante entre les services publics et le secteur privé.

7. Le contrôle de gestion public

La volonté de modernisation au Maroc se traduit par l'adoption des principes du Nouveau Management Public (NPM) et la mise en place d'un système de contrôle de gestion dans les organisations publiques. Cette

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initiative s'inscrit dans une transition vers une gestion axée sur les résultats. Néanmoins, la diversité des missions et le caractère public des organisations rendent le choix des outils de contrôle complexe. L'objectif est de soutenir la gestion et le pilotage de la performance en fournissant un système d'information adapté, incluant le contrôle budgétaire, l'analyse des coûts et les tableaux de bord.

7.1. Définitions de la notion du contrôle de gestion

Le contrôle de gestion a évolué d'une approche budgétaire rétrospective vers une orientation axée sur la performance. Selon Henri Bouquin (2006), il assure la cohérence entre la stratégie et les actions quotidiennes, agissant comme un dispositif de gouvernance. Robert N. Anthony (1998) le définit comme le processus garantissant une utilisation efficace des ressources pour atteindre les objectifs, avec un accent sur le rôle des managers. Kaplan et Norton (1992) soulignent l'importance de mesurer ce qui est géré, en utilisant des outils tels que la comptabilité analytique et le contrôle budgétaire.

7.2. Le contrôle de gestion au sein des organisations publiques

Dans le secteur public réglementé, le contrôle de gestion s'adapte aux missions et ressources spécifiques de chaque domaine, comme illustré dans la figure n°2 :

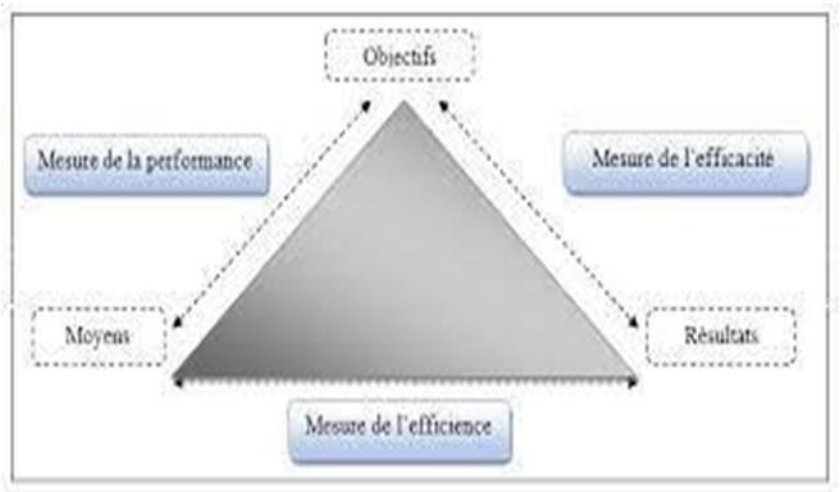

Figure n°2 : Le triangle du contrôle de gestion dans les organisations publiques

Le triangle du contrôle de gestion illustre la relation entre les moyens, les objectifs et les réalisations dans le secteur public Trois types de rapports émergent :

Celui entre les objectifs et les moyens, évaluant la qualité du service rendu (décision politique) ; entre les objectifs et les résultats, mesurant

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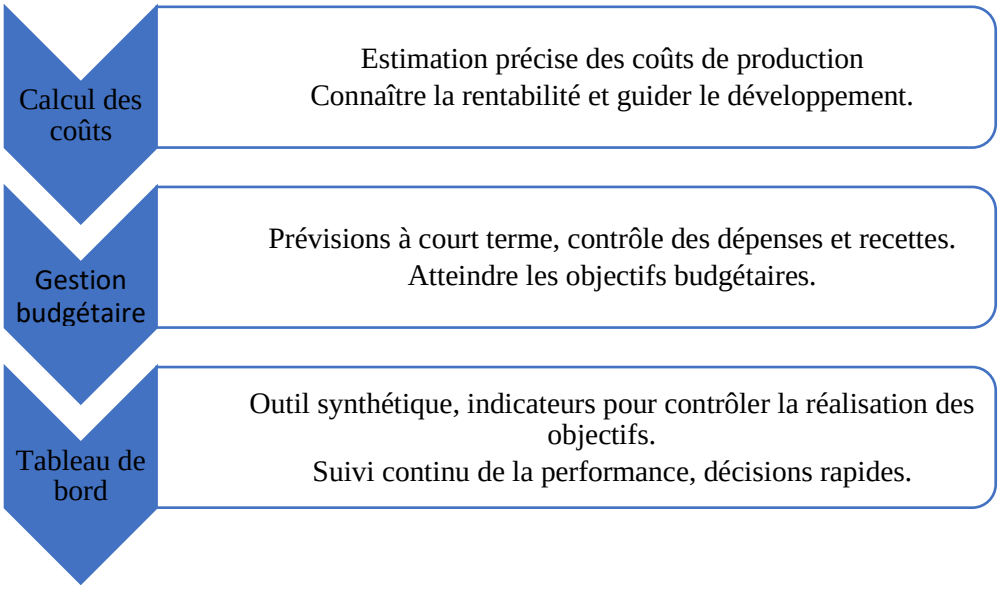
l'efficacité socioéconomique pour le citoyen ; et entre les moyens et les résultats, évaluant l'efficience vis-à-vis du contribuable. Le contrôle de gestion se concentre sur ces rapports, facilitant la transition de l'intention politique aux impacts socioéconomiques. Sa mise en œuvre offre transparence, gestion efficace des coûts et maîtrise des dépenses dans les organisations publiques marocaines, contribuant ainsi à l'atteinte des objectifs de performance (MOUMENE.J BENHRIMIDA.M,2019).

7.3. Les outils de contrôle de gestion

Les entreprises utilisent des outils de gestion adaptés à leur stratégie et objectifs. Berland & Simon (2010) identifient trois approches : Calcul des coûts, Gestion budgétaire, et Tableau de bord synthétique :



Les tableaux de bord de gestion et le Balanced Scorecard sont des outils couramment utilisés pour mesurer la performance. Ce dernier, particulièrement adapté au secteur public, intègre des indicateurs non financiers pour améliorer l'efficacité et l'efficience face aux lacunes courantes, sans chercher la compétition.

8. Optimisation de la performance des organisations publiques : Balanced Scorecard

L'évaluation cruciale de la performance des organisations publiques, alignée sur une orientation client similaire au secteur privé, a entraîné la détérioration de la gestion et de l'autonomie financière des entités publiques (Doe, 2015). Cette transformation intensifie la pression pour une utilisation plus efficace et efficiente des ressources. Dans le service public, la

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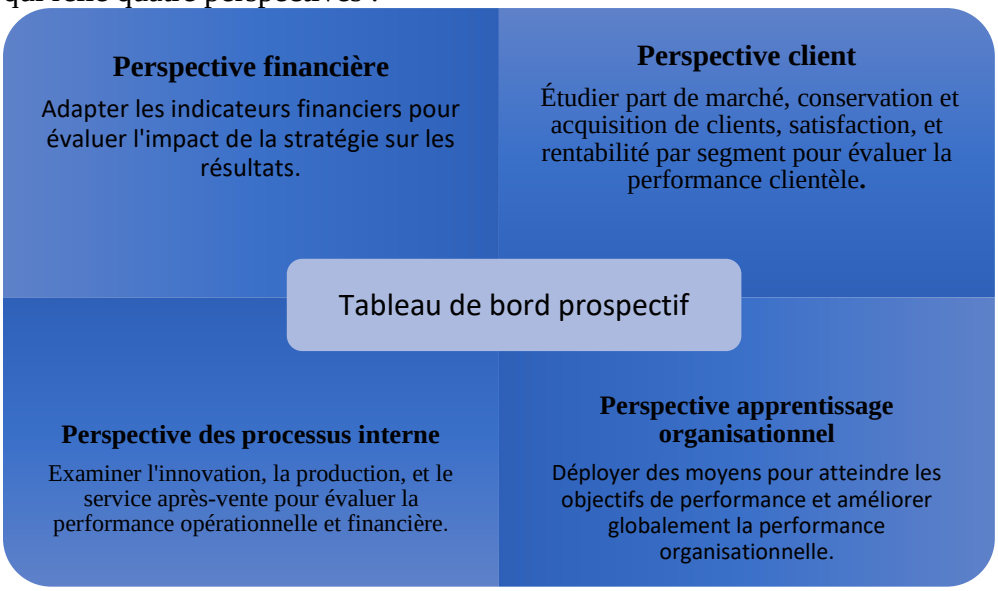
performance est maintenant mesurée par les citoyens en fonction des services fournis en échange des taxes et impôts payés (Brown, 2020). Dans le même temps, les entreprises marocaines, confrontées à une concurrence féroce, sont incitées à adopter des outils de gestion sophistiqués tels que le Balanced Scorecard, qui a connu un succès mondial (Johnson et al., 2017).

Balanced Scorecard outil de pilotage pour la Performance Optimale

D'après Kaplan & Norton (1992) « le tableau de bord est un instrument de direction, qui est souvent utilisé dans la pratique pour faciliter la mise en œuvre des stratégies », d'où ils expliquent que les indicateurs financiers ne permettent de donner que des informations a posteriori sur la valeur d'une entreprise, mais ne permettent pas de comprendre comment cette valeur ajoutée est créée. Et qu'ils nous permettent de créer un tableau de bord rétrospectif alors que les dirigeants ont besoin d'un tableau de bord prospectif qui relie quatre perspectives :



8.2. Balanced Scorecard: Mesure de la Performance dans le Secteur Public

Dans le secteur public, l'évaluation de la performance peut être abordée à trois niveaux :

1. Au premier niveau, on mesure la performance en évaluant la satisfaction des citoyens à l'égard des services rendus.
2. Au deuxième niveau, la performance est évaluée en termes d'efficacité interne de l'organisation.
3. Enfin, le troisième niveau concerne la mesure de la performance individuelle des fonctionnaires de l'État.

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La mise en place d'outils de gestion tels que le Balanced Scorecard dans les organismes publics s'inscrit dans le cadre d'une transition visant une gestion orientée vers les résultats et axée sur la transparence.

9. Résultats & Discussions

L'analyse approfondie de l'implémentation du Balanced Scorecard (BSC) dans le secteur public marocain révèle plusieurs constats significatifs. Tout d'abord, les organisations publiques ayant adopté le BSC ont manifesté des changements notables dans leurs dynamiques opérationnelles ; les ajustements stratégiques induits par l'introduction du BSC ont conduit à une meilleure clarté des opérations, avec une visibilité accrue sur les processus et les résultats. Cela s'est traduit par une gestion plus transparente des ressources et une optimisation des processus internes.

Il est clair que le BSC a influencé positivement la performance opérationnelle des organismes publics au Maroc. Les entités étudiées ont démontré une amélioration de l'efficacité et de l'efficience, mesurée par la réalisation des objectifs définis et l'optimisation des ressources engagées. Ces résultats soulignent les bénéfices tangibles de l'implémentation du BSC dans le secteur public marocain. L'adoption de cet outil de gestion stratégique a permis de renforcer la transparence, la responsabilisation et l'orientation stratégique des organisations publiques.

Tableau 1 : Impact du BSC sur la Performance Opérationnelle

Indicateur	**Avant l'implémentation du BSC**	**Avant l'implémentation du BSC**
Efficacité	Faible	Amélioration significative
Efficience	Manque de mesure claire	Optimisation des ressources
Pertinence	Déconnexion entre ressources et objectifs	Alignement stratégique accru

Les organismes publics ont mis en œuvre des stratégies d'adaptation significatives suite à l'intégration du BSC. Cela inclut des ajustements dans les politiques, les processus et les structures organisationnelles pour aligner les actions sur les objectifs stratégiques définis par le BSC.

Stratégies d'Adaptation	**Ajustements**
Politiques	Alignement sur les objectifs du BSC
Processus	Réorganisation pour l'efficacité accrue
Structures Organisationnelles	Création de départements dédiés au suivi du BSC

Ces adaptations démontrent la flexibilité des organismes publics à intégrer de nouvelles pratiques et à les mettre en œuvre de manière proactive. Ces résultats soulignent l'efficacité du BSC en tant qu'outil de gestion dans le contexte spécifique du secteur public marocain. L'amélioration significative

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de l'efficacité indique que les entités publiques ont réussi à atteindre leurs objectifs définis de manière plus cohérente après l'adoption du BSC. De même, l'optimisation des ressources, mesurée par une meilleure efficience, suggère que le BSC a contribué à maximiser les résultats obtenus par rapport aux ressources engagées.

Conclusion

L'introduction stratégique du Balanced Scorecard (BSC) dans les organismes publics marocains s'avère être un catalyseur essentiel dans cette quête d'efficacité, d'efficience et de transparence accrues ; l'exploration approfondie de la littérature a jeté une lumière vive sur les fondements théoriques du BSC, montrant comment cet outil, initialement forgé dans le secteur privé, s'adapte de manière agile aux spécificités complexes du secteur public marocain. Les résultats de cette recherche démontrent que le BSC n'est pas simplement une solution préfabriquée, mais plutôt un cadre modulable qui peut être ajusté pour répondre aux besoins variés des différentes entités publiques. Le Maroc, en embrassant cette démarche, pave la voie à une gouvernance publique plus agile, transparente et centrée sur les résultats, répondant ainsi aux normes élevées de gestion contemporaine. Cependant, cette transformation continue nécessitera une attention constante et une adaptation continue pour maintenir le momentum vers une performance optimale dans le futur.

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