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A Quantitative Cross-Regional Analysis of the Spanish VET Systems From a Systemic Approach: From a Regional Comparative VET Research Perspective

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Abstract

Purpose: The aim of this paper is to analyse comparatively, at regional level, the current state of a wide range of indicators of Vocational Education and Training (VET) in Spain. This will make it possible to characterise and better understand the existence of a variety of regional VET systems, including the Initial VET and Continuous VET subsystems within Spain, doing so under a multidimensional approach examining VET supply and demand.

Methods: Systemic analysis of Spanish VET indicators leads to a selection of 54 indicators, which are then compared at regional level using *k*-means clustering. This approach identifies similarities and differences (clusters) across all of Spain's 17 autonomous communities (Spanish regions). The correlation between the variables is then analysed to examine the interaction between the VET system's supply and demand dimensions.

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Findings: The results show that 19 indicators explain the main differences between autonomous communities, which form two distinct clusters. Both VET supply and VET environment and demand influence cluster formation and intercluster differences. In the set of indicators that differentiate the two clusters of autonomous communities, close interaction is detected between certain indicators of VET supply and demand, especially those referring to the STEM occupational group, which confirms the correlation between these dimensions, albeit to a limited extent.

Conclusions: While it is necessary to analyse the differences between clusters in greater depth, the results suggest that Spain's regions are split into two distinct groups (clusters) in which the respective VET systems are developing and advancing differently. Moreover, there is evidence of a small number of significant interrelations between indicators of VET supply and demand, which point to both the VET system's specialisation and its inclusive nature.

Keywords: Vocational Education and Training in Spain, VET Systems, VET Cross-Regional and Cluster Analysis, Comparative VET Research

1 Introduction

1.1 Context

Spain's vocational education and training (VET) system is designed institutionally and legislatively at state level. However, its development and implementation take place at regional level and are closely aligned with the local economic, labour market, business and sociocultural environment. Although not a federal state, Spain is a highly decentralised country comprising 17 devolved regions denominated autonomous communities.[1] This political-administrative division is enshrined in the Spanish Constitution of 1978, which guarantees the autonomy of nationalities and regions and which places great political weight, primarily, on the definition, implementation and evaluation of public policy (Subirats, 1992). Spain's regions therefore differ at various levels: Demography and population, economy and labour market, sectors and business, and society and culture. Certain phenomena encountered in Spain, such as rural depopulation, industrial concentration, multiculturalism, etc., highlight the relevance of performing regional analysis. Regions are understood not only on an institutional level as political-administrative units but also, from an evolutionary sociological and economic perspective, as social constructs that provide the context in which the different

[1] Within the framework of the EU's regional classification (NUT), these correspond to second-level regions (NUT2) within the NUTS 2021 classification that lists 104 regions at NUTS 1, 283 regions at NUTS 2 and 1345 regions at NUTS 3 level (Eurostat, 2020).

political, economic, social and cultural dimensions converge to enable the transfer and socialisation of knowledge and innovation (Florida, 1995; Glasmeier, 1999; Hommen & Doloreux, 2004; Landabaso, 1997; Lundvall, 1992; Morgan, 1997; Scott & Storper, 2003).

Spanish VET is made up of two subsystems, Initial VET (IVET) and Continuous VET (CVET), which for decades have operated under different institutions and structures while sharing the same qualifications framework (Chisvert-Tarazona, 2019; Homs, 2008; Rego-Agraso et al., 2017; Sancha & Gutiérrez, 2019). While IVET policies are formulated and implemented at regional level, CVET policies have tended to come under the authority of central government (Tejada-Fernández & Ferrández-Lafuente, 2012). Since 2002, there has been a drive towards integration at institutional level (led primarily by central government), structural level (with a major change in the CVET subsystem) and organisational level (promoting integrated VET schools — created back in 2002 for providing both IVET and CVET), although the global process is still in the early stages given that they account for 5% of the total number of Spanish VET schools (Ministerio de Educación y Formación Profesional, 2019, 2020). Traditionally, Spanish IVET follows the school-based model (Greinert, 2005; Marhuenda-Fluixá, 2019), which in the last 5 years has become increasingly attractive to young people and has seen enrolments rise around 20%. However, this has resulted in greater weight (from the total enrolees) of Basic VET students (characterised by inclusively bridging the transition between compulsory education and VET) and Higher VET students (ISCED 51, characterised by specialisation and which can be accessed via Intermediate VET or the baccalaureate), to the detriment of Intermediate VET (ISCED 3) (Gamboa-Navarro et al., 2021).

In the Spanish context, the comparison between regional VET systems, considering their current state and recent evolution, gives rise to several questions about how an integrated VET system (IVET and CVET systems) is not only an expression of professionalisation; they also indicate the systems' boundaries and interfaces. This paper will be focused on the need for quantification to understand VET from an integrated and systemic approach in order shed light around the boundaries and interfaces between regional VET systems considering context indicators as essential for their differentiation. Therefore, the present study hypothesizes and analyses if regional VET systems in Spain can be grouped based on the idea that there is a significant correlation and interaction with their context which plays an important role in this grouping.

1.2 Main Concepts

Comparative studies of VET are rooted in analyses of national VET systems conducted from a Weberian approach to cross-country comparison (Clarke et al., 2020). The literature shares an underlying vision of differentiation between VET systems, given their specific features

in each country based on their evolution over time and their relationship with the state, the labour market and the productive system (Klaus & Grollmann, 2009; Lauterbach & Mitter, 1998). In this sense, comparative studies of VET have mostly analysed the similarities and differences between VET systems by country from a model and policy transfer approach, doing so not only at political-institutional level (and highlighting Germany's institutional effort to internationalise its VET model), but also at the level of the large corporations that export their proprietary training culture and model and practice benchmarks from their countries of origin to those in which they have operations, thereby influencing the host country's local VET model (Gessler & Peters, 2020; Pilz & Li, 2020). This tradition is extended by the multilateral approach (Kis, 2020) which, taking a neoliberal view of the transition from VET to employment, proposes batteries of indicators that describe these transitions but develop little theory. Another emerging trend in Europe is associated with the challenges and strategies set by the European Commission, which are more thematic in nature and focus on specific issues (e.g. youth unemployment and qualifications, digitisation and skills systems, smart specialisation and VET, etc.), as a result of growing Europe-wide participation in cooperation programmes under the Horizon 2020 and Erasmus+ schemes, among others (Clarke, et al., 2020).

The systemic vision of VET has generally been analysed in terms of the nature of the relationship between VET supply and demand, which has evolved over time. Initially, the relationship between the VET system and its environment was either explained historically from a supply-led perspective (King, 1989) or viewed from a political-institutional standpoint as a result of countries' individual development needs (Green, 2016). Since then, proposals analysing the VET system from a demand-led perspective have gradually gained ground (Gill et al., 1998), emphasising labour market pressures as one of the main drivers of change in VET system transformation processes in the 21st century. In the European context, this trend is mainly reflected in apprenticeship-oriented systems, the embodiment of which is found in Germany, Austria and Switzerland.

The fact that the IVET and CVET systems have been designed, developed and implemented by different stakeholders, interests and institutions within the public policy sphere has usually led to the existence of two distinct subsystems. In this context, CVET analyses have tended to be determined by environmental characteristics as regards economic structure, predominant sectors, size of firms, corporate culture and governance systems (employers' associations, trade unions, etc.), as well as by issues such as immigration, youth unemployment and changes in the labour market (Keating et al., 2002).

In this way, analyses of national VET systems are giving way to other research focusing more on comparison between and within systems and on the diversity of VET from a multidimensional, multiagent and systemic approach. From this perspective, and given the changing nature of the systems, a multidimensional, multilevel analytical approach is required (Clarke

et al., 2020). Within this framework, we believe that analysing the relationship between VET systems and regions from a systemic evolutionary approach opens a window of opportunity to understand their systemic characteristics and possible responses in the context of rapid economic, social and environmental change. Thus, this study is novel since, as far as we are aware, it is the first attempt of a multidimensional comparative analysis at regional level that considers CVET, IVET and the context in which they operate.

At the Spanish level, comparative studies of VET are somewhat limited and have a strong descriptive and qualitative emphasis (Echeverría-Samanes & Martínez-Clares, 2019).[2] Traditionally, this research has usually been carried out from a historical-institutional standpoint and by making comparisons at country level, either with the EU overall, with other countries individually (De Olagüe-Smithson, 2017; Egg & Renold, 2014; Gonzálvez & Marhuenda-Fluixá, 2021; Murua, 2020), or, in a few cases, in the form of a pedagogical and methodological comparison (Gessler & Moreno-Herrera, 2015).

In Spain, the studies that associate the relationship between education and its socioeconomic environment have been carried out primarily in the university environment (Pastor et al., 2019; Pastor & Peraita, 2011) and normally from the perspective of the impact of university activity on the local or regional economy (in terms of attraction of students, mobility, research spending, cultural activities, etc.). In our review we have not detected this type of studies in the field of VET; and in any case, they refer to a more unidirectional relationship of value contribution in terms of the activity; and not so much to the correlation with its environment from the perspective of systemic configuration (economic, social and institutional).

Likewise, the scientific current most in line with this vision is that related to Regional Innovation Studies, which addresses the relevance of VET systems as channels for transferring knowledge and technologies that accelerate regional innovation processes. However, the studies are mainly qualitative in nature (Albizu et al., 2011; Navarro & Retegi, 2018). The results point to the fact that the relationship of VET centres with the environment is very intense, and the VET system is a factor of innovation both in its work of training professionals and in promoting applied innovation in companies close to its environment (Rosenfeld, 1998). Although the VET ecosystem is a newcomer to regional innovation policies, and specifically to smart specialization policies (Foray et al., 2014), there are case studies of leading Spanish regions in innovation that integrate the VET system into their regional smart specialization strategies. However, the deployment of RIS3 agendas differs greatly among Spanish regions, with the Basque Country and Navarre standing out (Hazelkorn & Edwards, 2019; Moso-Diez, 2020; Navarro et al., 2020; Olazaran & Brunet, 2013).

[2] The findings of these studies are compiled in a Knowledge Map of Spanish research into VET, which is being updated to include 2018–2020 and which spans doctoral theses, scientific articles, project reports and research volumes published between 2005 and 2017 in Spain and which meet certain scientific criteria.

2 Methods

2.1 Purpose of the Research

The general aim of this paper is to show the interrelated nature of the VET system with respect to its context or environment, in which the surrounding systems converge: The general education system, the socioeconomic environment, the labour market and the social system. Interaction between the VET system and its environment is driven by territorial proximity, which in this study is demarcated at the level of Spain's autonomous regions. We believe that Spain's VET system needs to be analysed from a socio territorial perspective to facilitate understanding of the interactions within the system and the close relationship between VET indicators and their regional context. In this article, we consider the system to comprise an overarching structure that explains the operation of the VET system and that involves both traditional dimensions alongside other, equally relevant contextual references (Kis, 2020; Papakitsos, 2016). Under this systemic view of VET, we will start by adopting a comprehensive (albeit partial) approach that includes analysis of formal (IVET) and non-formal VET (CVET), but which then excludes informal VET due to data limitations.

On the one hand, this paper analyses the differences between autonomous communities (Spain's politically and administratively devolved regions) based on a panel of indicators (a total of 54) whose systemic nature will support the study of the similarities and differences between Spanish regions. This comparative quantitative analysis makes it possible to characterise VET at regional level, an exercise that is important in understanding it and, consequently, in future policy making intended to improve it. The focus of this paper is to analyse comparatively, at regional level, the current state of a wide range of indicators of VET in Spain. This will make it possible to characterise and better understand the variety of regional VET systems, including the IVET and CVET subsystems within Spain. More specifically, this paper aims to identify if regional VET systems in Spain could be grouped according to their features. Based on previous literature and analysis, we hypothesise that there are different VET systems in Spain with different traits and results.

On the other, it analyses the interactions between the VET system's own indicators and its regional context, which implies that the study of regional VET extends to other convergent systems, making it necessary to limit the scope of analysis. Firstly, from the perspective of level of analysis (macro, meso and micro), the current study is limited to the macro level, leaving the rest for future examination. Secondly, this paper is based on a VET framework (Table 1) that considers its evolving nature from a systemic perspective. At the same time, it includes both VET supply and the social and economic demand derived from its territorial environment (social challenges, labour market and sustainable competitiveness) (Green, 2016; Rees, 1997). This framework makes it possible to analyse the fundamental pillars that

constitute VET systems, combining supply pillars (general education system, IVET, Dual VET and CVET) and demand pillars (structural conditions of the territory, employment and labour market and social inclusion and challenges), which helps identify similarities, differences between systems and interactions between the subpillars within the systems.

Table 1: Structured Framework for Analysing VET Indicators

Approach	Pillar	Indicator types
Skills, qualifications and VET supply	Education and training system	Refer, among others, to the structure of the education system in terms of enrolees and graduates and the level of education of the population, revealing VET's position within that system.
	Initial VET	Characterise VET for young people in terms of enrolees and graduates, level of internationalisation, schools and training supply, teaching staff, transition to university, etc.
	Dual VET	Characterise this form of IVET separately, given its relationship with the business environment. Its indicators measure number of enrolees, schools offering this option and the courses available.
	Continuous VET	Indicators covering the various forms, like VET for Employment for the unemployed, VET for Employment for employees (subsidised and non-subsidised training), as well as the sector providing this type of training.
VET environment and demand	Regional structural conditions	Refer to factors that condition the VET system, such as current and projected demographics, GDP per capita, company size and distribution of the working population by sector.
	Employment and labour market	Refer to VET graduates entry and participation in the labour market and the latter's characteristics based on indicators like distribution of working population by level of education, rates of employment and unemployment among VET graduates, etc.
	Social challenges	Refer to factors like social inclusion of vulnerable groups (e.g. foreign nationals and people with disabilities), reducing early leavers from education and training and encouraging lifelong learning among older workingage adults, etc.

Source: Compiled in-house.

2.2 Hypotheses

The starting hypotheses are as follows:

1. In the Spanish context, regional VET systems differ despite existing in the same state and operating under the same VET regulations and teaching model. At the same time, these systems share common elements that allow us to group them into clusters.

2. As VET systems are supposed to encompass internal and external dimensions, a significant correlation is expected to exist between VET supply indicators and more contextual and demand side indicators (general education, labour market, economy, and society).

2.3 Procedure

The methodology of this study is quantitative. On the one hand, it takes as a reference the fieldwork and results of the study 'Observatory on Vocational Education and Training in Spain' (Gamboa-Navarro et al., 2020), which, built upon its comprehensive pillar-based "supply-demand" framework, analyses the total of secondary data sources on Spanish VET, identifying 365 indicators. In this study, after a detailed analysis of the indicators, 54 indicators have been selected (under criteria of synthesis and relevance) to compare 17 Spanish regions within a 5-year time frame (2015-2019). Different sets of indicators (i.e. Cedefop, 2020) were considered when selecting the definitive group of indicators (shown in Table 2).

The indicators selection followed a simple procedure of expert assessment that comprised 3 stages. First, a group of three different experts on Spanish VET systems separately were asked to analyse each indicator of a list of 365 according to some criteria performing an initial selection of the best set of indicators. A first list was obtained when the three experts or two out three experts selected an indicator. Second, the preliminary set was analysed by the three experts together to confirm or modify the list specially in the case that only two experts agreed about an indicator. Third, a final set of 54 indicator was selected after verifying the fulfilment of the required criteria. The main criteria that guided the process were: (1) Content validity, the indicators should be the more accurate measures of each pillar they intended to measure. The better indicators to describe the functioning of the regional VET systems should be chosen (2) parsimony, in order to get the simplest set of indicators. As many indicators were available for some pillars, the shorter the list of indicators selected was the better. As Gauch (2015) points out, parsimonious models, those than require less data can be extremely efficient than more complicated models to achieve similar accuracy (3) variability, the potential indicators should show a minimum variability for discriminating differences among regions.

Once the list of indicators was identified, the first phase of the data generation and analysis consisted of two steps. Firstly, for the data generation, the secondary sources that contribute these data were identified and selected based on their methodological transparency, time span covered and public accessibility. Sources include the Ministry of Education and Vocational Training, the National Statistics Institute, the State Foundation for In-Work Training, the State Public Employment Service and Eurostat. Secondly, the data from these secondary sources were extracted, compiled and processed according to data consolidation, continuity and regional representativeness criteria.

Table 2: Indicators Used to Analyse and Characterise Regional VET Systems

Approach	Pillar	Indicator
Skills, qualifications and VET supply	Education and training system	1. VET students as a proportion of post-compulsory education (2018–2019) 2. Population aged 25–64 with VET qualifications (2020) 3. Population aged 25–64 participating in education and training (2020)
	Initial VET	4. Students enrolled in VET (2018–2019) 5. VET graduates (2018–2019) 6. Gross VET graduation rate (2018–2019) 7. Basic VET students (2018–2019) 8. Basic VET completion rate (2018–2019) 9. Intermediate VET students (2018–2019) 10. Intermediate VET completion rate (2018–2019) 11. Higher VET students (2018–2019) 12. Higher VET completion rate (2018–2019) 13. Female VET students (2018–2019) 14. Students in industrial occupational groups (2018–2019) 15. Students in STEM occupational groups (2018–2019) 16. VET students on distance-learning programmes (2018–2019) 17. VET students in state schools (2018–2019) 18. Erasmus+ mobility (Basic VET + Intermediate VET) (2017) 19. Erasmus+ mobility (Higher VET) (2017) 20. Exclusive VET schools (2020) 21. Integrated VET schools (2020)
	Dual VET	22. Students enrolled in Dual VET (2018–2019) 23. Female students enrolled in Dual VET (2018–2019) 24. Higher VET students enrolled in Dual VET (2018–2019) 25. Schools providing Dual VET (2018–2019)
	Continuous VET	26. Unemployed coverage ratio (2019) 27. Companies with 10 or more employees (2019) 28. Employees participating privately (2019) 29. Training expenditure per employee (2019) 30. Schools providing Dual VET (2018–2019)
VET environment and demand	Regional structural conditions	31. Population aged 15–19 (2020) 32. Average firm size (2018) 33. GDP per capita 34. Population density
	Employment and labour market	35. Working population with VET qualifications (2020) 36. Employment premium for Basic and Intermediate VET vs lower qualifications (2019) 37. Employment premium for Higher VET vs university degree or similar (up to 4 years) (2020) 38. Working population with VET qualifications on temporary contracts (2020) 39. Employment by 4 sectors (agriculture, industry, construction and services) 40. Job offers for Intermediate VET graduates (2019) 41. Job offers for Higher VET graduates (2019) 42. Social Security affiliation rate among Intermediate VET graduates four years after graduating (2019) 43. Social Security affiliation rate among Higher VET graduates four years after graduating (2019) 44. Balance within working population (2020) 45. Balance within working population with Basic and Intermediate VET qualifications (2020) 46. Balance within working population with Higher VET qualifications (2020) 47. Unemployment rate (2020) 48. Unemployed population with VET qualifications (2020)

	Social challenges	49. Female students enrolled in STEM occupational groups (2018–2019) 50. Population aged 50–64 participating in education and training (2020) 51. Foreign students enrolled in VET (2018–2019) 52. VET students with disabilities and severe disorders (2018–2019) 53. Early leavers from education and training (2020) 54. Population aged 15–24 neither in employment nor in education and training (2020)

Source: Compiled in-house.

In the second phase, focused on the data analysis, a statistical cluster analysis (K-means) was carried out through SPSS to target different groups of regions according to their respective characterisations of VET supply and demand, taking into account the panel of 54 indicators as reference (displayed in Table 2). This analysis reveals two statistically distinct clusters of autonomous communities built from 19 variables. The other 35 variables were discarded because they do not contribute significantly to differentiation between the clusters. The means of these clusters are significantly different in each of the 19 variables, with significance levels exceeding 95% (Table 3). Subsequently, based on observation of the *F* statistic, a hierarchical order is established prioritising those variables that make the greatest contribution to the construction of the two groups and that characterise the inter-cluster differences.

Finally, correlation analysis was performed, applying Pearson's statistic to the 19 variables that define the two clusters. The usefulness of this statistic when working with quantitative interval or ratio variables, i.e. with distinct ordered values, is that it measures the strength of the correlation between one variable and another and its direction (either positive or negative). This allows us to determine the correlations that exist between the indicators of VET supply and demand.

3 Findings

The results of K-means clustering distinguish between two groups of autonomous communities with significantly different means in each of the 19 variables, with significance levels exceeding 95% (Table 3). Cluster 1 groups together 9 regions: Andalusia, Asturias, Balearic Islands, Canary Islands, Castile-La Mancha, Valencian Community, Extremadura, Galicia and Murcia. Cluster 2 groups together 8 autonomous communities: Aragon, Cantabria, Castile and Leon, Catalonia, Madrid, Navarre, Basque Country and Rioja.

Based on observation of the *F* statistic (Table 3), it is possible to validate and rank the list of variables, placing at the top those that contribute most to construction of the two clusters. The six variables that make the greatest contribution include GDP per capita, unemployment rate among both the general population and VET graduates, Social Security affiliation among both intermediate and higher VET graduates (taken as an employment rate indicator), and number of students enrolled in VET at stateowned training centres.

Table 3: Mean and Standard Deviation of the Variables by Cluster, and F-test of Independent Samples for Mean Equivalence (Equal Variances not Assumed)

	Sample		Cluster 1		Cluster 2			
Variable	Mean	SD	Mean	SD	Mean	SD	*F*	Signif. (2-tailed)
GDP per capita	25278	5016	21831	2681	29155	4105	19,429	,001**
Unemployment rate among population aged 16–64	13,4	4,3	16,3	3,9	10,2	1,1	18,476	,001**
Unemployment rate among VET graduates aged 16–64	12,2	4,1	15	3,8	9,1	1,2	17,169	,001**
Social Security affiliation rate among Higher VET graduates	69,4	4,4	66,6	3	72,6	3,5	14,429	,002**
Social Security affiliation rate among Intermediate VET graduates	69,6	3,3	67,5	2,6	72	2,3	14,355	,002**
Students enrolled in VET in state-owned schools	75,4	10	81,8	6,9	68,3	8,1	13,632	,003**
Training expenditure per employee across all businesses	65,4	21,6	52,3	11	80,2	21,5	11,796	,008**
% population aged 50–64 participating in learning activities	5,9	1,1	5,2	0,8	6,7	1	11,16	,005**
Population aged 15–24 neither in employment nor in education and training	11,3	2,9	13	2,6	9,4	1,9	10,614	,005**
Erasmus+ mobility (Basic VET + Intermediate VET)	54,9	15,3	63,8	12,6	45	11,9	10,016	,006**
Erasmus+ mobility (Higher VET)	45,1	15,3	36,2	12,6	55	11,9	10,016	,006**
% foreign students enrolled in VET	7,9	3,3	6	3,1	9,9	2,1	9,171	,008**
% women enrolled in Dual VET	33,8	13,6	41,5	10,8	25,3	11,4	9,028	,009**
Mean size of companies with employees	8,5	1,4	7,7	0,9	9,4	1,4	8,747	,014*
Working population aged 16–64, by sector of industry	15,4	6	12,2	4,7	19	5,3	7,864	,015**
% students enrolled, by STEM occupational group	37,1	6	33,9	4,9	40,6	5,3	7,361	,017*
% early leavers from education and training	14,8	4,6	17,1	4,2	12,3	3,7	6,113	,025*
% population aged 25–64 with VET qualifications	22,3	3,9	20,4	2,7	24,4	4,2	5,655	,040*
% Higher VET students enrolled in Dual VET	69,4	16,2	62,3	17	77,5	11,4	4,544	,047*
** $p < 0,01$ * $p < 0,05$								

Source: Compiled in-house.

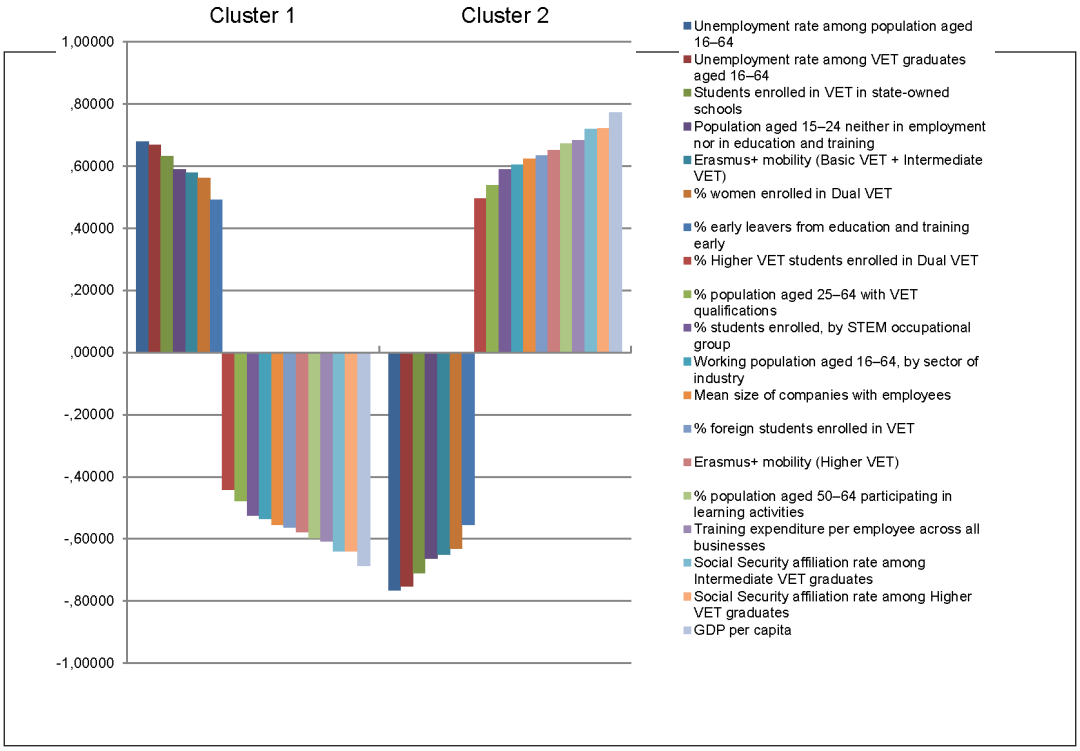
Table 4 shows the distances between each variable and the centroid of each cluster. This is a standardised score (Z) with a value of between 1 and -1. It is the result of iteratively reassigning cases to the respective clusters until the convergence criterion is met.

Table 4: Standardised Score for the Centres of the Final Clusters

Indicators	Cluster 1	Cluster 2
Unemployment rate among population aged 16–64	,67951	-,76445
Unemployment rate among VET graduates aged 16–64	,66821	-,75173
Students enrolled in VET in state-owned schools	,63112	-,71001
Population aged 15–24 neither in employment nor in education and training	,58878	-,66238
Erasmus+ mobility (Basic VET + Intermediate VET)	,57877	-,65111
% women enrolled in Dual VET	,56065	-,63073
% early leavers from education and training early	,49217	-,55370
% higher VET students enrolled in Dual VET	-,44105	,49618
% population aged 25–64 with VET qualifications	-,47860	,53843
% students enrolled, by STEM occupational group	-,52479	,59039
Working population aged 16–64, by sector of industry	-,53643	,60348
Mean size of companies with employees	-,55511	,62450
% foreign students enrolled in VET	-,56340	,63383
Erasmus+ mobility (Higher VET)	-,57877	,65111
% population aged 50–64 participating in learning activities	-,59741	,67208
Training expenditure per employee across all businesses	-,60686	,68272
Social Security affiliation rate among Intermediate VET graduates	-,63961	,71956
Social Security affiliation rate among Higher VET graduates	-,64046	,72051
GDP per capita	-,68710	,77299

Source: Compiled in-house.

The results shown in Table 4 confirm the significant differences between Clusters 1 and 2 in the means of the 19 variables. It reveals that whenever a variable has a positive score in Cluster 1 it will have a negative one in Cluster 2, and vice versa. It can also be appreciated in Figure 1.



Source: Compiled in-house.

Figure 1: Standardised Score for the Centres of the Final Clusters

Moreover, the results indicate that inter-cluster differences occur in both supply and demand indicators within the VET framework, although they are more accentuated in the latter (as regards both structural and labour market conditions and social challenges). As regards the VET supply, the differences with the IVET indicators stand out, fundamentally with regard to characterisation of students by level of education (in both Dual VET and Erasmus+ mobilities) as well as with regard to ownership of the school, the proportion of STEM students and gender differences in Dual VET. The autonomous communities grouped in Cluster 1 are characterised by having higher percentages of VET students at state-owned schools and of women enrolled in Dual VET. International mobility is likewise higher in Basic and Intermediate VET in Cluster 1 than in Cluster 2. In the employment sphere, unemployment rates are higher in Cluster 1, where early leavers from education and training and the mean number of young people neither in employment nor in education and training (NEET) exceeds the percentage in Cluster 2 (Table 5).

Table 5: Structured Framework for Analysing VET and the Level Shown of Every Indicator in Each Cluster

Approach	Pillar	Indicators	C1	C2
Skills, qualifications and VET supply	Education system	% population aged 25–64 with VET qualifications	-	+
	Initial VET	Students enrolled in VET in state-owned schools	+	-
		Erasmus+ mobility (Basic VET + Intermediate VET)	+	-
		Erasmus+ mobility (Higher VET)	-	+
		% students enrolled, by STEM occupational group	-	+
	Dual VET	% women enrolled in Dual VET	+	-
		% Higher VET students enrolled in Dual VET	-	+
	Continuous VET	Training expenditure per employee across all businesses	-	+
VET environment and demand	Regional structural constraints	GDP per capita	-	+
		Mean size of companies with employees	-	+
		Working population aged 16–64, by sector of industry	-	+
	Employment and labour market	Unemployment rate among population aged 16–64	+	-
		Unemployment rate among VET graduates aged 16–64	+	-
		Social Security affiliation rate among Higher VET graduates	-	+
		Social Security affiliation rate among Intermediate VET graduates	-	+
	Social challenges	Population aged 15–24 neither in employment nor in education and training (NEET)	+	-
		% early leavers from education and training	+	-
		% population aged 50–64 participating in learning activities	-	+
		% foreign students enrolled in VET	-	+

Source: Compiled in-house. (-) Low level (+) High level. (C1 = cluster 1, C2 = cluster 2)

Meanwhile, characterisation of the autonomous communities in Cluster 2 shows higher proportions of students enrolled in STEM and industrial occupational groups, as well as in Higher Dual VET. The Lifelong Learning indicator is also higher than in Cluster 2. As regards the variables referring to the labour market, Cluster 2 exhibits high levels of Social Security affiliation among VET graduates and a higher percentage of the working population employed in the industrial sector. Mean size of companies is bigger and the amount of money those firms spend on VET for Employment per worker is higher. Finally, the regions in this cluster have a higher GDP per capita than those in the first one.

Summarizing, we observe that the territories grouped in Cluster 2 present a better balance for the development of VET than Cluster 1. In the case of Cluster 2, its greater training offer at different educational levels, its lower rates of early leavers from education and training, the development of an apparently more industrial business fabric that requires STEM

profiles, its lower unemployment and higher transition of VET graduates from education to the work, suggest that these territories are better positioned to push VET and Dual VET towards new horizons. However, characteristics of Cluster 2 also suggest that VET system traits and outcomes could be also contributing to their better performance in socioeconomic indicators.

In this sense, regions in Cluster 1 are also able to achieve the indicators of Cluster 2. However, they should work in parallel on additional fronts to reduce the gaps in early abandonment, the NEET rate and improving the transition to the labour market of their population by improving training with VET qualifications and the amount of the population (all ages) participating in learning activities. These actions could also contribute to a better performance of socioeconomic indicators of regions in Cluster 2 in the long run.

The next step in the analysis is to ascertain the relationship between the 19 variables that determine the differences between the clusters we have just described. This analysis will allow us to identify the variables associated with the VET context that are closely related to VET educational variables. Table 6 presents the correlation of all the variables, following the same order as in the VET system outline presented previously. As a first finding, we ascertained that 16 of the 19 variables are correlated.

Table 6: Pearson Correlation of the Variables That Determine Differentiation Between VET System Clusters in Spain's Regions

Correlations	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Population aged 25–64 with VET qualifications (%)																		
2. Students enrolled in VET in state-owned schools	-,294																	
3. Erasmus+ mobility (Basic VET + Intermediate VET)	-,467	,340																
4. Erasmus+ mobility (Higher VET)	,467	-,340	-1,000**															
5. Students enrolled, by STEM occupational group (%)	,761**	-,468	-,331	,331														
6. Females enrolled in Dual VET (%)	-,454	,288	,555*	-,555*	-,606**													
7. Higher VET students enrolled in Dual VET (%)	,427	-,053	-,390	,390	,373	-,369												
8. Training expenditure per employee across all businesses	,358	-,858**	-,226	,226	,552*	-,152	,051											
9. GDP per capita	,349	-,727**	-,204	,204	,484*	-,318	,231	,806**										
10. Mean size of companies with employees	,205	-,710**	-,282	,282	,258	-,011	,029	,787**	,849**									
11. Working population aged 16–64, by sector of industry	,655**	-,289	-,313	,313	,724**	-,665**	,292	,317	,359	,130								
12. Unemployment rate among population aged 16–64	-,641**	,539*	,377	-,377	-,625**	,635**	-,249	-,590*	-,794**	-,590*	-,655**							
13. Unemployment rate among VET graduates aged 16–64	-,669**	,513*	,410	-,410	-,590*	,601*	-,198	-,559*	-,760**	-,578*	-,633**	,982**						
14. Social Security affiliation rate among Higher VET graduates	,527*	-,445	-,358	,358	,518*	-,475	,367	,487*	,811**	,602*	,626**	-,801**	-,785**					
15. Social Security affiliation rate among Intermediate VET graduates	,361	-,334	-,442	,442	,505*	-,736**	,320	,334	,603*	,297	,444	-,680**	-,670**	,640**				
16. Population aged 15–24 neither in employment nor in education and training (NEET)	-,743**	,493*	,358	-,358	-,846**	,683**	-,272	-,568*	-,621**	-,421	-,679**	,863**	,812**	-,584*	-,625**			
17. % Early leavers from education and training (%)	-,767**	,435	,400	-,400	-,779**	,301	-,367	-,674**	-,544*	-,506*	-,457	,628**	,582*	-,493*	-,333	,792**		
18. Population aged 50–64 participating in learning activities (%)	,404	-,669**	-,316	,316	,449	-,351	,280	,611**	,771**	,672**	,414	-,679**	-,633**	,696**	,288	-,569*	-,482	
19. Foreign students enrolled in VET (%)	,176	-,572*	-,437	,437	,216	-,468	,093	,416	,631**	,570*	,456	-,684**	-,657**	,730**	,573*	-,411	-,187	,554*

*Note.** The correlation is significant at level 0.01 (2-tailed). * The correlation is significant at level 0.05 (2-tailed).*
Source: Compiled in-house.

In order to focus the analysis of the relationship between VET supply and demand dimensions, the emphasis will be placed on the correlations between the two dimensions' variables (pillars and subpillars), excluding correlations within the same dimension. Analysis is grouped by the blocks in each dimension presented above. The results show a significant correlation between the VET supply system and its demand environment; in fact, all context-related variables show significant correlations with VET supply variables.

First, it is noteworthy that the 'percentage of students enrolled in STEM occupational groups' variable correlates strongly with almost every dimension of VET demand. In this sense, it correlates significantly with aspects of the environment (structural dimension) like 'GDP per capita' ($r = 0.484$, $p \leq 0.05$) and 'Working population aged 16–64, by sector of industry ($r = 0.724$, $p \leq 0.01$). In turn, on the employment dimension the percentage of students enrolled in STEM occupational groups is negatively related to 'Unemployment rate among population aged 16–64' ($r = -0.625$, $p \leq 0.01$) and 'Unemployment rate among VET graduates aged 16–64' ($r = -0.590$, $p \leq 0.05$) and is positively related to 'Social Security affiliation rate among Higher VET graduates' ($r = 0.518$, $p \leq 0.05$) and 'Social Security affiliation rate among Intermediate VET graduates' ($r = 0.505$, $p \leq 0.05$). Finally, on the social dimension we observe that the percentage of students enrolled in STEM occupational groups is inversely related to 'Population aged 15–24 neither in employment nor in education and training (NEET)' ($r = -0.846$, $p \leq 0.01$) and 'Early leavers from education and training' ($r = -0.779$, $p \leq 0.01$).

Second, we have focused attention on the variable '% of foreign students enrolled in VET' which, although originally included as one of the social challenges (demand), should rather be included as part of the IVET system since it alludes to student enrolment, i.e. to the IVET supply system. We found a close relationship with all dimensions, highlighting as regards the structural and employment dimension the following direct or positive correlations: 'GDP per capita' ($r = 0.631$, $p \leq 0.01$), 'Mean size of companies with employees' ($r = 0.570$, $p \leq 0.05$), 'Social Security affiliation rate among Higher VET graduates' ($r = 0.730$, $p \leq 0.01$) and 'Social Security affiliation rate among Intermediate VET graduates' ($r = 0.573$, $p \leq 0.05$). Conversely, the variable' % foreign students enrolled in VET' correlated negatively with unemployment rates: 'Unemployment rate among population aged 16–64' ($r = -0.684$, $p \leq 0.01$) and 'Unemployment rate among VET graduates aged 16–64' ($r = 0.657$, $p \leq 0.01$).

Third, we note that the variable 'Students enrolled in VET in state-owned schools' relates nega-tively to the structural dimension ('GDP per capita' ($r = -0.727$, $p \leq 0.01$) and 'Mean size of companies with employees' ($r = -0.710$, $p \leq 0.01$)) while relating significantly and positively to the employment dimension ('Unemployment rate among population aged 16–64' ($r = 0.539$, $p \leq 0.05$) and 'Unemployment rate among VET graduates aged 16–64' ($r = 0.513$, $p \leq 0.05$)) and the social dimension (posatively related to 'Population aged 15–24 neither in

employment nor in education and training (NEET)' (r = 0.493, $p \leq 0.05$) and negatively to '% population aged 50–64 participating in learning activities' (r = -0.669, $p \leq 0.05$)).

Fourth, in the field of CVET, a variable that has a close relationship with the VET demand environment — 'Training expenditure per employee across all businesse' — stands out par-ticularly. It is directly related to the structural dimension ('GDP per capita' (r = 0.806, $p \leq 0.01$) and 'Mean size of companies with employees' (r = 0.787, $p \leq 0.01$)). As regards the employment dimension, 'Training expenditure per employee across all businesses' correlates positively with 'Social Security affiliation rate among Higher VET graduates' (r = 0.487, $p \leq 0.05$) and inversely with 'Unemployment rate among population aged 16–64' (r = -0,590, $p \leq 0.05$) and 'Unemployment rate among VET graduates aged 16–64' (r = -0.559, $p \leq 0.05$). Finally, it relates positively to the social dimension, specifically to '% population aged 50–64 participating in learning activities' (r = 0.611, $p \leq 0.01$).

4 Discussion

Firstly, it can be understood that the clusters of autonomous communities differ according to the indicators that, by adopting a systemic approach that encompasses both the skills, qualifications and VET supply and the VET environment and demand, capture their lifelong learning scores (including IVET and CVET). Cross-regional analysis reveals the existence of two distinct clusters on all the dimensions of the indicators assessed (pillars and subpillars) and demonstrates that the two clusters exhibit highly differentiated quantitative scores in terms of the key indicators of their position on the supply and demand continuum, supporting Hypothesis 1. These results are aligned with studies related to knowledge and territory, which integrates specific dimensions of a demographic, economic, labour and cultural context that need to be addressed when studying the institutionalization of knowledge, in this case, of regional VET systems (Lundvall, 1992; Scott & Storper, 2003).

Secondly, it should be noted that the differences identified, and which affect 35% of the indicators analysed, are significant and influence the systemic functioning of the two clusters identified at regional level. Among all these indicators, differences are observed in two respects; firstly, in the macro dimension that distinguishes between VET supply and VET demand (pillars); and secondly, within each dimension (subpillars). On the one hand, the results show that the indicators related to demand for VET and its environment are the ones that make the most difference, although within this area there is a certain balance between the structural, labour market and social challenge indicators. On the other hand, in the sphere of the education and training supply, the differences lie mainly in two pillars that relate to the Initial VET system (both dual and non-dual), with few differences in VET for Employment and the rest of the education system. Therefore, we can conclude that, in general terms, the indicators that show greatest differentiation between autonomous communities are those

relating to the VET environment and demand for it, followed by those relating to the VET system. This differentiation of clusters by context or environment at the regional level follows the same path as the literature that differentiates VET by country based on their evolution over time and their relationship with the state, the labour market and the productive system (Klaus & Grollmann, 2009; Lauterbach & Mitter, 1998), varying the territorial scale and the political-institutional level. In this sense, the region could become a unit of analysis of VET, achieving greater concreteness and specificity on regional development in terms of VET, while taking into account the intensive deployment of VET schools at the local and regional level (Gamboa-Navarro et al., 2020; 2021).

Thirdly, the inter-cluster differences suggest that Spain's regions are split into two groups that are developing and advancing their respective VET systems at different paths. This is a consequence of the regions' territorial and structural idiosyncrasies, making an understanding of this situation essential to future policy making at national and regional levels. The distribution of autonomous communities at unit level shows that in almost half of them (Cluster 1), the VET environment scores lower on the economic and labour indicators, VET is most frequently provided in state-owned schools and has a higher proportion of Basic and Intermediate VET and a lower proportion of graduates in STEM occupational groups. In contrast, the labour market in Cluster 2 is characterised by higher levels of education and training, greater emphasis on industry and greater employment opportunities. Moreover, differentiation is even greater in Higher VET. All the above depicts a complex reality in which the VET supply is strongly conditioned by the structural and labour market constraints present in the local environment. The implications of that show the importance of adopting a comprehensive and systemic outlook when defining regional VET policies, programmes and initiatives in Spain. It may be concluded that regional and local factors make a significant and relevant difference in Spanish VET. The resulting regional difference is aligned with Spanish studies on the socioeconomic contribution of Spanish universities, which although its scope and geographical atomization is different from that of VET, contrasts influence of the university system on its environment showing impacts on the endowments of available resources, such as employment, human or technological capital, and the indirect impacts derived from this increase in the supply of productive factors on aspects such as economic growth, income or tax revenue (Pastor et al., 2019; Pastor & Peraita, 2011).

Fourthly, the results show a significant correlation between the VET supply system and its demand environment. This close relationship affects a low number of variables, among which the one that stands out most is 'Percentage of students enrolled in STEM occupational groups', which is strongly and directly correlated with almost all the dimensions of VET demand. Therefore, predominantly scientific-technological VET is strongly and directly correlated with its regional context, establishing a virtuous relationship between STEM students and the economic and labour market environment. Other indicators that follow the lead of

the one above alludes to the percentage of foreign students, which although included as one of the social challenges, and originally part of the IVET system in terms of enrolment, has a close relationship with almost every dimension. This shows that the proportion of foreign students in VET is positively related to GDP per capita, the size of companies and higher employment rates among Higher VET graduates and is negatively related to unemployment rates both overall and among VET graduates. This correlation is relevant from the perspective of social inclusion and integration of foreign communities, and if this line of research were to be pursued in greater depth progress could be made in developing levers to support social sustainability. Another IVET system variable that correlates strongly with the environment is 'Students enrolled in VET in state schools', which does so inversely with the structural, labour market and social dimensions, thereby indicating the inclusive nature of the education system in state VET schools in regions where economic indicators are lower. Finally, the only variable in the CVET subpillar that relates to the environment is 'Training expenditure per employee across all businesses', which is significantly and positively related to structural conditions (GDP per capita and company size) and labour market dynamics in terms of lower unemployment rates. Correlation analysis therefore demonstrates that there is a strong correlation between VET supply and demand in areas related to students' scientific-technological specialisation, as well as in areas related to students' origins, the nature of VET schools and company expenditure on employee training, thereby supporting hypothesis 2. These results are aligned with case studies on Spanish regional VET systems (Albizu et al., 2011; Navarro & Retegi, 2018; Olazaran & Brunet, 2013), which posit the sophistication of the systems as a function of the socioeconomic fabric, while feeding back into institutionalized systems of knowledge generation and socialization.

To sum up, both hypotheses are validated by identifying differences and similarities between the regional VET systems (first hypothesis) while identifying intense significant correlations that interrelate the VET environment and demand for it with the VET system, especially VET in the educational sphere (second hypothesis).

Finally, although we did not perform an analysis to test a causal relationship be-tween VET provision and economic development or the other way around, we could guess a bi-directional relationship meaning a mutual influence between VET provision and economic development. Therefore, we could hypothesize, based on our results, on the previous and partial empirical evidence and on specific regional cases in the Spanish context, that higher and better VET provision could contribute to a better socioeconomic performance and, at the same time, a better socioeconomic performance, especially in terms of economic and business performance and a higher enterprise size, could contribute to a better VET provision in terms of a stronger dual VET and a better integration of VET graduates in the labour market because stronger economies could imply a higher demand for them in the market. However, future studies should test these new hypotheses at regional level.

5 Conclusions

Firstly, there are similarities and differences between Spain's regional VET systems, meaning they cannot be considered identical despite sharing the same political, regulatory and institutional framework. Not only are there differences within the VET supply system, but also in terms of structural, labour market and social demand. This has implications for the understanding of Spain's VET system at conceptual, empirical and social level. In this sense, it also affects the design, implementation and evaluation of public VET policy, both in the vertical policy domains (VET education policy, training for employment policy) and the horizontal policy domains, which span competitiveness, lifelong learning, social inclusion, etc., and are framed within other public policy (social, economic, industrial, research and innovation, etc.).

Secondly, on the VET supply side the differences between clusters are particularly concentrated in IVET (including Dual VET), while on the demand side there is a wider spread across the structural, labour market and social dimensions. In part, this is explained by the distribution of powers over VET itself, since the transfer of authority from the state to regional governments has so far been greater in IVET than in CVET. From this, it can be inferred that most room for manoeuvre in defining IVET policies and instruments in Spain is likely to stem from the differentiation that exists between the regions.

Thirdly, the relationship between the VET supply system and its demand environment is determined by a low number of indicators, meaning that while its systemic and multidimensional nature is evident, the scope is narrow. On the one hand, it reflects the VET system's significant interrelationships with the general educational, labour market, economic and social dimensions. On the other, however, it seems premature to definitively characterise the nature, scope or even existence of an intraregional VET typology. Although it can be postulated from a historical and sociological perspective, the data in this study are insufficient to support it. In this sense, it is necessary to highlight the need for more research to deepen understanding of both differentiation between regions and the interrelationship between the VET supply and demand dimensions. This is achieved by changing from a correlational analysis to one of a more predictive nature that determines with greater clarity whether the environment's variables predict those of the IVET system or vice versa. This option is not, however, feasible, given the low number of observations available (maximum 17).

Fourthly, we can conclude that, as a result of this study, comparative research into VET is a scientific field that offers opportunities to analyse VET systems from a systemic regional perspective (multidimensional and intra/inter-territorial). In this context, regionality acquires differentiating value — providing specificity and contextualization — due to its direct connection with the individual details of the economic, social and cultural setting in which each VET system is embedded. This regional approach does not surpass analyses of national

VET systems, but rather offers a complementary view of VET that accentuates the relevance of local context.

Finally, the need is shown for more integrated indicators, accessibility to microdata at regional level and better characterisation of the training systems. Moreover, it is important to emphasise the need for further analysis in the future, given the topic's novelty at both regional level and in Spanish society at large.

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