The importance of teaching practices in relation to regional educational policies in explaining PISA achievement

Importancia de la actuación docente frente a la política educativa regional en la explicación del rendimiento en PISA

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Abstract

Among the variables that explain schools and students' performances as measured in PISA stand out those that provide information about the social, economic and cultural context. These factors are non-malleable and are not within the educational agents' reach. So that, once the effect of the socio-economic context on assessment was controlled, we focused the study on the role that variables related to regional educational policy, to schools' institutional culture and to the teaching practices play in schools performance in PISA. For this purpose we carried out a secondary analysis with data from 976 secondary schools distributed throughout the 17 regions of Spain participating in the PISA-2015 assessment cycle, and also with data about public/private enrolment, educational spending and available resources of the regional systems. We have built successive multilevel regression models -through a hierarchical linear analysis- in order to know the role of schools and educational policy of all the Spanish regions in the explanation of schools' scientific competence. The findings focused on educational policy variables show that the student-teacher ratio and the quantity of computers per classroom do matter regarding achievement. About the influence on the performance of schools' variables, we found that the school climate and the teaching practices have significant effects on outcomes. Students' disruptive behaviour and teachers' disrespectful interaction with pupils are both variables related to a lower level of competence. Nevertheless, efficacy in the

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classroom management, a direct teaching approach and the adaptation of the teaching activities to students' needs are variables related to a higher level of competence. Students' support and feedback exists when a low-level of scientific competence is found. Finally, some proposals have emerged from these findings in order to do better in schools and to redirect educational policy.

Keywords: secondary education, achievement, educational policy, schools, teaching practices.

Resumen

Entre los factores que explican el rendimiento en PISA, destaca el papel de las variables que informan sobre el contexto social, económico y cultural. Este tipo de variables no son directamente moldeables, y escapan a las posibilidades de intervención de los agentes educativos. Controlado el efecto del contexto socioeconómico, en este trabajo consideramos variables relativas a las políticas educativas regionales, la cultura institucional de los centros y el desempeño docente, con el fin de analizar su relación con los resultados obtenidos en PISA. Para ello, llevamos a cabo un análisis secundario a partir de datos correspondientes a 976 centros educativos de las 17 regiones españolas participantes en PISA-2015, junto con datos relativos a escolarización, financiación y recursos disponibles a nivel autonómico. Mediante análisis lineal jerárquico, construimos sucesivos modelos de regresión multinivel para valorar el papel de los centros y las políticas regionales en la explicación de la competencia científica alcanzada en los centros. Los resultados obtenidos, en lo que respecta a las políticas educativas, destacan el efecto positivo de la ratio alumnos-profesor y el negativo del número de ordenadores por aula, medidos a nivel regional. En cuanto al papel de los centros, se han encontrado efectos significativos para el clima escolar y la actuación del profesorado. En particular, las conductas negativas del alumnado y el trato irrespetuoso al alumno se vinculan a menores niveles de competencia. En cambio, un buen control de la clase, el ejercicio de una enseñanza dirigida por el profesor o la adaptación de la enseñanza a las necesidades del alumnado se asocian a una mayor competencia. Se registran niveles bajos de competencia científica cuando están presentes la retroalimentación y el apoyo al alumno. A partir de estos hallazgos se formulan propuestas orientadas a la intervención en los centros y a la revisión de las políticas educativas.

Palabras clave: educación secundaria, rendimiento, política educativa, centros educativos, actuaciones docentes.

Introducción

During the last decades international performance evaluations have been carried out on a large scale with the participation of a growing number of countries. In particular, the publishing of three-year reports corresponding to the PISA report, which has now had six editions, has generated numerous scientific articles at a national and international level (Luzón and Torres, 2013). The relation between the results of these evaluations and specific characteristics of educational systems has been analysed in both the pedagogical and the economic fields (Cordero, Crespo and Pedraja, 2013; González, Caso, Díaz and López, 2012; Nieto and Recamán, 2012), and there have been reflections on its implications in the area of educational policies (Ferrer, 2012; Pedró, 2012). The data of the successive editions of PISA have enabled comparative studies to be done which have contributed an evolutionary view of students' achievements and of the educational systems themselves (Carabaña, 2008; De-Jorge, 2016; Lenkeit and Caro, 2014). Moreover, in some countries studies have been carried out which investigate the inter-regional differences, trying to explain those differences observed from the regions' own features. In the case of Italy, Bratti, Checchi and Filippin (2007) found that the main inter-regional differences lie in their resources and in the characteristics of the labour markets. On the other hand, when analysing the differences between Portuguese regions, Coutinho and Reis (2012) found a limited role for the purely regional factors, conceding a greater relevance to the individual, family and school characteristics.

Spain has had disaggregated data at a regional level in various editions. Works have been done from them to explain the differences in the performance of Spanish students, analysing aspects of each region's own educational policies (Foces, 2015; García and Robles, 2013; Gil, 2014). In PISA 2015 we had results for the first time for all the Spanish autonomous regions. In general terms, the studies carried out have a positive correlation between the students' achievements and the variables which reflect the social and economic development of the different countries or regions, such as, for example, the socio-economic and cultural level, the GDP per capita, the unemployment rate and the poverty risk rate (Ferrer, Valiente and Castel, 2010; Mancebón and Pérez, 2010). Measured by each student or aggregated at the level of centres or regions, the socio-economic and cultural status (ESCS) constructed in PISA is the variable

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which best explains the differences of performance (Calero and Escardíbul, 2007; Elosua, 2013). Given the nature of this kind of variables, the educational agents lack a margin of action concerning them. For this reason, our interest is centred on analysing the role of regional educational policies and of school institutions in explaining the differences of achievement, areas where intervention is possible, with the aim of achieving improvements in students' learning.

In relation with educational policies, the scientific literature reflects the role of specific variables in explaining achievement, such as for example: educational expenditure (Calero and Escardíbul, 2014), scholarisation in state or private centres (Duncan and Sandy, 2007), resources available in the centres (De-Jorge, 2016), or the quantity and use of computer resources (Spiezia, 2010). In general, it is assumed that greater financing is translated into more possibilities of access to scholarisation and more personal and/or material resources. There is thus a link between academic achievement and the investments which are carried out in the educational system. Calero and Escardíbul (2014) analysed the effects of educational expenditure and found that this relation is weakened from certain levels of expenditure. As to the public financing of privately-owned centres, those countries which economically support private centres tend to achieve better learning results (OECD, 2012). Nevertheless, the differences of achievement in PISA in favour of private centres have been attributed to the effect of unequal socio-economic levels (Calero and Escardíbul, 2007; Ferrer et al., 2010). Closely related with financing, the connection between the availability of material resources and educational performance has been explored, finding a positive relation (Haegeland, Raaum and Salvanes, 2012; Murillo and Román, 2011). Regarding ICT resources, the positive effect of the use of computers on educational performance has not been clearly demonstrated (Claro, 2010; Mediavilla and Escardíbul, 2015). The effects on learning for variables such as the size of the classes and the student-teacher ratio have also been explored. Blatchford, Bassett and Brown (2011) conclude that smaller groups facilitate learning for all the students. However, at the educational systems level, Van Damme, Liu, Vanhee and Pustjens (2010) noted that the modification of the size of the classes hardly explains the changes observed in the average marks obtained within a country in successive editions of large scale evaluations.

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Regarding the role of the centres in explaining the students' achievement, research has centred on different aspects of institutional culture. This can facilitate or hinder innovation and improvement processes, impacting on the efficiency of the teaching-learning processes in classrooms. A key element of school culture and organisation are the management teams, whose pedagogical leadership must influence the actions of the teachers for motivation, implication and the students' academic achievements (Day, Gu and Sammons, 2016; Hallinger and Heck, 2010; Murillo and Hernández-Castilla, 2015). This leadership is also reflected in the concern for quality. In this vein, evaluating practices at the heart of educational institutions are evidence of the interest in improving academic results and involve both the management and the teaching teams (Bolívar, 2006). Another variable with a clear and recognised influence on achievement is the involvement of the families. In general, it is sustained that their participation has positive effects on academic achievements (Collet-Sabé, Besalú, Feu and Tort, 2014).

Along with institutional culture, teaching action in the classrooms must be considered. The performance of the teachers plays a relevant role in explaining the students' learning (Clavel, Crespo and Méndez, 2016; Freiberg, 2013; Stronge, Ward and Grant, 2011). The by now classic works of authors such as Doyle (1980) placed an emphasis on the teachers and their management of the teaching-learning processes in classrooms, highlighting the importance of establishing an appropriate order, climate and atmosphere in classrooms. Gaskins, Herres and Kobak (2012) and Krüger, Formichella and Lecuona (2015) uphold that the sole variable at the school level with a significant influence on achievement is the classroom climate. There has also been an exploration of the effects on learning of inclusive educational practices or innovative methodologies. According to Bietenbeck (2014), the approaches of more active teaching have more positive effects than traditional ones, highlighting the value of following up the students' tasks. Both the follow-up and the feedback have positive consequences for achievement (Harks, Rakoczy, Hattie, Besser and Klieme, 2014). Especially relevant are the personal relation and the emotional aspects (López-González and Oriol, 2016; Reyes, Brackett, Rivers, White and Salovey, 2012), the role of the social and emotional competence of the teachers being crucial to regulate the relations with the students and favour their achievement (Jennings and Greenberg, 2009; Kunter, Klusmann, Baumert, Richter, Voss and Hachfeld, 2013).

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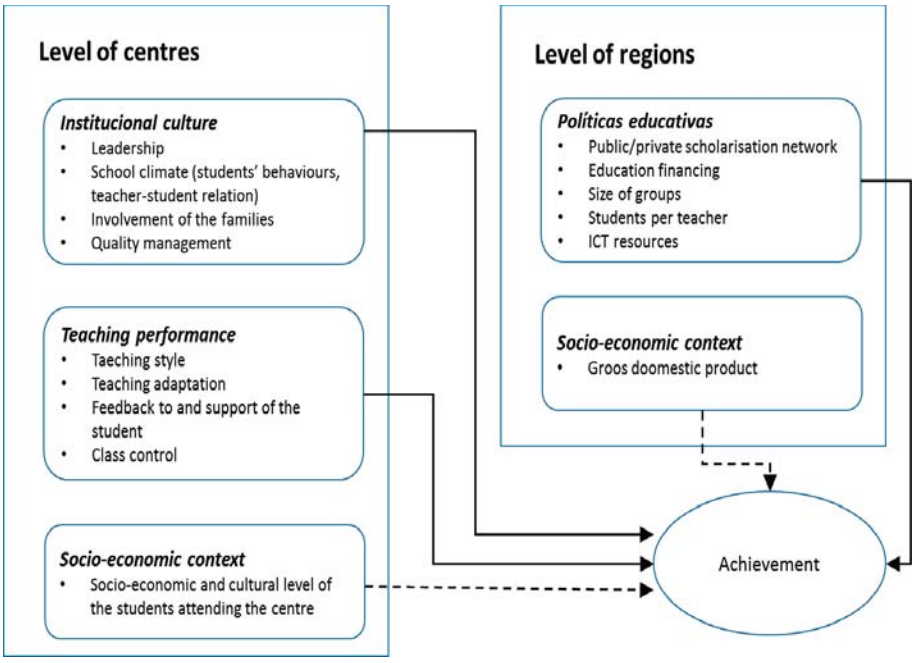
In the light of the aforementioned, the conceptual framework worked out for this study considers that achievement can be explained by the socio-economic and cultural context and also by the characteristics of educational policies, by the institutional culture of the centres and the teaching performance (see Graph I). Given the difficulties to intervene concerning the variables related to the socio-economic and cultural context, the explanatory models of achievement which value the efficacy of the educational systems or of the schools tend to control them (Chudgar and Luschei, 2009). The broken lines in Graph 1 denote the control of the socio-economic variables, specifically the socio-economic and cultural index measured in PISA, and the regional gross domestic product (GDP) per capita. The solid lines represent the relations which are the aim of this study, linked to the performance variables in each of the sections considered. These variables come from the PISA database and from other statistical sources consulted.

GRAPH I. Conceptual framework of the research.



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Setting out from this conceptual framework, the aim is to know the role which educational policies and school centres play in explaining achievement. The identification of factors which explicate the achievement differences observed is the basis upon which to found recommendations for teaching action, the management of the centres and/or regional policies. Specifically, we mean to reply to the following questions:

- Controlling the effect of the socio-economic context, is there a relation between achievement in PISA and regional educational policies in matters of scholarisation, financing and resources?
- Controlling the effect of the socio-economic context and regional educational policies, is achievement related with the institutional culture of the centres and the teaching action carried out in the classrooms?

Method

We have developed a secondary analysis of the data related to 976 Spanish educational centres participating in PISA-2015. The data for the centres analysed come from context questionnaires answered by their managers and by 32,330 15-year-old students (50.6% boys, 49.4% girls) who studied there. We also consider the data referring to the economic context and the regional educational systems, extracted from different statistics reports (Instituto Nacional de Estadística, 2016; MECD, 2016, 2017).

Variables

a) Dependent variable

We consider as a dependent variable the score in scientific competence, an area the last PISA evaluation goes deeply into. This competence is measured in PISA via standardised tests, generating individual scores through models of Item Response Theory (IRT). These scores are expressed in a scale of standard deviation 100 and mean 500, this value

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coinciding with the average achievement for all the students of OECD countries in the first edition of PISA. As is usual in large-scale evaluations, the method of plausible values is used (Wu, 2005) to determine the level of competence attributed to a student. We have taken the 10 plausible values extracted in PISA for each individual as a starting-out point in the estimation of the average achievement in sciences attained by each educational centre. To obtain the value attributed to the centre, we use the *IDB Analyzer* programme provided by the *Data Processing and Research Center* of the IEA (*International Association for the Evaluation of Educational Achievement*). This software is specifically aimed at the statistical analysis of data from large-scale international studies. It enables work with plausible values, taking into account the sample weights corresponding to each individual and applying the method of balanced repeated replications.

b) Centre-level explanatory variables

Among the centre-level explanatory variables we include some indices available in the PISA-2015 database, derived from the context questionnaires answered by the students or the management. These indices summarise the answers to sets of items using diverse procedures. The details on the building of these indices, as well as the items used, can be consulted in the technical report worked out for PISA-2015 (OECD, 2017). Other variables have been constructed specifically for this analysis, as we will point out when presenting them.

The first variable is the *socio-economic and cultural index* (ESCS). This is an index built for each student from the parents' studies, their professional jobs and the possessions in the home (number of books, computer, Internet connection, etc.). The value attributed to the centre has been obtained averaging those corresponding to each of its students. Along with this index, we have used others which are the variables related with the centres' institutional culture:

- *Educational leadership.* This is the LEAD index contained in the PISA database. It informs about the strength of leadership carried out by the centre's management. It is constructed from the answers to 13 items. The managers indicated the frequency with which

certain actions linked with leadership had taken place in the last year, using a 6-level scale, from "it didn't happen" to "more than once a week".

- *Negative student behaviours*. STUBEHA in PISA. Based on 5 items which gather the perceptions of the managers about the extent to which specific behaviours of the students of the centre hinder the learning processes. The answer scale includes 4 modalities, from "not at all" to "a lot".
- *Respecting the students*. Built for this study via principal component analysis for categorical data (CATPCA) from the items ST039Q04NA, ST039Q05NA and ST039Q06NA, answered by the students in relation with the way in which their teachers treat them. The answers are supported on a 4-level scale from "never or almost never" to "once or more a week". The value for each centre is obtained averaging the attributes of the students.
- *Involvement of the families*. The SCHEFFPAR index in PISA, which indicates if efforts are being made to involve parents in the centre's activities, in accordance with the responses of the managers to 4 items. The index expresses the percentage of statements which are applicable to the centre.
- *Inprovement of quality*. An index built for this study, which informs about the number of measures adopted to ensure and increase the centre's quality from the managers' perspective (items SC037Q01TA, SC037Q02TA, SC037Q04TA, SC037Q05TA and SC037Q07TA).

Another group of explanatory variables measured at the level of the centres refers to the teaching-learning processes, centring on the teaching performance in science classes. They correspond to indices available in the PISA database, generated from the students' questionnaires. In them they are asked how frequently specific situations occur, providing an answer scale with 4 modalities which go from "never or almost never" to "in all or in almost all the classes". The values of the centre were obtained averaging the scores corresponding to their students. These variables are the following:

- *Headteacher style* (TDTEACH). Constructed from the answers of the students to 4 items, which reflect to what extent the teachers establish the dynamic of the classes.

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- *Research methodology* (IBTEACH). Supported by 9 items which refer to a research-based teaching style.
- *Adaptation of the teaching* (ADINST). Generated from 3 items which reflect how the teacher adapts the teaching processes to the students' characteristics.
- *Feedback to the students* (PERFEED). Based on 5 items referring to the information which they receive about their learning.
- *Support of the students* (TEACHSUP). Worked out from 5 items relative to the support which the teacher gives to facilitate learning.

We have considered an additional variable on the teaching developed in the centre which we have built via CATPCA analysis from the answers to the students' questionnaire:

- *Class control*. Report on the way in which the teachers manage the class, creating appropriate conditions for learning. To construct it we use 5 items (ST097Q01TA to ST097Q05TA) which reflect negative situations in the classrooms. The students express the frequency with which these situations occur, in accordance with a scale of 4 levels which go from "in all the classes" to "never or almost never".

All these indices are expressed as standardised scores, with the exception of the index *involvement of the families*, which is expressed as a percentage, and the index *improvement of quality*, which has values between 0 and 5. The descriptive statistics for the set of variables in the centres of the sample are presented in Table I.

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TABLE I. Descriptive statistics for the variables measured at the level of centres.

Variables	Mean	Standard deviation
ESCS	-.50	.62
Educational leadership	-.22	.83
Negative behaviours of the students	-.19	1.08
Respect of the students	.00	.26
Involvement of the families	91.77	15.01
Improvement of quality	4.19	1.02
Headteacher style	.02	.30
Rsearch methodology	-.31	.37
Adaptation to the teaching	.14	.33
Feedback to the studensts	.11	.34
Support of the students	.04	.37
Class control	.00	.37

c) Explanatory variables at the regional level

The independent variables measured at the regional level correspond to information external to the PISA evaluation. They are the following:

- *GDP per capita*. Regional gross domestic product per inhabitant, expressed in euros.
- *Students in public centres.* Percentage of Compulsory Secondary Education (CSE) students enrolled in school in publicly-owned centres.
- *Spending on education per student*. Indicator of financing of education in the regional educational systems, defined as the public spending per student in non-university teaching.
- *Size of groups*. Average number of students per educational group in CSE.
- *Student-teacher ratio.* Average number of students per teacher in non-university teaching.

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- *Computers per group*. Number of computers per unit or group in primary and secondary education centres, allocated to teaching with students.

The GDP per capita data correspond to 2015 and have been obtained from the *Spanish Regional Accounting* (Instituto Nacional de Estadística, 2016). The data of the students in public centres, spending on education per student, student-teacher ratio and computers per group come from *Figures in education in Spain* (MECD, 2017) and correspond to the academic year 2014-2015. The size of the groups is extracted from the *State System of Education Indicators* (MECD, 2016). The values for these variables in the 17 autonomous regions are shown in Table II.

TABLE II. Values for variables measured at the regional level

Autonomous Region	GDP per capita (€)	Students in public centres (%)	Expenditure on education per student (€)	Size of the groups (nº students)	Student-teacher ratio	Computers per group
Andalusía	17263	75.2	4042	26.1	13.1	9.3
Aragón	25552	65.8	4707	23.6	12.1	6.7
Asturias	20675	66.3	5530	22.5	10.9	7.7
Balearic Islands	24394	60.8	4808	25.8	11.7	10.9
Canary Islands	19900	75.8	4539	24.3	13.7	5.1
Cantabria	20847	66.3	5623	23.7	11.2	6.4
Castile-La Mancha	18354	80.1	4295	24.5	12.4	6.1
Castile & León	21922	64.0	5109	23.4	11.3	4.8
Catalonia	27663	62.0	4198	27.8	13.2	5.8
Extremadura	16166	76.7	5276	21.4	11.3	9.5
Galicia	20431	70.3	5404	20.4	10.5	7.2
La Rioja	25507	61.4	4827	23.5	12.3	6.0
Madrid	31812	52.0	3857	26.4	14.1	3.7
Murcia	18929	69.8	4352	24.9	12.5	3.3
Navarre	28682	60.2	5692	24.1	11.3	3.9
Basque Country	30459	46.4	6448	21.6	12.1	11.5
Valencian Com.	20586	63.8	4449	25.7	12.9	3.9

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Data analysis

We have variables measured by the centres and variables which characterise the regional educational systems. Given that the centres are within regions, certain characteristics of the centres belonging to the same region are not independent of each other, as they are conditioned by the same educational policy developed in the regional context. Consequently, we turn to multilevel models, considering in the same analysis variables measured at the level of centres (first level) and regions (second level). In response to the questions proposed in this work, we have developed a modelling process verifying successive models of multilevel regression. Firstly, we verify the null or unconditional model (Model 0) to check the existence of significant differences between regions and value belonging to the multilevel approach. The following models successively add variables related to the socio-economic context (Model 1), to the regional educational policies (Model 2), as well as to the institutional culture of the centres and to the performance of the teachers in the classrooms (Model 3).

The null multilevel model includes a sole factor of random effects. It is formulated according to the formula (1):

$$Y_{ij} = \gamma_{00} + u_{0j} + e_{ij} \quad (1)$$

where Y_{ij} is the average score in scientific competence for centre i in region j. This score is the result of adding the global mean of competence in the set of centres (γ_{00}), the random variation of the regional averages with respect to the global average (u_{0j}), and the random variation of the centres with respect to the average of their region (e_{ij}).

From this null model we have constructed the remaining models. We have incorporated new variables in them, maintaining those which have negative effects on the immediately preceding model. The final model, therefore, includes explanatory variables at the level of centres and regions. M and N being the number of variables in both levels, this model is expressed by equation (2):

$$Y_{ij} = \gamma_{00} + \sum_{p=1}^{N} \gamma_{p0} X_{pij} + \sum_{q=1}^{M} \gamma_{0q} Z_{qj} + (u_{0j} + e_{ij}) \quad (2)$$

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Where the fixed part of the model is made up of γ_{00} (effect of the global mean), γ_{p0} (main effects for each of the centre's variables) and γ_{0q} (main effects for the regional variables). In this model, X_{pij} represents the value of the *p*th variable in the centre *i* of region *j*, while Z_{qj} is the value of the *q*th variable in region *j*. In the models built, we assume an independence between the errors u_{0j} and e_{ij}, whose distributions tend to normal models $N(0, \sigma^2_{u0})$ and $N(0, \sigma^2_e)$.

Results

In Table III we show the results of the multilevel regression. We set out from the null model of a factor of random effects, taking the region as the factor and without including any explanatory variable. The variation of the scores in scientific competence between regions (u_{0j}=187.32; p<0.001) and the variation between centres within each region (e_{ij}=1012.74; p<0.01) are significant. Taking as a reference the total of the variation observed in the performance of the Spanish centres in sciences (e_{ij}+u_{0j}=1200.06), the differences between centres within the same region (e_{ij}) are 84.39%, while 15.61% correspond to the differences registered between regional educational systems (u_{0j}). The existence of a significant variance within the regions and between regions recommends pursuing the multilevel model, including variables in the analysis which contribute to explaining the variability observed in both levels.

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TABLE III. Parameters and typical errors for the multilevel regression models concerning scientific competences measured in the centres

	Model 0	Model 1	Model 2	Model 3
Fixed effects				
• Interception	495.31 (3.48)***	514.54 (13.36)***	778.36 (10.78)***	656.16 (42.09)***
Socio-economic context				
• GDP per capita		0.01 (0.00)	-	-
• ESCS		37.85 (1.21)***	37.94 (1.21)***	31.31 (1.38)***
Regional educational policies				
• Students in the public centres			-0.39 (0.24)	-
• Expenditure on education per student			-0.01 (0.01)*	-.01 (0.00)
• Size of the groups			-0.91 (1.41)	
• Student-teacher ratio			-10.85 (2.51)***	-8.29 (2.33)**
• Computers per group			-2.36 (0.66)**	-2.45 (0.71)**
Institutional culture of the centre				
• Educational leadership				-1.10 (0.87)
• Negative behaviours of the students				-3.31 (0.72)***
• Respect of the students				-9.14 (2.95)**
• Involvement of the families				0.09 (0.05)
• Improvement of quality				-1.00 (0.71)
Teaching performance				
• Headteacher style				15.87 (3.54)***
• Research methodology				-2.11 (2.48)
• Adaptation of the teaching				10.16 (3.80)**
• Feedback to the students				-19.32 (2.89)***
• Support of the students				-8.83 (3.48)*
• Class control				13.14 (2.06)***
Random effects				
e_{ij} (intra-region variance)	1012. 74 (46.25)***	505.15 (23.08)***	505.27 (23.09)***	392.63 (18.91)***
u_{0j} (inter-region variance)	187.24 (72.66)**	105.02 (41.14)*	26.53 (15.36)	33.82 (16.53)*

* p< .05: ** p<.01; ***p<.00

We construct Model 1 with the aim of controlling the GDP variables and the socio-economic and cultural level, measured respectively for the regions and the centres. The results obtained show significant effects of the ESCS (p<.001). In the presence of this, the effect of the regional GDP per capita is not significant, so this variable has been removed in later models. In accordance with the estimated effect for the ESCS, when its

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value increases in a unit the average scientific competence in the centre is raised by 37.85 points. The non-explained variance between regions (u_{0j}) is reduced from the value 187.32 registered in the null model to the value 105.02, while the intra-region variance (e_{ij}) goes from 1012.74 to 505.15. As a consequence, the percentage of variance explained in both levels by the variables of the socio-economic context is 45.94% and 50.12%, respectively. These figures show the important role of the ESCS in explaining the differences observed between centres and between regions. Given that our interest is centred on explaining achievement from malleable factors of educational policies, the institutional culture of the centres and the performance of the teachers, it is appropriate to control the effect of the socio-economic context in successive models.

Maintaining the ESCS as the fixed part, the variables related with the regional educational systems were added to Model 2. In this model, the spending on education ($p<.05$), the computers per group ($p<.01$) and the student-teacher ratio ($p<.001$) have significant effects. For this last variable, each increase of a unit in the ratio corresponds to a drop of 9.08 points in the scientific competence attained in the centres. The inter-region residual variance is u_{0j}=26.53. This represents a reduction of 85.83% of the initial variance noted in the mull model. That is to say, the including of the regional variables considerably increases the percentage of inter-region variance explained in Model 1.

Finally, Model 3 adds the variables measured at the centre-level. In the presence of these variables, the effect associated with spending on education ceases to be significant ($p>.05$). The variables which measure aspects of the centres' institutional culture have generally turned out to be less relevant than those which refer to the teaching performance. Among the former, only the effects of the negative behaviours of the students ($p<.001$) and the disrespectful relation of the teacher with the students ($p<.01$), both linked to the school climate, have been significant. The unitary increase in these variables means a reduction of scientific competence of 3.31 and 9.14 points, respectively. Teaching practices have a greater importance. A good control of the class ($p<.001$), teaching directed by the teacher ($p<.001$) and the adaptation of the teaching to the students' needs ($p<.01$) significantly raise the average scientific competence in the centre. Specifically, the scientific competence is raised 15.87 points with the unitary increase of the index of headteacher style, 13.14 points with the same increase in the control of the class, and 10.16

points in the case of the index of adaptive teaching. On the other hand, specific actions such as the feedback to (p<.001) and support of the student (p<.05), are negatively related with the level of competence. Each unit more in these variables corresponds with decreases in the scientific competence of 19.32 and 8.83 points, respectively. Introducing variables of the centre in the model makes the intra-region residual variance drop to e_{ij}=392.63. This value represents a reduction of 61.23% with respect to the null model, improving the percentage attained with the control variables (50.12% in Model 1).

The fit of the final model constructed can be valued from the decrease in the deviance (the fit statistic used for comparing hierarchical linear models). The deviance of the final model (-2LL=7838.31) is less than that registered for the remaining models (between -2LL=9560.11 in the null model and -2LL=8861.93 in Model 2). The difference of deviances between the two models is distributed according to the chi-squared in so many degrees of freedom as the number of parameters of fixed effects which one model adds in relation to another. As a consequence, the final model's fit has significantly improved (p<.001) with respect to all the previous models.

Discussion and conclusions

Our study confirms the link between performance and the socio-economic and cultural context. The ESCS index is a variable of maximum relevance in the explaining of the results obtained in PISA-2015, as was concluded in previous works which considered the ESCS at the regional level (Elosua, 2013; Ferrer et al., 2010; Gil, 2014), or at the level of centres (Calero and Escardíbul, 2007). This corroborates the suitability of the control of this variable in the explanatory models constructed to answer the aims of this work.

In answer to the first aim, we note the relation of performance in PISA with variables connected with regional educational policies. The previous literature has insisted on the financing of education as one of the aspects which explain the differences between countries or regions (Duru-Bellat and Suchaut, 2005). Although in our analysis public spending per student has been a relevant factor, the effect of variables linked with the provision of both personal and material resources has been more important. That

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is to say, compared to the budget amount allocated to education, a greater influence is the way in which this financing is distributed, generating greater resources in the educational system. The relation between achievement and the availability of ICT resources, operationalised in this work as the number of computers per classroom has a negative sign. This would reflect the scant efficacy of the efforts of the educational Authorities to tackle the problems of low achievement via policies aimed at increasing this type of resources in educational centres. When reviewing the autonomous policies for introducing ICT, Meneses, Fàbregues, Jacovkis and Rodríguez-Gómez (2014) highlight that the increase of ICT resources has not always been accompanied by a sufficient training of the teachers for their use, and this should be especially considered when providing the centres with ICT resources.

In our analysis, the student-teacher ratio has been the variable of greatest weight in explaining the differences of achievement between regions, which is why it seems reasonable to reduce the size of the groups and prioritise the provision of teachers (Grau, Pina and Sáncho, 2011). The scholaraisation in centres of public or private ownership, once the socio-economic context has been controlled, does not explain the differences between regions. This result is consistent with those obtained in studies which also analyse this factor, comparing the achievement of the Spanish regions (Ferrer et al., 2010) or that of different countries (De-Jorge and Santín, 2010).

Answering the second aim of the study, we have analysed the relation between the variables of the centre and achievement. We note a greater effect of the performance of the teachers than of the institutional culture. Previous works had pointed out the need to centre efforts on intervening with the students, given the slight relevance of other centre variables in explaining achievement (Cordero et al., 2009). In this same line, Heargraves and Fullan (2014) highlight the role of the centre and the processes which take place in the classroom to achieve satisfactory learning results. According to our results, the class climate, the headteacher style, the order and control of the class, teacher-student respect and the adapting of the teaching to the needs of the students are significantly related with the centre's average scientific competence. These results coincide with those of previous works where similar variables were considered (Clavel et al., 2016; Krüger et al., 2015; López, Ascorra, Bilbao, Oyanedel, Moya and Morales, 2012). The negative effects

of feedback to and support of the students could be explained by an intensification of this kind of actions in the centres with lower achievement levels.

With respect to institutional culture, aspects such as educational leadership, the involvement of the families and measures in favour of educational quality are not relevant to explain the differences of achievement. On the other hand, negative behaviours of the students are significant, in accordance with the studies which underline the negative repercussions of disruptive behaviours in terms of learning (Torregrosa, Inglés, García-Fernández, Gázquez, Díaz-Herrero and Bermejo, 2012). In this sense, it would be desirable to foster measures oriented towards the students who have a greater school disaffection: to boost personal and academic orientation, to drive group tutorials, to employ participative teaching methodologies and to diversify leisure activities.

As we indicated when establishing the conceptual framework of this study, the variables of the socio-economic context are not malleable by the educational agents. However, there is a clear margin for intervention if we pay attention to the remaining variables. Our findings point to the educational centres and the performance of the teachers as the main areas for the implementation of measures aimed at boosting learning. Beyond claiming an increase in educational spending, the provision of more technological resources, the defence of the public network compared to the private network or vice versa, we believe that it is necessary to specifically spotlight the centres. These require having suitable conditions to develop the teaching-learning processes which, among other measures, means having a stable provision of teachers adjusted to the volume of students. The fundamental role of the teaching performance in explaining achievement recommends the adopting of measures aimed at facilitating the work of the teachers in the classroom, providing the necessary support and the recognition of their work. The stability of the teaching workforce would be another challenge in this same line.

Finally, we highlight some strengths and weaknesses of our study. As it is a question of a secondary analysis of PISA data, we have had a broad, rigorously measured sample of centres and variables. Unlike other works which have been limited to exploiting the data available in PISA, we have integrated into the analysis information from external sources. The main limitation is inherent to the methodology used. The models constructed identify relevant variables in the explanation of the achievement but do

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not enable the establishing of cause-effect relations which would generate greater confidence in the efficacy of a possible intervention on the independent variables whose effects have been relevant. Taking into account that the differences of achievement between centres continues being significant in the final model constructed, future works would have to analyse the incorporation of new variables which would reduce the residual variance and carry on advancing in the explanation of the achievement registered in the Spanish educational centres. Continuing this study, an interesting line of research could be to centre on the role of the teaching performance. In particular, it would have to go more deeply into the role of variables not dealt with in international evaluations, such as is the case of the teachers' emotional competence, in tune with the works of Kunter et al. (2013). From the methodological point of view, future research could tackle mixed approaches, facilitating via qualitative perspectives a greater comprehension of the differences of inter-regional and inter-centre achievement noted in the quantitative analyses carried out from evaluations such as that of PISA.

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