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Background questionnaires of PISA: a study of the assessment indicators

Cuestionarios de contexto PISA: un estudio sobre los indicadores de evaluación

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Abstract

The PISA assessment system has generated and continues to generate intense debate about its structure and usefulness. This article focuses on the context questionnaires as a way to analyze and understand the results properly. The objectives are to analyze the background indicators used in the different editions of the PISA tests, used in different studies and the results of these studies. An overview of the model used is provided to ensure that these indicators are no longer something that accompanies the performance test to reach their true meaning: jointly analyze the performance along with the variables that may be influencing the results. As methodology is used document analysis of publications related to PISA and results, as well as a semantic analysis of scientific work that has generated PISA. The results show that some indicators have remained throughout the various editions of PISA, while others have changed. The translation of a stable model in editions from PISA 2015 in which the most relevant items are included will undoubtedly facilitate the study of results at vertical and horizontal level. Thus, the importance of PISA context questionnaires established to properly understand their results and the need for more complex studies of multilevel or nested that normally used, generally based on descriptive statistics and / or percentages.

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Resumen

El sistema de evaluación de PISA ha generado y continúa generando intensos debates sobre su estructura y utilidad. Este artículo se centra en los cuestionarios de contexto, como forma de analizar y entender de manera adecuada los resultados. Los objetivos son analizar los indicadores de contexto que se utilizan en las distintas ediciones de las pruebas PISA, su utilización en distintos estudios y en los resultados de estos estudios. Se proporciona una visión general del modelo utilizado para conseguir que estos indicadores dejen de ser algo que acompaña a las prueba de rendimiento para que alcancen su verdadero sentido: analizar conjuntamente el rendimiento junto con las variables que pueden estar influyendo en los resultados. Como metodología se utiliza el análisis documental de publicaciones relacionadas con PISA y sus resultados, así como un análisis semántico sobre trabajos científicos que ha generado PISA. Los resultados muestran que algunos indicadores se han mantenido a lo largo de las distintas ediciones de PISA, mientras que otros han ido variando. La plasmación de un modelo estable en las ediciones a partir de PISA 2015 en el que se especifican los

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ítems más relevantes facilitará sin duda el estudio de los resultados a nivel vertical y horizontal. Así, se establece la importancia de los cuestionarios de contexto de PISA para poder entender de manera adecuada sus resultados y la necesidad de realizar estudios más complejos del tipo multinivel o anidados que los que normalmente se utilizan, en general basados en estadísticos descriptivos y/o porcentajes.

Palabras clave:

PISA, cuestionarios de contexto, indicadores de evaluación, evaluación de sistemas educativos, educación, medición.

The presence of PISA in our environment is indisputable. The opinions range from support for this system and criticism of the same (Popkewitz, 2013; Rindermann, 2007). PISA, born in the framework of the OECD as a way to analyze the differences between countries with common tests focused on measuring expectations regarding school performance and benchmarks (Duru-Bellat, 2013; Popkewitz, 2013), compares the reading, mathematical and scientific competence with tests away from curriculum in order to describe the situation of education in the countries and promote its improvement. The results of these evaluations should be used by countries to solve their problems in education and to improve their education systems, not to be compared with others in performance issues (Rendon & Navarro, 2007). In Spain the combination of factors has led to growing unrest about the education system (Marchesi, 2006).

Since the Coleman report (Coleman, et al., 1966) has been proving the relationship between the socio-cultural level and academic performance so it is essential to know the contextual conditions in which it occurs through context questionnaires (see Sancho Álvarez, Jornet, & González Such, 2016). The evaluation of educational systems has some weaknesses, including the limited statistical treatment of obtained information, which could be improved by explanatory analysis of the product from context, by means of simple and complex indicators represented by instruments derived from well-designed scales. Limited knowledge of some explanatory models are among the causes of this limited statistical treatment, which leads to analyze data descriptively, or fear to manipulate data, based on which statistical analysis disrupts the initial configuration.

> In our view, the greatest difficulties in an assessment reside in the definition of a theoretical model that supports the system and in addressing the indicators of input variables, context and product with quality instruments (López-González, González-Such, & Lizasoain, 2012, p. 128).

In general, it is considered that PISA tests are methodologically well built, although there are issues to be resolved, "such as lack of motivation of students in assessments without consequences, rigor in controlling the response rates and exclusions, fairness and neutrality in research and the use and impact of results" (Martínez Arias, 2006, p. 111).

A structure that delimits a body of issues that should facilitate the comparison between cycles for the monitoring of the educational systems was established in PISA 2012 (OECD, 2016). Taking into account the objectives of the evaluation of the context, the decisions of the Government team of PISA, the overall framework developed by PISA 2012 and recommendations of the research, PISA 2015 assumes that those responsible for the education system in participating countries need to be informed on four major areas: results, context of students, teaching and learning processes, and educational policies and Government (OECD, 2016).

In the design of PISA in general it holds change in the approach of context questionnaires in cognitive assessment: reading is the main reference domain in PISA 2000, 2009 and 2018; Mathematics in PISA

2003, 2012 and 2021 and sciences in PISA 2006, 2015 and 2024 (OECD, 2016).

In the majority of studies on educational evaluation is not respected the nested structure of the PISA data, i.e., students are in a school, within a district, in a city, region, etc.

> However, many studies have shown how factors relating to school, classroom and teacher variables influence the educational achievement of students (Cervini, 2002, 2003b & 2004; Piñeros & Fernández & Blanco, 2004; Theule, 2006;) (Rendon & Navarro, 2007, p. 119).

A solution are multilevel studies (Gaviria & Castro, 2005). However, research on the PISA databases is relatively scarce in our country.

Objectives

This article aims to analyze the context indicators that have been used in the various editions of PISA. Documentary analysis based on the PISA-related publications and its results will be used as a methodology. In addition, presents a global model based on the items of context that is to be introduced in studies on PISA and analyzed what these items have been used in different studies.

Method

From a collection of official documents - technical reports and context questionnaires - there has been done a documentary analysis (Bisquerra, 2012) to help complement and contrast information across years.

Analyzed questionnaires have been shown below:

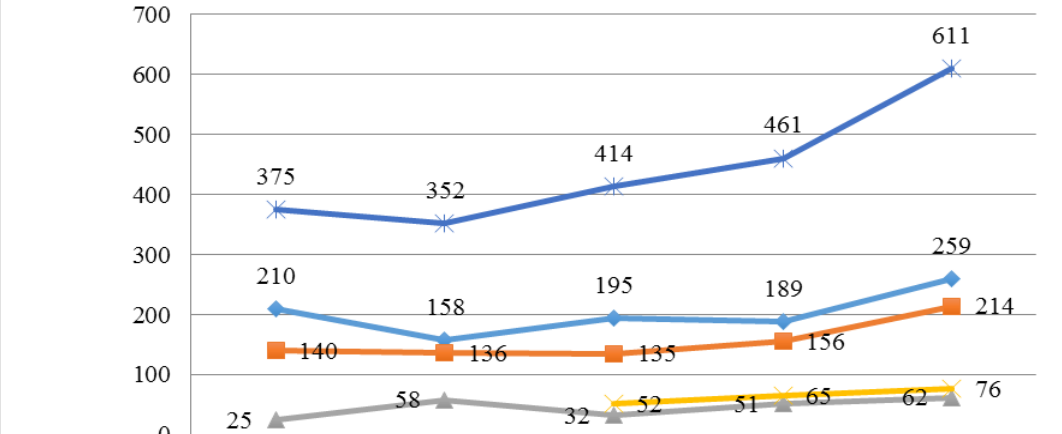
Table 1. Source of information across countries of questionnaires

Questionnaires	**2000**	**2003**	**2006**	**2009**	**2012**
Student (ST)	Chile/OECD	Mexico /OECD	Mexico /OECD	Spain/OECD	Mexico /OECD
School (SC)	Chile/OECD	Mexico	Mexico /OECD	Spain /OECD	Mexico /OECD
Family (PA)			OECD	Mexico /OECD	Mexico /OECD

Note: 2015 is not yet available full information

The phases developed, according to Bisquerra (2012, pp. 351-352), were the following:

1. Tracking and inventory of existing and available documents.
2. Classification of documents identified.
3. Selection of documents more relevant for research purposes.
4. A close reading of the contents of the selected documents.
5. A cross and comparative reading of the documents in question.



	2000	2003	2006	2009	2012
ST	210	158	195	189	259
SC	140	136	135	156	214
ICT	25	58	32	51	62
PA			52	65	76
TOTAL	375	352	414	461	611

Figure 1. Totals of context questionnaires items across years

We found a total of 1011 items administered from 2000 to 2012 for students, 781 questionnaires center, ICT 228, 193 for families ; a total of 2213.

Through the analysis of 2213 items between 32 background questionnaires across the countries (Chile, Mexico and Spain) and the primary and official background questionnaires of the OECD, finally it has worked with structured 964 items between 101 and 100 simple indicators and complex indicators, according the currently existing technical reports (Adams & Wu, 2002; OECD, 2005, 2009, 2012, 2014) about the *Programme for International Student Assessment*, PISA 2000, 2003, 2006, 2009 and 2012.

Results

PISA work with two types of indicators (or indices):

- Simple indicators: base on direct recoding of responses to one or more variables.
- Complex indicators: constructed by applying a methodology of scale, involving multiple questions and responses.

To confirm the theoretically expected behavior of the indicators and to validate their comparability across countries, was used the structural equation modelling. The analysis was done using Structural Equation Modelling (SEM) for a Confirmatory Factor Analysis (CFA) of questionnaire items. CFA was used to validate the indicators, and item response theory (IRT) techniques were used to produce scale scores. For the complex indicators was scaled using the Rasch item response model, and was estimate the maximum likelihood estimate, indicated the parameters estimates and delta for the any variable of the indicator and across countries (Adams & Wu, 2002).

Therefore, in this part the simple index variables (those based on direct recoding of responses to one or more variables) are described first, followed by complex indices (those that have been constructed by applying IRT scaling methodology), indicating for each indicator variables used by the OECD to provide parameters estimates for any item and for this reason finally this variables is finally analyzed in depth.

Simple indicators

Table 2. Results of the Simple indicators

PISA Indicator Noun	Acronym	Year				
		2000	2003	2006	2009	2012
Student age	AGE	X	X	X	X	X
Relative grade of student	GRADE		X		X	X
Study program	PROGN	X	X	X	X	X
Family structure	FAMSTRUC	X	X		X	X
	INMIG	X	X	X	X	X
Language spoken at home	LANGN	X	X	X	X	X
Birth order	BRTHORD	X				
Highest occupational status of parents	HISEI	X	X	X	X	X
Educational level of parents	PARED	X	X	X	X	X
Hours of schooling	TOTHRS	X				
School type	SCHLTYPE	X	X	X	X	X
School size	SCHLSIZE	X	X	X	X	X
Class size	CLSIZE	X		X		X
Learning time	LMNS	X	X		X	X
Out-of-school study time	OUTHOURS	X	X			X
Proportion of girls enrolled at school	PCGIRLS	X	X	X	X	
Availability of computers	RATCOMP	X	X	X	X	X
Quantity of teaching staff at school	STRATIO	X	X	X	X	X
Expected educational level	SISCED		X			
Expected occupational status	BSM		X	X		X
School selectivity	SELECT		X	X	X	X
Use of assessments	ASSESS		X			X
Ability grouping	ABGROUP		X	X	X	X
School management	AUTRES/AUTCURR		X			
Poor student-teacher relations	MSTREL		X			
Blue-collar/White-collar parental occupation	HSECATEG			X	X	
Science-related occupations for parents and students	SCISS			X		
School responsibility for resource allocation	RESPRES			X	X	X
School responsibility for curriculum and assessment	RESPCURR			X	X	X
Meta-cognition	METASUM				X	
Immigration status of parents	PQIMMIGF/M					X
Citizenship of parents	PQCTITZF/M					X
Grade repetition	REPEAT					X
	TOTAL	17	22	19	20	23

Complex indicators

As shown in table 2, there is diversity of simple indicators that vary according to each wave of application. Highlight School management and Poor student-teacher relations indicators, which were used in the implementation of the 2000 and who have not subsequently been used. Others have been parsed every year as they can be *Study program, Immigration background, Highest occupational status of parents* (HISEI), *Educational level of parents* (According to the ISCED through years of schooling PARED), *School size and type, Availability of computers, Quantity of teaching staff at school*

and Ability grouping. However, some have been incorporated in recent years to enrich the analysis of the context, such as those relating to *Blue-collar/White-collar parental occupation, Science-related occupations for parents and students, Meta-cognition, immigrant background and citizenship of parents*; It is worth mentioning that others have changed since converted along with other variables in complex indicators, as we will see later.

The scaling methodology and construct validation of the complex indicators were scaled using IRT, with the One-Parameter Rasch model (Rasch, 1960) for dichotomous items, according to the following formula (OECD, 2014):

$$P_i(\theta_n) = \frac{\exp(\theta_n - \delta_i)}{1 + \exp(\theta_n - \delta_i)}$$

Where $P_i(\theta_n)$ is the probability of person *n* to score 1 on item *i*, θ_n is the estimated latent trait of person *n* and δ_i the estimated location of item I on this dimension. For each item, item responses are modelled as a function of the latent trait θ_n (p.312)

In the case of items with more than two (k) categories (as for example with Likert-type items) this model can be generalized to the partial credit model (Masters and Wright, 1997), according to the following formula (OECD, 2014):

$$P_{x_i}(\theta_n) = \frac{\exp \sum_{k=0}^{x} (\theta_n - \delta_i + \tau_{ij})}{\sum_{h=0}^{m_i} \exp \sum_{k=0}^{h} (\theta_n - \delta_i + \tau_{ik})} \quad x_i = 0, 1, \ldots, m_i$$

Where $P_{xj}(\theta_n)$ denotes the probability of person *n* to score *x* on item *i* out of the *m* possible scores on the item. θ_n denotes the person's latent trait, the item parameter δ_i gives the location of the item on the latent continuum, and τ_{ij} denotes an additional step parameter (p. 312)

The following table contains complexes indicators with their categories of response for each application and we indicated in italics and underlined the indicators that are repeated identical across years (see table 4). Therefore, we also indicate the differences between the indicators.

Table 3. Results of complex indicators across years and calculation of items

PISA INDICATOR NAME	ACRONYM	Years and items analyzed of scales				
		2000	2003	2006	2009	2012
Cultural communication	CULTCOM	ST19Q01-Q03				PA08Q01-Q03 PA08Q06-Q08
Social Communication	SOCCOM	ST19Q04-Q06				PA03Q01-Q04 PA03Q06-Q09
Family educational support	FAMEDSUP	ST20Q01-Q03				PA15Q01-Q08
Cultural activities	CULTACTV	ST18Q02 ST18Q04-Q05				
Family wealth possessions	WEALTH	ST21Q01-Q04 ST22Q01-Q02 ST22Q04 ST22Q06-Q07	ST17Q02 ST17Q04-Q07	ST13Q02 ST13Q06 ST13Q13-Q17 ST14Q01-Q04	ST20Q02 ST20Q06 ST20Q13-Q17 ST21Q01-Q05	ST26Q02 ST26Q06 ST26Q14-Q17 ST27Q01-Q05
Home educational resources	HEDRES	ST21Q05-Q08 ST22Q03	ST17Q01 ST17Q03 ST17Q07 ST17Q11-Q12	ST13Q01 ST13Q03-Q05 ST13Q07 ST13Q11-Q12	ST20Q01 ST20Q03-Q05 ST20Q10-Q12	ST26Q01 ST26Q03-Q05 ST26Q10-Q12
Cultural possessions	*CULTPOSS*	ST21Q09-Q11	ST17Q08-Q10	ST13Q08-Q10	ST20Q07-Q09	ST26Q07-Q09
Teacher Support	TEACHSUP	ST26Q05-Q10	ST38Q01 ST38Q03 ST38Q05 ST38Q07 ST38Q10			
Achievement Press	ACHPRESS	ST26Q02-Q04 ST26Q15				
Disciplinary climate	DISCLIM	ST26Q01 ST26Q12-Q14 ST26Q16 ST26Q17-Q17	ST38Q02 ST38Q06 ST38Q08-Q09 ST38Q11		ST36Q01-Q05	
Teacher-student relations	*STUDREL*	ST30Q01-Q05	ST26Q01-Q05		ST34Q01-Q05	
Students' perceptions of school	*BELONG*	ST31Q01-Q06	ST27Q01-Q06			
Enjoyment of reading	JOYREAD[1]	ST35Q01-Q07		ST16Q01-Q05	ST24Q01-Q11	
Reading diversity	DIVREAD	ST36Q01-Q06		ST25Q01-Q05		
Instrumental motivation	INSMOT[2]	CC01Q06 CC01Q14 CC01Q22	ST30Q02 ST30Q05 ST30Q07-Q08	ST35Q01-Q05		
Interest in Reading	INTREA	CC02Q06 CC02Q13 CC02Q17				
Interest in Mathematics	INTMAT	CC02Q01 CC02Q10 CC02Q21	ST30Q01 ST30Q03-Q04 ST30Q06			
Interest in science learning	INSTSCI			ST21Q01-Q08		
Control strategies	*CSTRAT*[3]	CC01Q03 CC01Q13 CC01Q29 CC01Q23 CC01Q27	ST34Q01 ST34Q03-Q04 ST34Q10 ST34Q12		ST27Q02 ST27Q06 ST27Q09 ST27Q11 ST27Q13	
Memorisation strategies	*MEMOR*[4]	CC01Q01 CC01Q05 CC01Q10 CC01Q15	ST34Q06-Q07 ST34Q09 ST34Q13		ST27Q01 ST27Q03 ST27Q05 ST27Q07	

[1] 2006 focus in science (JOYSCIE)

[2] 2003 focus in mathematics; 2006 focus in science

[3] 2003 focus in mathematics

[4] 2003 focus in mathematics

Elaboration strategies	ELAB	CC01Q09 CC01Q17 CC01Q21 CC01Q25	ST34Q02 ST34Q05 ST34Q08 ST34Q11 ST34Q14		ST27Q04 ST27Q08 ST27Q10 ST27Q12
Effort and perseverance	EFFPER	CC01Q07 CC01Q12 CC01Q20 CC01Q28			
Preference for co-operative learning	COOPLRN	CC02Q02 CC02Q08 CC02Q19 CC02Q22	ST37Q02 ST37Q04 ST37Q06 ST37Q08-Q09		
Preference for competitive learning	COMPLRN	CC02Q04 CC02Q11 CC02Q16 CC02Q24	ST37Q01 ST37Q03 ST37Q05 ST37Q07 ST37Q10		
Self-concept in reading	SCVERB	CC02Q05 CC02Q09 CC02Q23			
Mathematics self-concept	SCMAT[5]	CC02Q12 CC02Q15 CC02Q18	ST32Q02 ST32Q04 ST32Q06-Q07 ST32Q09	ST37Q01-Q06	
Academic self-concept	SCACAD	CC02Q03 CC02Q07 CC02Q20			
Perceived self-efficacy	SELFEF[6]	CC01Q02 CC01Q18 CC01Q22	ST31Q01-Q08	ST17Q01-Q08	
Control expectation	CEXP	CC01Q04 CC01Q11 CC01Q16 CC01Q24			
Perceived ability to use computers	COMAB	IT02Q01-Q03 IT03Q01			
Condidence in routine tasks	ROUTCONF		IC06Q01 IC06Q03-Q05 IC06Q07-Q11 IC06Q18 IC06Q21		
ICT program/software use	PRGUSE[7]	IT05Q03-Q04 IT06Q02-Q05	IC05Q03 IC05Q05 IC05Q07-Q09 IC05Q11	IC04Q03 IC04Q05 IC04Q07-Q08 IC04Q10	IC06Q01-Q09
Confidence in internet tasks	INTCONF		IC06Q12-Q14 IC06Q19 IC06Q22	IC05Q01 IC05Q07-Q09 IC05Q13 IC05Q15	
Confidence in ICT high level tasks	HIGHCONF		IC06Q02 IC06Q06 IC06Q15-Q17 IC06Q23	IC05Q02-Q04 IC05Q10-Q12 IC05Q14 IC05Q16	IC08Q01-Q05
ICT Internet/entertainment use	INTUSE		IC05Q01-Q02 IC05Q04 IC05Q06 IC05Q10 IC05Q12	IC04Q01-Q02 IC04Q04 IC04Q06 IC04Q09 IC04Q11	IC04Q01-Q09
Attitudes towards	*ATTCOMP*	IT07Q01 IT08Q01	IC07Q01-Q04		IC10Q01-Q04

[5] 2006 focus in science

[6] 2003 focus in mathematics; 2006 focus in science

[7] 2012 focus at school

computers		IT09Q01 IT10Q01				
School autonomy	*SCHAUTON*	SC22Q01-Q12	SC26Q01-Q12			SC24Q01-Q12
Teacher Participation	*TCHPARTI*	SC22Q01-Q12	SC26Q01-Q12			SC24Q01-Q12
Teacher-related factors affecting school climate	TEACBEHA	SC19Q01 SC19Q03 SC19Q07-Q08 SC19Q15 SC19Q13 SC17Q16	ST25Q03 ST25Q05-Q06 ST25Q09 ST25Q11 ST25Q13			SC17Q01 SC17Q03 SC17Q05-Q06 SC17Q09 SC17Q11 SC17Q13
Student-related factors affecting school climate	*STUDBEHA*	SC19Q02 SC19Q06 SC19Q09-Q10 SC19Q13 SC19Q15	ST25Q02 ST25Q04 ST25Q07-Q08 ST25Q10 ST25Q12			SC17Q02 SC17Q04 SC17Q07-Q08 SC17Q10 SC17Q12
Teacher morales	*TCMORALE*	SC20Q01-Q04	SC24Q01-Q04			
Quality of the school's educational resources	*SCMATEDU*[8]	SC11Q04-Q09	SC08Q09 SC08Q15-Q20	SC14Q07-Q13	SC11Q07-Q13	
Quality of the school's physical infrastructure	*SCMATBUI*	SC11Q01-Q03	SC08Q11-Q13			
Teacher shortage	*TCSHORT*[9]	SC21Q01-Q04	SC08Q01-Q06	SC14Q01-Q04		SC11Q01-Q04
Home possessions	HOMEPOS		ST17Q02-Q12 ST19Q01	ST13Q01-Q17 ST14Q01-Q04 ST15Q01	ST20Q01-Q17 ST21Q01-Q05 ST22Q01	ST26Q01-Q12 ST26Q14-Q17 ST27Q01-Q05 ST28Q01
Index of economic, social and cultural status	*ESCS*[10]	HISEI PARED WEALTH HEDRES CULTPOSS	HISEI PARED HOMEPOS	HISEI PARED HOMEPOS	HISEI PARED HOMEPOS	HISEI PARED HOMEPOS
Attitudes towards school	*ATSCHL*		ST24Q01-Q04		ST33Q01-Q04	
Mathematics anxiety	ANXMAT		ST32Q01 ST32Q03 ST32Q05 ST32Q08 ST32Q10			
Student morale	STMORALE		SC11Q01-Q07			
Teacher consensus	TCCONS		ST21Q03 ST22Q03 ST23Q03			
Future-oriented science motivation	SCIEFUT			ST29Q01-Q04		
School preparation for science career	CARPREP			ST27Q01-Q04		
General value of science	GENSCIE			ST18Q01-Q02 ST18Q04 ST18Q06		
Parent's views on importance of science	PQSCIMP			PA04Q01-Q04		
Parent's vie won general value of scienca	PQGENSCI			PA06Q01-Q02 PA06Q04 PA06Q06 PA06Q09		
Mathematics activities	MACTIV[11]	SCQ17Q01-Q05		ST19Q01-Q06		SC21

[8] 2000 one less
[9] 2003 one more
[10] Every years with variation in the HOMEPOS
[11] 2006 focus in science (SCIEACT)

at school					SC16Q05-Q06 SC16Q08
Personal value of science	PERSCIE		ST18Q03 ST18Q05 ST18Q07-Q08 ST18Q10		
Parent's view on personal value of science	PQPERSCI		PA06Q03 PA06Q05 PA06Q07-Q08		
Awareness of environmental issues	ENVAWARE		ST22Q01-Q05		
Perception of environmental issues	ENVPERC		ST24Q01-Q06		
Parent's perception os environmental issues	PQENPERC		PA07Q01-Q06		
Environmental optimism	ENVOPT		ST25Q01-Q06		
Parent's environmental optimism	PQENVOPT		PA08Q01-Q06		
Responsibility for sustainable development	RESPDEV		ST26Q01-Q07		
Student information on science careers	CARINFO		ST28Q01-Q04		
Science teaching: interaction	SCINTACT[12]		ST34Q01 ST34Q05 ST34Q09 ST34Q13	ST37Q01-Q07	
Science teaching: hands-on activities	SCHANDS[13]		ST34Q02-Q03 ST34Q06 ST34Q14	ST38Q01-Q08 ST38Q01	
Science teaching: student investigations	SCINVEST		ST34Q08 ST34Q11 ST34Q16		
Science teaching: focus on models or applications	SCAPPLY		ST34Q07 ST34Q12 ST34Q15 ST34Q17		
School activities to promote the learning of science	SCIPROM		SC20Q01-Q05		
School activities for learning environmental topics	ENVLEARN		SC22Q01-Q05		
Science activities at age 10	PQSCIACT		PA02Q01-Q05		
Parent's perception of school quality	*PQSCHOOL*		PA03Q01-Q07		PA14Q01-Q07
Parent's reports on science career motivation	PQSCCAR		PA05Q02-Q05		
ICT availability at home	ICTHOME	ST17Q04-Q06		ST20Q05-Q06	IC01Q01-Q08
Online Reading	ONLNREAD			ST26Q01-Q07	
Library use	LIBUSE			ST39Q01-Q07	
ICT availability at school	ICTSCH				IC02Q01-Q05
ICT use at home for	HOMESCH				IC05Q01-Q05

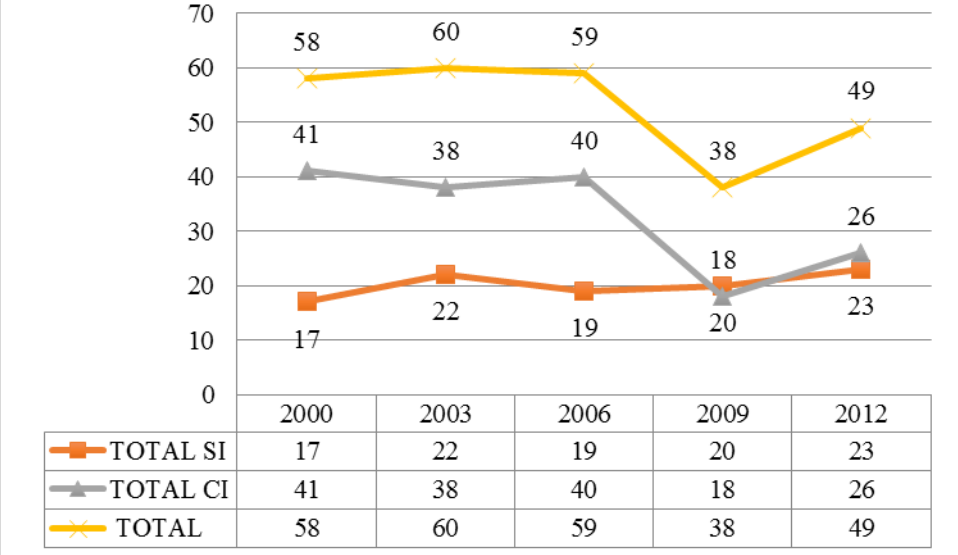
[12] 2009 focus in Read (STIMREAD)
[13] 2009 focus in read (STRSTRAT)

school related tasks		
Extra-curricular activities at school	EXCURACT	SC13Q01-Q13
School principal leadership	LDRSHP	SC26Q01-Q14
Motivational attributes of parent's own Reading engagement	MOTREAD	PA06Q01-Q04
Student's Reading resources at home	READRES	PA07Q01-Q06
Cultural communication		

Highlights the complex indicators of *Academic self-concept, Control expectation, Cultural activities, Achievement Press, Interest in Reading, Effort and perseverance, Self-concept in Reading, Academic self-concept* and *Perceived ability to use computers* that only analyzed in 2000, as well as confidence in c*arrying out daily tasks, mathematics anxiety, Moral learner and teacher collegiality* in 2003. It also highlights many interesting regarding science and environmental indicators, but has only been so wide in 2006, as shown in Table 3; from future motivation science or overall value science to school activities promoting science. In this regard, during the years 2009 and 2012 indicators are extended with respect to digital technology and competition.

In general, we can see that the complex indicators across years are focused between differents topics. For example, in PISA 2000 and PISA 2009 the focus is Mathematics, in PISA 2003 and PISA 2012 is Reading, and in PISA 2006 are the Sciences; also in PISA 2012 there are many indicators focused in digital competence.

Therefore, as shown in the chart below, analytically we can observe the variation of variables studied, and its evolution in terms of trends in PISA waves depending on the type of indicator-simple SI or complex CI- with the total set.



	2000	2003	2006	2009	2012
TOTAL SI	17	22	19	20	23
TOTAL CI	41	38	40	18	26
TOTAL	58	60	59	38	49

Figure 2. Totals of types of indicator

The evolution is growing in terms of simple indicators but will be lower in relation to complex indicators. Also, we found a total of 101 simple indicators and 100 complex indicators (a total of 201 indicators analyzed - see table 1 and 2).

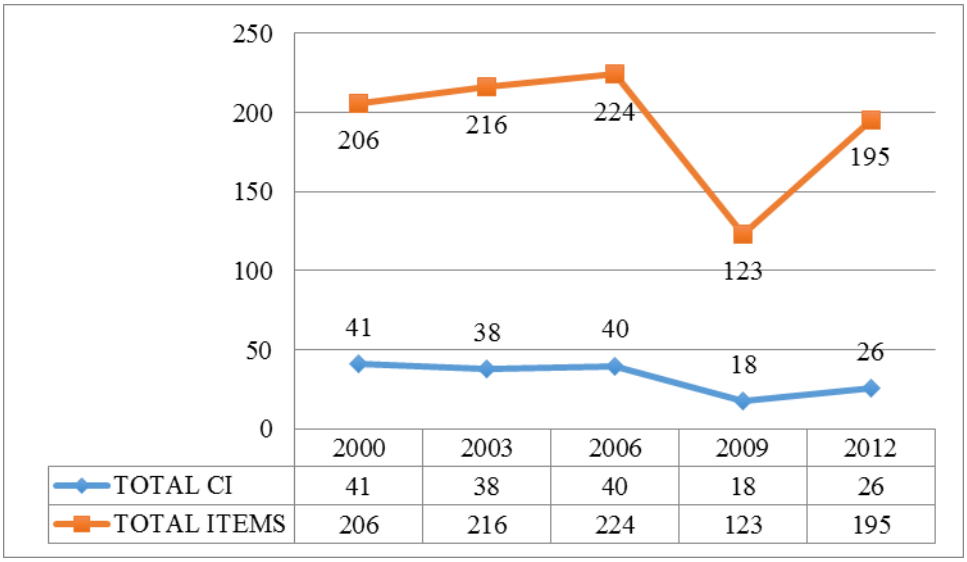


Figure 3. Totals of complex indicators and items

If we look in depth in the number of complex indicators associated with his variables respective, we can see that the trend is decreasing in some measure. Also, in relation to the 100 complex indicators we have been studied a total of 964 associated variables (see Table 3).

However, although the number of complex indicators is declining -figure 3-, the items that are included in the questionnaires are higher by year -see graphic 1- ; as it happened in relation to simple indicators -figure 2-.

The case of the index of economic, social and cultural status (ESCS)

The indicator of ESCS was used first time in the PISA 2000 with an analysis derived from five indicators: *highest occupational status of parents* (HISEI), *highest educational level of parents* (in years of education according to ISCED), *family wealth* (WEALTH), *cultural possessions* (CULTPOSS), and *home educational resources* (HEDRES).

The ESCS for PISA 2003 and 2006 was derived from three indicators related to family background: *highest parental education* (in number of years of education according to ISCED classification), *highest parental occupation* (HISEI scores), and *number of home possessions including books in the home*.

For this reason, in PISA 2003 and PISA 2006, PISA 2009 PISA 2012 variables compressed for the possessions of the household (HOMEPOS) indicator are all items of WEALTH, CULTPOSS and HEDRES indicators. As well as the books at home (specific question structured in a scale of response of four points; less or equal to 25 books, 26-100 books) (, 101-500 books, more than 500 books).

For each country, the ESCS scores were obtained as (OECD, 2014):

$$ESCS = \frac{\beta_1 HISEI' + \beta_2 PARED' + \beta_3 HOMEPOS'}{\varepsilon_f}$$

where β_1, β_2 and β_3 are the OECD factor loadings, *HISEI'*, *PARED'* and *HOMEPOS'* the "OECD-standardised" variables and ε_f is the eigenvalue of the first principal component.(p.352).

Table 4. Results of the ECSC calculation by items across years

Index of economic, social and cultural status	**ESCS:**	2000	2003	2006	2009	2012
Family wealth possessions	WEALTH	In your home, do you have:				
		ST21Q02: A room of your own	ST17Q02:	ST13Q02:	ST20Q02:	ST26Q02:
		ST21Q04: Link to the internet	ST17Q06:	ST13Q06:	ST20Q06:	ST26Q06:
		ST21Q01 a dishwasher? ST21Q03 educational software?	ST17Q04 d) A computer you can use for school work ST17Q05 e) Educational software ST17Q07 g) Your own calculator	ST13Q13 A dishwasher ST13Q14 A <DVD or VCR> player ST13Q15 <Country-specific wealth item 1> ST13Q16 <Country-specific wealth item 2> ST13Q17 <Country-specific wealth item 3>	ST20Q13 A dishwasher ST20Q14 A <DVD or VCR> player ST20Q15 <Country-specific wealth item 1> ST20Q16 <Country-specific wealth item 2> ST20Q17 <Country-specific wealth item 3>	ST26Q14 A <DVD or VCR> player ST26Q15 <Country-specific wealth item 1> ST26Q16 <Country-specific wealth item 2> ST26Q17 <Country-specific wealth item 3>
		How many of these do you have at your home? ST22Q01 <Cellular> phone ST22Q02 Television ST22Q04 Computer ST22Q06 Motor car ST22Q07 Bathroom		How many of these are there at your home? ST14Q01 Cellular phones ST14Q02 Televisions ST14Q03 Computers ST14Q04 Cars	How many of these are there at your home? ST21Q01 Cellular phones ST21Q02 Televisions ST21Q03 Computers ST21Q04 Cars ST21Q05 Rooms with a bath or shower	How many of these are there at your home? ST27Q01 Cellular phones ST27Q02 Televisions ST27Q03 Computers ST27Q04 Cars ST27Q05 Rooms with a bath or shower
Home educational resources	HEDRES	In your home, do you have:				
		ST21Q07 ST21Q06 ST21Q05 A desk to study at A quiet place to study A dictionary	ST17Q01 ST17Q03 ST17Q12	ST13Q01 Un ST13Q03 Un ST13Q12 Un	ST20Q01 ST20Q03 ST20Q12	ST26Q01 ST26Q03 ST26Q12
		ST21Q07 a desk for study? ST21Q08 text books? How many of these do you have at your home? ST22Q03 Calculator	ST17Q07 your own calculator ST17Q11 books to help with your school work	S ST13Q04 a computer you can use for school work ST13Q05 educational software ST13Q07 you own calculator ST13Q11 Books to help with your school work	ST20Q04 a computer you can use for school work ST20Q05 educational software ST20Q10 Books to help with your school work ST20Q11 Technical reference books	ST26Q04 a computer you can use for school work ST26Q05 educational software ST26Q10 Books to help with your school work ST26Q11 Technical reference books

Cultural possessions	*CULTPOSS*	In your home, do you have:				
		ST21Q09 ST21Q10 ST21Q11	ST17Q08 ST17Q09 ST17Q10	ST13Q08 ST13Q09 ST13Q10	ST20Q07 ST20Q08 ST20Q09	ST26Q07 ST26Q08 ST26Q09
		Classical literature (e.g., <Shakespeare>) Books of poetry Works of art (e.g., paintings)				
Home possessions	HOMEPOS	WEALTH+ HEDRES+ CULTPOSS	WEALTH+ HEDRES+ CULTPOSS+ How many books are there in your home? (ST19Q; ST15; ST22; ST28)			
Highest parental occupation	HISEI	ISEI	The highest occupational status of parents according to the ICED clasification			
Highest parental education	PARED (expressed as years of schooling)	ISCED	The highest educational level of parents according to the ISCED clasification			

The case of the ESCS is odd because although it has been significantly varying your calculation regarding the inclusion of differences between variables for indicators and general index, over the years been coming as a single status to consider for its analysis. I.e., as you can see between years, wealth and family possessions are not equal in any of the waves. As you can see the same situation with regard to the educational resources home. On the contrary, there is certain unification in relation to the indicator cultural possessions, possessions from home, level highest family occupation and level higher than family studies; Stressing that from 2003 includes the variable number of books home.

For this reason, the OECD has had to go making great efforts of compensation between the calculations of this controversial index made up of several simple and complex, indicators that certainly deserves a more thorough analysis and in depth; focus of attention will be addressed in future research.

In this order of things, it is convenient to observe which analyzes PISA about 2015 context questionnaires. To do this, below the measures with respect to the core of evaluation of context and its planned structure modular.

Table 5. Measures to be included in the core context assessment for Pisa

	Student and school background	Processes	Non-cognitive outcomes
System level		**Governance:** Decision making, horizontal and vertical differentiation	(aggregated student data)
School level	School location, type and size of school, amount and source of resources (incl. ICT) Social/ethnic/academic composition Class size, teacher qualification	**School policies:** Programmes offered, admission and grouping policies, allocated learning time, additional learning time and study support, *extracurricular activities*, professional development, leadership, parental involvement, assessment/evaluation/accountability policies, school climate (teacher and student behaviour) **Teaching and learning:** Disciplinary climate, teacher support, *cognitive challenge*	(aggregated student data)
Student level	Gender, socio-economic status (parents' education and occupation, home possessions, number of books at home), language and migration background, grade level, pre-primary education, age at school entry	Grade repetition, programme attended, learning time at school (mandatory lessons and additional instruction), *out-of-school learning*	Domain-general non-cognitive outcomes (e.g. achievement motivation, well-being in school) Domain-specific non-cognitive outcomes (*motivation, domain-related beliefs and strategies, self-related beliefs, domain-related behaviour*)

Note: Measures in italics are adapted to the respective major domain, e.g. science in PISA 2015.Source: (OECD, 2016)

Table 6 shows the modular structure of PISA 2015, placing the modules in the overall structure of context, process and results, including the areas of non-cognitive outcomes, context of the student content, political and Government of teaching and learning.

Table 6. Modular structure of the PISA 2015 context assessment design

	Student background		Processes			Non-cognitive outcomes
	Family	**Education**	**Actors**	**Core processes**	**Resource allocation**	
Science-related topics		5 Out-of-school science experience	1. Teacher qualification and professional knowledge **Teaching and learning**	2. Science teaching practices 3. School level learning environment for science	12. Learning time and curriculum	4. Science-related outcomes: motivation, interest, beliefs…
General topics	7. Student SES and family 8. Ethnicity and immigration	9. Educational pathways in early childhood	14. Parental involvement 15 Leadership and school management **School policies**	13. School climate: interpersonal relations,, trust, expectations	16. Resources	6. Career aspirations 10. General behaviour and attitudes
			17. Locus of decision making within the school system	19 Assessment, evaluation and accountability **Governance**	18. Allocation, selection and choice	11. Dispositions for collaborative problem solving

Source: (OECD, 2016, pág. 107)

Non-cognitive outcomes include high priority modules 10 (general domain student attitudes and behavior) and 4 (results related to science; motivation, attitudes, beliefs) as well as low-priority modules 6 (Science Careers) and 11 (available for collaborative problem solving).

Table 7 • Measures of non-cognitive outcomes included in the Pisa 2015 main survey

Area	Science-related (Module 4)	Domain-general (Modules 6, 10, 11)
Self	**Self-efficacy**	Test anxiety Well-being in general (life satisfaction) **Well-being at school (sense of belonging)**
Interest, attitudes, and motivation	Interest in broad science topics **Enjoyment of science Instrumental motivation**	Achievement motivation
Beliefs and preferences	Epistemological beliefs **Environmental awareness Environmental optimism**	Collaboration and teamwork dispositions Career aspirations
Technology – ICT		**ICT use** Interest in ICT Perceived ICT competence Perceived Autonomy in using ICT ICT use in social interaction
Behaviour		Health: physical activities Time use: activities before/after school

Note: bold = trend measures. Source: OECD, 2016, p. 109.

Another considered paragraph is the evaluation of the processes of teaching and learning, with high-priority modules 2 (teaching practices of science), 12 (learning and curriculum) and 1 (qualifications of teacher and professional knowledge), together with the low-priority module 5 (experience outside of school science).

Table 8. Assessment of learning time and loss of learning time in PISA 2015

	Student Questionnaire	School Questionnaire	
Student	+ Additional instruction and study (time use) - Truancy		Engaged time (ET) = RT – student absenteeism, truancy, mentally disengaged time
Classroom	- Disciplinary climate and loss in science classes		Realised learning time (RT) = PT – loss due to classroom management, assessment time, waiting time, etc.
School	+ Amount of school learning time + Number and type of science classes	- Loss on school level	Provided learning time (PT) = AT – loss due to weather, holidays, teacher absenteeism, etc.

Source: OECD, 2016, p. 113.

The teacher-related measures are shown in table 9.

Table 9. teacher-related measures in the Pisa 2015 field trial

	Science-related	General
Background	Gender, age, employment status, job experience, subjects studied	
Initial education	Goal of first qualification, type of teacher education and training programme (if attended), mode of qualification	
	Science-related content Number of science teachers by level of qualification	
Professional development	Participation in different type of activities Obligation amount of participation, school policies (ScQ)	
	Collaboration Science-related content	Co-operation General content
Beliefs	Self-efficacy (related to science content and teaching science)	Job satisfaction

Source: OECD, 2016, p. 114

Note: If not indicated otherwise, constructs are included in the optional PISA 2015 Teacher Questionnaire

Finally, in the section on evaluation policies, advice and Government, include module 19 (advice, assessment and accountability) of high priority and modules of low-priority 3 (level school for science learning environment) and 13-18 - see table 10.

Table 10. Measures in Pisa 2015 related to assessment, evaluation and accountability

	External evaluation	**Teacher evaluation**	**Internal evaluation**	**Formative assessment**
Purpose and criteria	General assessment practice (ScQ) Purpose of assessment results (ScQ)			
	Evaluation policies (ScQ)			Teacher's grading (TQG)
Practices		Teacher-evaluation methods (ScQ)		Classroom-assessment instruments (TQG/TALIS)
Use and consequences	Processes of external evaluation (ScQ) Use of achievement data for accountability (ScQ)		Consequences of internal evaluation (ScQ)	Feedback: student perception (StQ) Adaptation of instruction (StQ)

Source: OECD, 2016, p. 116.

Indicators studies

Studies that used these indicators focuses on the relationship between one or more variables of type performance, gender, autonomous and simple or complex indicators such as those reported by PISA in Focus (general - http://www.mecd.gob.es/inee/PISA-in-focus.html). Or in some of the newsletters EducaINEE (http://www.mecd.gob.es/inee/Boletin-de-educacion.html) where relevant results are extracted from PISA studies in general or focusing on specific countries, in our case in Spain, in some cases by analyzing the differences by autonomous communities, as is the case with the series of AACC.

Some of the results have been:

Table 11. Summary of results of some research context indicators.

DATE	TITLE	RESULTS	INDICATORS
JUN-15	Assistance to early childhood education and performance in mathematics. The case of the Spanish autonomous communities. (INEE, 2015a)	Students attending preschool show superior performance in math than those who did not. This difference is significant between all the autonomous communities.	To greater economic, Social and Cultural status of PISA index likely to gain access to early childhood education by AACC
DEC-14	Motivation to learn Mathematics and PISA 2012: the case of the Spanish autonomous communities. (INEE, 2014a)	In Spain students who are more motivated to learn math, because they believe that it will be beneficial to their future studies and careers, earn best score in math.	On average, boys are more motivated to learn mathematics than girls are. In the autonomous communities, this gender gap in motivation is positively associated with the difference in score in mathematics between boys and girls. AACC
JUN-14	Persevering to success in studies: PISA 2012 and the autonomous communities. (INEE, 2014b)	Spanish students demonstrate levels of perseverance that are among the highest in the OECD countries. All the communities that have participated in PISA 2012 exceed the average for developed countries, except for Balearic Islands and Catalonia. Basque country, Andalusia, Madrid and Extremadura stand out for the high rates of perseverance	the data indicate the existence of a positive effect of perseverance on the score PISA 2012 raises students specific questions about if at the onset of a problem surrender immediately; they postpone the difficult problems; or on the contrary remain interested in tasks that start and continue working on a task until everything is perfect. AACC
MAY-14	Occupations of parents and PISA 2012 (INEE, 2014c)	There are substantial differences in the educational achievement of students according to the type of work of the parents. At international level, children of parents with more skilled occupations tend to perform better than the other students. The educational systems of the autonomous communities with a composition of employment more oriented to the most qualified occupations, obtain best average scores.	Occupations of parents AACC
MAR-14	Truant and PISA 2012 (INEE, 2014d)	PISA 2012 students were asked about how many times had arrived late or missed some classes or whole days of school without permission during the two weeks prior to the test. Throughout the OECD 35% arrived later once the Center percentage identical to the Spain. There are differences of up to 15 points between AA CC participating in PISA. The higher the percentage of students who miss class for days, tends to be lower scoring students who never missing	Question being late or missing. Performance by AACC
FEB-16	Low achievers: why get left behind and how we can help them (INEE, 2016)	The PISA study defines students with underachievement as those whose score is below the level 2 on the PISA scale.	Performance / GDP / repeat course / duties / subjects / sex / absences attendance / perseverance / leadership / resources.
JUN-15	Effects of the schoolmates in academic performance (INEE, 2015b)	An increase of 10 percentage points in the proportion of girls improves educational outcomes in children mathematics and General. Results on girls is not significant.	Classes gender composition / performance

NOV-14	The results of learning in mathematics at PISA 2012 (INEE, 2014e)	The most important factor in explaining differences in the results of mathematics is repetition. The difference in performance between students who have repeated ever and the non-repeaters corresponds to more than two years of schooling. There is an inverse relationship between the socio-economic level and the percentage of repeaters, made that questions the fairness of the system. • On the other hand, as reflected in other reports of PISA, education in a public or private Centre hardly influences the results of mathematics • Both the effort and productivity are important factors in explaining academic results.	Index of sociometric status and Cultural (ESCS) / Center (Pub, priv) / repeat course (Yes/No) productivity / effort
JUL-14	Spanish results in financial competence in PISA (I) (INEE, 2014f)	The level of financial competence of Spanish students is below the OECD average. This is due mainly to the lower percentage of students with a high level of financial competence. • 64% of the variation in the results in financial competition in Spain is measured by the skills in math and reading. The percentage of financial competition variation explained by competition in mathematics is in Spain the highest of the whole sample of countries assessed. • The Spanish girls score lower in financial skills than boys, although the differences are not statistically significant. • Immigrant status affects the scores achieved in financial competition in the negative sense. • The educational level of the parents has a positive influence on the financial competence of children. • Students who have repeated course are worse than the non-repeaters. The gap between these groups is lower in Spain than in the OECD. The Spanish repetitive score is higher than the counterparts in the OECD. • Larger municipalities are associated with higher scores in financial competition.	Financial competence / performance / troubleshooting / gender / immigrant / repeat / parent education / size town / skills in math and reading
MAY-14	Computers and academic performance (INEE, 2014g)	There is moderate evidence on the positive effect of the use of computers in the school performance in Spain. In the most disadvantaged socio-economic contexts, the effect is even more significant, which would be a potential tool to achieve greater equity. However, the results are not at all significant, raising doubts about the impact of the use of computers on academic performance.	Performance / use of goats and Tena (2013) computers in a recent article estimated the causal effect of the use of computers in the results of the Spanish students in the PISA 2012 event. Non-parametric Bayesian modelization
APR-14	Spanish results in competence of problem solving in PISA (INEE, 2014h)	Evaluation of the ability of students to solve problems this competition aims to measure the essential cognitive processes that students should use to resolve problems that may be found in your everyday life. Problem solving is evaluated by a computer, which allows you to record data on aspects such as the type, frequency, duration and order of the actions carried out by the students when they answered the questions.	Troubleshooting / gender / immigrant / repetition / sociometric status socio-economic status of students, approximate in PISA by an index that includes the educational level of the parents, your professional occupation and the technological and cultural resources available in the home.

FEB-14	Disaggregated analysis of the results of Spain in PISA (INEE, 2014i)	In the case of Spain results from PISA 2012 show differences of up to 53 points in favour of the natives, up to 57 points in favor of those who have not repeated ever and up to 132 points in favor of the students when one of the parents has completed tertiary studies. The results suggest that if: 1) stabilizes the phenomenon of immigration, 2) Gets a greater reduction of the problems of repetition, supported by a real educational improvement, and 3) continues the improvement of educational levels of parents, one might expect in the future a further progress of results and better positioning of Spain in the international context in this area as relevant for the possibilities of social and economic development.	Techniques shift-share of decomposition of differences, the impact of the condition of immigrant, Repeater and the educational level of the parents in the evolution in time of the results obtained by Spain in PISA, as well as in the position relative to developed countries
DEC-13	PISA 2012: results by computer (INEE, 2013)	The results of Spain are significantly lower when students take the test in computer instead of doing it on paper. • Compared to what was happening on paper, Spain has one higher proportion of students to the OECD in the lower levels, especially in reading comprehension. At higher levels, the OECD presents percentages much higher than Spain, as it did in the paper. • In the whole of the OECD, in mathematics, both sexes perform better when they perform the test by computer than when do them on paper, as opposed to in Spain. However, in reading comprehension only boys perform better on the test computer for the whole of the OECD. In addition, the differences between both modes of testing are much higher in Spain than in the OECD average.	Evaluation of mathematical competition. • Evaluation of General knowledge and skills related to the technologies of information and communication technology (ICT): use of the keyboard and mouse, and other common conventions. • Evaluation of competences related to the interaction between mathematics and ICT: realization of graphics through an Assistant, planning and implementation of a strategy for sorting in a spreadsheet to locate the desired data
		autonomy in the management of the centers, the differences between public and private schools, the use of instruments of accountability or the discipline in the classroom.	Centre / Performance / Discipline

On the other hand, the table 12 shows some studies on PISA 2006 context indicators are used.

Table 12. Selected analytical models used in publications on the PISA 2006 data for contexts of science achievement

Publication	Research Question or Model
Nagengast and Marsh (2014)	Cross-cultural measurement invariance for motivation and engagement in science
Drechsel, Carstensen and Prenzel (2011)	Dimensionality of science interest
Olsen and Lie (2011)	Country- and culture specific profiles of interest
Ainley and Ainley (2011a)	Students' enjoyment, learning engagement, and achievement
Ainley and Ainley (2011b)	Knowledge, affect, value, and students' interest in science
Lavonen and Laaksonen (2009)	Learning activities, interest in science, self-efficacy, self-concept, and performance
Fensham (2009)	Gender, task context and science performance
Buccheri, Gruber and Bruhwiler (2011)	Gender specificity in interest and vocational choices
Mc Conney et al. (2011)	Science interests among minority students
Luu and Freeman (2011)	Scientific literacy and ICT-related variables
Kubiatko and Vlckova (2010)	
Ho (2010)	Parental involvement and students' science performance
Basl (2011)	Explaining interest in future science-related careers
Kjaernsli and Lie (2011)	
Willms (2010)	School composition, school and classroom context, and students' literacy skills
Dincer and Uysal (2010)	Effects of school programme types
Coll et al. (2010)	influence of educational context in a western vs. Asian country

Source: OECD, 2016, p. 127

Conclusion

The PISA tests have become a global benchmark for evaluation and improvement of educational systems of the countries that conducted them. Despite the opinions against, PISA has come to stay. It is in general something abstract the public fails to understand but which everyone says.

The need to establish instruments of context which put the results merely performance on their actual situation is beyond doubt. They are especially necessary when it comes to evaluating education systems and improve them based on the comparison between countries, as it is the end of PISA.

In this work we have performed a review on the main indicators used by the various editions of PISA. Through this study, we have seen how some indicators have been used in all editions, while others have fallen by the way, surely due to its little use.

It has been like some context indicators have been maintained throughout the various editions of PISA, while others have been varying from simple to complex or disappearing. Others have appeared in some editions, disappeared in the following and returned to use in others. The establishment of a model in which there are indicators which remain throughout different editions will allow comparison between the editions and a better adaptation of the results for longitudinal studies. This model has established itself already in PISA 2015, based on the experience of PISA 2012.

De la Orden and Jornet (2012) already noted the importance of considering the selection of the variables that measure in any plan of evaluation put this has consequences both in the approach and results. Why highlight that many reports on evaluation of systems provide results on variables of performance in a way isolated with respect to context variables referring to these aspects in a very superficial manner. For this reason, it advocates a model of evaluation of innovative, incorporating the knowledge acquired in educational research, the explanatory models of performance and a way of optimizing working for the development of systems of context questionnaires.

There is no doubt that the focus of indicators is an analysis to guide level macro on education, therefore, information that we must call this type of evaluations should be at this level and not to others, i.e., nor meso or micro analytical.

In this sense, although evaluative approaches most macro indicators have the shaft noun related to the performance of students, as they point out Jornet, López González & Touron (2012) there is also an option that allows to explain the performance from contextual so-called indicators - really of input, process, and context-(Jornet, 2012). In this way, would have the possibility to provide more holistic information in order to identify the keys to improving education, or give a reason for the why of certain results, from the performance variables relate to these context variables.

The possibility of accessing to the PISA data allows researchers realize studies that are not left in the mere description based on averages or percentages, but integrated into more complex studies nested variables which undoubtedly enhance the effect pursued by PISA.

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