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Relationship between reading comprehension, spelling and academic performance. A study in Primary School students

Relación entre la comprensión lectora, la ortografía y el rendimiento: un estudio en Educación Primaria

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Abstract

There are many studies that have been produced to deepen the knowledge into the relationship among reading comprehension, spelling and school performance. Decoding and coding are two required skills to learn reading and writing in the first steps of learning. The aim of this study is to verify the existing relationships among all these variables, by the end of primary school. The spelling coding was assessed by means of a dictation and the reading comprehension by means of Angel Lazaro´s test. 252 students, ages 11 to 12, took part in this survey. A correlation design was made. Three groups were split according to the levels of implementation of these variables. In the sample a significant correlation between school performance and reading comprehension was found, and also a weak correlation between spelling marks and reading comprehension. Regarding the overlapping of both skills, a good reading comprehension was confirmed not to be a guarantee for a good spelling coding. In the discussion this relationship is analyzed and some measures for its improvement have been proposed.

Resumen

Son numerosos los trabajos realizados para conocer relación entre la comprensión lectora, la ortografía y el rendimiento académico. La codificación y la decodificación son habilidades necesarias para el aprendizaje de la lecto-escritura en las etapas iniciales de su aprendizaje. El objetivo del estudio es comprobar las relaciones existentes entre estas variables al final de la etapa de primaria. Se evaluó la ortografía con un dictado y la comprensión con el test de compresión lectora de Ángel Lázaro. En el estudio participaron 252 alumnos con edades comprendidas entre 11 y 12 años. Para conocer estas relaciones se empleó un diseño correlacional. Se crearon tres grupos en función de los niveles de ejecución en comprensión lectora y ortografía y se realizaron diferentes contrastes. En el total de la muestra se encontraron correlaciones significativas entre el rendimiento académico y la comprensión lectora y débiles y sin significación estadística entre las medidas ortográficas y la comprensión lectora. Con respecto al solapamiento entre ambas, el análisis por grupos confirmó que una buena ejecución en comprensión lectora no asegura un desempeño adecuado en decodificación ortográfica. En la discusión se analizan estas relaciones y sus implicaciones educativas.

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Introduction

The results of the *Progress in International Reading Literacy Study* (PIRLS; National Institute for Education Assessment, INEE, as per its Spanish acronym, 2012) for 2011 and the results of the *Programme for International Student Assessment* for 2012 (PISA; National Institute for Education Assessment, INEE, 2014)) show that Spain is one of the countries with the lowest scores in terms of reading skills and literacy. Although the results obtained in 2015 are better, this progress has only taken place in certain Autonomous Communities, and it is thus considered necessary to keep exploring such skill.

Many works have explored the models, strategies and variables related to Reading literacy in depth, both at a national and an international level (Alegría, 2006; Alonso-Tapia 2005; Alonso-Tapia, Carriedo & González, 1992; Cuetos, 2008; Elosúa, 2000; Elosúa et al. 2012; Kintsch, 1988, 1998; Perfetti, 1989). Research on this field identifies three theoretical models that explain the language understanding process -both spoken and written- and focuses on different processes: bottom-up or ascending models, top-down or descending models and interactive models (Orellana, 2000; Parodi, 2003). Bottom-up models focus on perception and the coding and decoding processes. For these models, identifying the letters is an essential step to recognise words, to get to the sentence and the text and, so that comprehension finally exists. Top-bottom models emerge as a response to other type of processes related to comprehension and explain the so-called ‹‹macroprocesses›› that are linked with to metacognitive operations. Finally, interactive models integrate the foregoing approaches (bottom-up and top-down) because they highlight the importance of both basic and complex language processes. In this model, both processes are interdependent and underlie the reading literacy process (Kintsch & Rawson, 2005); those involved in the recognition or identification of written words are called low-cognitive level processes or ‹‹microprocesses›› and those high-level cognitive processes related to the in-depth understanding of the text are called ‹‹macroprocesses››. The information processing mechanisms operate in parallel and interact with each other. Therefore, the complex cognitive and linguistic processes provide the most basic processes with information; from this point of view, reading is seen as a continuous interaction between the aforesaid processes (Parodi, 2003).

First of all, reading means decoding, decrypting the printed signs, but above all it means constructing a mental model that is consistent with the text's meaning (Kintsch, 1988). Decoding allows turning written words into oral expressions. Learning to decode is a necessary stage in the reader's development. Nevertheless, in spite of its prevalence and although it is an essential element of the reader's development, it does not guarantee reading literacy in previous stages, which sometimes results in dissociations between both processes. Therefore, it is important to deepen the knowledge of this relationship, because comprehension of written texts is what will allow to acquire significant learning throughout school age.

Studies on spelling and reading literacy

With regard to the spelling access models, Morton's *logogen* model (1980), McClelland & Rumelhart 's interactive-activation model (1981) and the dual route *model* initially proposed by Coltheart (1978), are empirically supported both from the point of view of neurology and psycholinguistics. Nevertheless, from an evolutionary perspective, there is no agreement on their development and there are two proposals in this regard: sequential models, whose main contribution focuses on the fact that children go through a series of stages of phases that are qualitative different in their learning (Ehri, 1986; Frith, 1980); and the proposal of continuous models. The latter raises the issue that, when writing is being developed, children use a range of strategies from the beginning (Treiman & Cassar, 1997; Varnhagen, McCallum & Burstow, 1997)

instead of certain type of information at specific time points.

There is no agreement with regard to the joint development of both skills: some authors argue that reading and writing are based on processes or representations that are the same for both skills (Treiman, 1998), while other authors who have conducted longitudinal studies assure that there are certain dissociations between both skills (Bryant & Bradley, 1980).

The link between the acquisition of spelling and its relationship to other linguistic skills was dealt with by several authors (Elosúa et al., 2012; Lázaro, 1988; Roman, Kirby, Parrila, Wade-Woolley, & Deacon, (2009); Rodrigo et al., 2009) evidencing that there is a correlation between the coding and reading literacy skills in the first stages of learning to read (Infante & Coloma, 2005; Perfetti, 1985, 1989; Perfetti & Hart, 2002; Perfetti & Matron, 1996; Stanovich, 2001). Some of the skills are more related to decoding processes (such as word segmentation), while other skills involve processes of understanding (such as making inferences). As the former are automated, the latter are developed, because the ‹‹microprocesses›› are automated and more energy is applied to the ‹‹macroprocesses›› in the interest of comprehension (Elosúa et al., 2012). Oakhill, Cain & Bryant (2003) found different development patterns in the benefits readers refer to throughout their reading experience in terms of decoding (pace and accuracy) and comprehension. In the early years of learning, the increase in terms of pace and accuracy is greater, when these two skills emerge; subsequently, there is a time when they hit the ceiling and that is when the benefits seem to stabilise.

Nevertheless, there is fewer research aimed at analysis these relationships in subsequent stages, when dissociations between both skills may emerge (Muñoz-Valenzuela & Schelstraete, 2008).

If we take the aforesaid contributions into account, the general objective of this work is to identify whether the problems at this stage are more present in the coding or in the reading literacy process, or in both. The specific objectives are: a) to verify the existing relationship between the variables of reading literacy, spelling coding and performance at the end of primary education; b) to check for overlapping in the difficulties of reading literacy and spelling coding.

As far as the first objective is concerned, it is assumed that there still will be high correlations between the variables. With regard to the overlapping between both difficulties, it is assumed that a reader having difficulties with spelling coding will also have difficulties with reading literacy, and vice versa.

Method

Participants

Our sample is made up by a total of 252 students aged between 11 and 12 years. We worked with groups of year 6 of primary education because at this point reading has already been acquired, the students' performance in the subjects of mathematics and Spanish language was selected, because they are instrumental subjects that require fluent comprehension.

All the students belong to 8 classes of State schools from the Autonomous Community of Madrid. As far as gender distribution is concerned, 46,4% were boys and 53.6% were girls.

They are Spanish-speaking students having normal intelligence quotients (average IQ = 30 in the Goodenough-Harris intelligence test, the minimum score being 28 points and the maximum being 50 points, in the age range of the sample).

Instruments

In order to know the overall intelligence quotients, the Goodeoguh-Harris test (Harris & Goodenough, 1963) was applied collectively. This test evaluates overall intelligence through representation of the human figure. Its level of reliability is 0.80. By using this instrument, we

do not intend to offer a measurement of intellectual performance but to offer a measurement of intellectual skills that is still widely used in spite of its limitations. This test was selected because it is easy to apply and correct and certain studies have found that it moderately correlates to Wechsler's human figure drawing system (1998) or Raven's Coloured Progressive Matrices Test (1993).

Some authors such as Abell, Wood and Liebman or Scott, referred to by Fernández-Nistal, Tuset & Ochoa (2014) justify its use:

> It is so widely used due to the fact that the task proposed is an activity that emerges naturally in childhood whereby it is attractive and non-threatening for children, and to its non-verbal nature, whereby children with language, hyperactivity, attention and learning problems can be evaluated (p. 298).

Lázaro's *Reading Comprehension Test* (1988) was used to evaluate reading literacy. This test can be considered as traditional and it allows to assess what the individual understood after finishing reading; this test focuses on the comprehension ‹‹product››. Its studies two aspects of reading from a qualitative point of view: the structure of the written message and its intention and the form of perception. It also takes into account the authors' objectives both when they intend to write a text and when they actually write it, as well as the reader's competence to capture its meaning. It is made up of 18 short texts followed by a series of 28 questions, most of them are multiple-choice and matching. It presents texts of different genres, such as the narrative, poetic and expository genre, with different length and level of difficulty. In this text, the individual has to pick the answer that corresponds to the text he/she has read. The right answer means that the text has been understood from the point of view of direct and indirect comprehension, which in turn means that the individual has to make inferences in those cases. The validity of the test is 0.801 and its reliability is 0.62.

In order to obtain a measurement of the academic performance, the educational establishments were requested the GPAs obtained by their students in the fields of Spanish language and mathematics at the end of the school year. The teachers were requested to provide the grades in each of these fields on a 0-10 scale.

An *ad hoc* test was designed to evaluate spelling. The spelling skills of the students were identified through a dictation using sentences extracted from textbooks of the relevant stage. The text had 10 sentences; it was used to evaluate the command of the phoneme-grapheme conversion, the command of the rules of spelling (checking the difference between b-v, ll-y, h, x and y), the rules of accentuation, the use of upper case and the use of punctuation marks. Grapheme swaps, omissions, rotations, additions, fragmentations and consonant swaps were codified as errors in such test.

Proceeding

The reading literacy, intelligence and dictations tests were performed collectively, in each class group and in tutoring hours. The order in which the tests were performed was the same for all the individuals: the reading literacy test was performed in the first place, then the intelligence test and lastly the dictation test. The objective of this works and the fact that the results would not have any impact whatsoever in their grades was explained to the students. The performance data were provided by their academic tutors.

Results

The descriptions of the variables used in the study were calculated in order to characterise

Table 1. *Statistical description of the variables*

n=252	Minimum	Maximum	Average	D.T.
Language	**4**	10	6.58	1.87
Mathematics	**4**	10	6.56	1.87
Reading literacy	**1**	28	10.64	3.89
Spelling	**0**	40	8.24	3.12
Intelligence	**3**	50	30.51	9.17

Source: Prepared by the authors.

the skills of the sample. The results are shown in table 1.

The most frequent performance levels are above the "pass" level in both subjects. 8% of the students failed Spanish language. The failure rate (7.9%) in the field of mathematics was similar. As far as the highest grades are concerned, they were obtained by 13.1% of the students in the subject of Spanish language 15.1% in the subject of mathematics. The results of the Goodenough-Harris test showed and average intelligence of 30.59 points (*DT*= 9.1).

The levels of implementation in the reading literacy tests are low (10.64 right answers on average out of a maximum score of 28). As it can be seen in table 2, only two students achieved the highest levels of implementation (0.8%) and 13.5% did not successfully complete 25% of the reading literacy test.

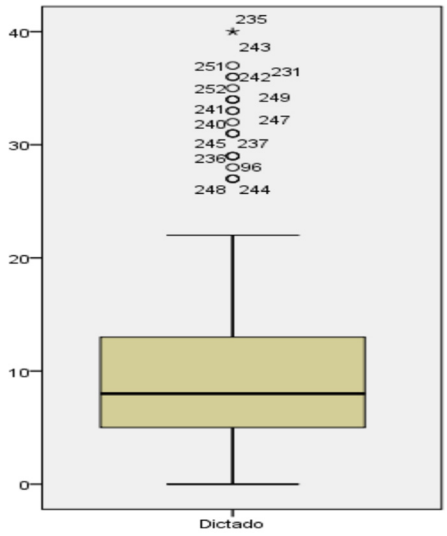
Table 2: *Results in the reading literacy test by levels of right answers*

	N	%
25% Right answers	34	13.5
50 % Right answers	**161**	63.9
70 % Right answers	**55**	21.8
100 % Right answers	**2**	0.8

Source: Prepared by the authors.

As far as spelling is concerned, the average number of spelling mistakes in the dictation test is 8 (*DT*= 3.12). There are some extreme values, as it can be seen in graph 1, with very high levels of spelling mistakes, and greater value dispersion can be seen in the top of the graph. This means that there is a wider range of spelling mistakes between 50% and 74% of the sample.

The link rates between the variables are shown in table 3. A high link rate between the performance in mathematics and Spanish language (*r*= 0.747, *p*=0.000) is evidenced, as well as an average link rate between the performance in Spanish language and reading literacy, (*r*= 0.396, *p*= 0.00), and the performance in mathematics and reading literacy



Graph 1. *Box plot for the "spelling" variable*

(*r*= 0.351, *p*= 000). As far as the relationship between reading literacy and spelling coding skills are concerned, the link is weak and is not statistically significant in the case of spelling (*r*=-0.118, *p*= 0.062). In last place, as far as the relationship between intelligence and the other variables is concerned, statistically significant links between intelligence and performance in Spanish language were found (*r*= 0.201, *p*=.001), as well as between intelligence and spelling (*r*=-0.463, *p*=.000).

Table 3. P*earson correlations between the variables*

	Language	Mathematics	Reading literacy	Spelling
Language		.747*	.396*	-.194*
Mathematics	.747*		.351*	-.131*
Reading literacy	.396*	.351*		-.118*
Spelling	.194*	-.131*	-.118*	
Intelligence	.201*	.081	.019	.-.463*

Source: Prepared by the authors.
Note: *p<0.05

New comparisons were made to try to analyse the relationship between intelligence and the variables studied. The "intelligence" variable was categorised in 3 groups (students with a deviation below average, at the average and above average) and it also was compared to the "performance in Spanish language"

and "performance in spelling" variables. The comparisons of the averages verified this relationship both in spelling (*F*=37,84, *p*=0,00) and performance in Spanish language (*F*=5,303; *p*=0,006). It could not be verified in the case of reading literacy (*F*=1,369; *p*=0,249).

Characterisation of the sample of children according their levels of reading literacy and coding

As it can be seen in table 4, 3 subgroups were created by following the following criteria: the first group had a higher level of reading literacy (n=37), made up by those students whose average of reading literacy was one deviation above the average. The second group (n= 165) had values close to the average and the third group was made up by those students who were one deviation below the average (n=50).

Table 4. *Results of the variables analysed according to the level of reading literacy*

	Low level n=50		Average level=165		High level n=37	
	M	D.T.	M	D.T.	M	D.T.
Literacy	6	1	12	2	18	2
Spelling	12	5	9	5	5	4
Language	6.74	1.71	6.90	1.86	7.06	1.63
Mathematics	6.63	1.70	6.86	1.92	7.43	1.69
Intelligence	28	9	31	9	32	12

Source: Prepared by the authors.

As expected, the highest average score in all the variables were found in the group having a higher level of reading literacy: their average in Spanish language was 8 points; the average in their performance in mathematics was 8 points and they had a very low range of spelling mistakes (56.4% of these students made less than 6 mistakes). Nevertheless, it was also found that 30.8% of the students of this group were one deviation below the average in their intelligence scores.

In order to identify any statistically significant differences in the variables depending on the level of reading literacy between groups, the averages were compared and the effect size was calculated. Significant differences were found in the variables of performance in Spanish language (*F*= 5878.0, *p*=0.00, $^{eta}2$=0.889) and performance in mathematics (*F*=1224.00, *p*=0.000, $^{eta}2$=0.988), as well as in the spelling test (*F*=19.381, *p*=0.00, $^{eta}2$=0.135).

The same preceding procedure was used to establish the subgroups depending the performance in the spelling test. The first group (n=35) having a higher level of spelling (its score in spelling was one deviation above the average), the second group (n= 109) having an average level of spelling and the third group (n=108) was made up by those students having a lower level, their average score being one deviation below the average. In order to determine the level of overlapping between groups, a contingency table analysing prevalence in each group the was created A relationship between the level of reading literacy and spelling coding (χ2= 33. 947, p=0.00, V=0,260) was identified.

As it can be seen in table 5, 2.78% of the individuals have a very low level of spelling and a very high level of reading literacy. 0.4% of the individuals obtain poor results in the reading literacy test while they obtain good results in the spelling tests. 13.1% of the individuals obtained poor results in both tests and 5.56% of the individuals obtained good scores in both tests.

When the two variables are analysed jointly, it is found that a very small proportion of the students (5.56%) obtains good results both in the spelling and the reading literacy test; only 30.56% of the sample have an average level in both skills; and that those students having a lower lever in reading literacy and spelling represent 13.1% of whole sample.

It should also be highlighted the fact that there are students who, in spite of having a high and average level of reading literacy, have difficulties in spelling (29.7%) and that, in the case of those students having difficulties in both skills, a large proportion has difficulties in reading literacy (66% of the students). This proportion represents 13.1% of the whole sample.

Table 5. *Results depending on the level of reading literacy and spelling*

		High Level of Spelling	Average Level of Spelling	Low Level of Spelling	Total
High Level of Reading Literacy (CL, as per its Spanish acronym)	n	14	16	7	37
	% CL	37,84%	43,24%	18,92%	100%
	% Spelling	40,00%	14,68%	6,48%	14,68%
	% of the total	5,56%	6,35%	2,78%	14,68%
Average Level of CL	n	20	77	68	165
	% CL	12,12%	46,67%	41,21%	100%
	% Spelling	57,14%	70,64%	62,96%	65,48%
	% of the total	7,94%	30,56%	26,98%	65,48%
Low Level of CL	n	1	16	33	50
	% CL	2,00%	32,00%	66,00%	100%
	% Spelling	2,86%	14,68%	30,56%	19,84%
	% of the total	0,40%	6,35%	13,10%	19,84%
Total	n	35	109	108	252
	% CL	13,89%	43,25%	42,86%	100%
	% Spelling	100 %	100%	100%	100%
	% of the total	13,89%	43,25%	42,86%	100%

Source: Prepared by the authors.

Discussion

The development of reading literacy, spelling and academic performance among students in their last year of primary education was compared in this work. The scores obtained by groups with and without any difficulties in reading literacy and spelling were compared.

First and foremost, it can be assumed that those schoolchildren in Year 6 of primary education had a low and/or poor performance in their assignments of spelling and reading literacy, in the same line as the results referred to in the PIRLS (INEE, 2012) and PISA (INEE, 2014) reports mentioned above.

The relationship between performance in Spanish language and reading comprehension still exists, in the same line as the results that have been obtained by González and Delgado (2009). In their study, those children who had followed the programme of intervention in reading and writing had a better academic performance in Spanish language. Similarly to the results obtained by Moje, Stockdill, Kim & Kim (2011); in their study, the relationship between reading literacy and performance in other curriculum areas was evidenced.

Nevertheless, the relationship between performance in Spanish language and spelling coding could not be confirmed in the same line as Alegría, Marín, Carrillo & Mousty (2003). These authors could not demonstrate the predictive ability of the skill of spelling in the academic performance in Spanish language in any of their prior studies. Although some authors such as Mata, Ortega & Mieres (2007) refer to other studies that are not in that same line (Bryant, Nunes & Bindman, 2000; Defior 1990; Jiménez & Artiles 1990; Jiménez-Gregg & Díaz, 2004). With regard to the relationship between intelligence and the other variables, a moderate relationship with spelling and performance in Spanish language could be confirmed, but not with reading literacy. We believe the absence of such relationship can be due to the type of test selected to measure it; the test measures general intellectual abilities but it does not specifically take into account any abilities or processes related to the verbal component of intelligence.

With regard to the relationship between reading literacy and spelling, when they are analysed jointly and their levels are differentiated, it is found that good performance in reading literacy does not assure any equivalent and appropriate performance in spelling. Three profiles of students were identified:

one group had difficulties both with spelling and reading literacy who could be referred to as ‹‹poor readers››. These results match those obtained in prior works by Perfetti & Lesgold (1979); in their opinion, those children with a low level of reading literacy have a less automated coding that those children with a good level of reading literacy, which makes reading comprehension more difficult. In second place, some individuals with average levels of spelling and a poor level of reading literacy, called "poor comprehenders" (Yuill & Oakhill, 1991) were identified. In last place, a third profile that is more heterogeneous was identified, made up by those students who, in spite of having a good level of reading literacy, they have average or poor levels of spelling.

The correlational nature of the study and the limitation of the number of variables studies (no sensory, visual and aural variables could be taken into account) do not allow to establish a causal relationship, but it can provide some guidelines that should be taken into consideration when these skills are worked on in the classroom.

The spelling activities proposed for the classroom should not promote repetitive, mechanical practices but significant learning, which promote the students' own interest. The teaching of spelling cannot be understood merely as cramming rules through exercise that are stripped of context. Memory-based learning of spelling is necessary but it is not sufficient. Teachers should try to integrate several linguistic skills in the didactic activities and offer their students the opportunity to reflect on and understand what they are doing and become aware of their mistakes in order to correct them (Rodríguez-Ortega, 2015).

From a constructive point of view, mistakes are not seen as infringements, but as symptoms of the difficulties faced by the students' thought process. Actual learning cannot be achieved if learning checks in new environments cannot be conducted. Therefore, transfer should not take place after didactic work, but it should be part of it (Astolfi, 1999).

The teaching of spelling cannot be approached from the point of view of grammar only, but it should be approached by strengthening the communicative aspects through production of written texts. Written production is a more complex process where, in addition to monitor spell checking, ideas should be generated and arranged and syntax should be verified. By attaching emphasis to the process instead that to the final product, more positive attitudes will be generated towards the relevant abilities in order to be able to work with ideas and words (Cassany, 1990).

In our opinion, a holistic approach that highlights both the written production process and the final process is the most appropriate approach. From the point of view of the language teaching, spelling can be presented as a multiple activity, with different levels of complexity, where spelling is combined with other activities to produce a written message (Pujol-Llop, 2001). The learning of spelling should not be abstracted from real situations; in other words, it should be approached as a complex communicative activity, and seek the support of technologies, where possible. The activities performed in the classroom (reading, essays, etc.) can be used to remember and memorise spelling rules, to identify and search for words that comply them and underline those words covered from the point of view of spelling (Cuetos, Ramos & Ruano, 2004). As meanings are extracted from readings and essays, ideas are integrated and inferences are made. Reading literacy and spelling are thus approached jointly. Any programme dealing with the improvement of these two skills simultaneously will help students improve their academic performance globally.

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