Testing the direct and inferential mediation model of reading comprehension in Spanish students

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Abstract

The direct and inferential mediation model (DIME) proposes that reading comprehension is the result of interactions between prior knowledge, word reading, vocabulary, comprehension strategies, and inference skill. In this study, its relevance was tested through structural equation modelling in a sample of 241 5th and 6th graders in primary education schools in Spain. The model showed an adequate relevance explaining 60.5% of the variance in reading comprehension of expository texts using general domain tests to measure the predictor components. Prior knowledge was the component with the greatest total effect on reading comprehension, followed by vocabulary, inference skill, and comprehension strategies. The total effect of word reading was not significant. The direct and indirect effects on reading comprehension of prior knowledge, vocabulary, and comprehension strategies were significant. The direct effects from prior knowledge to comprehension strategies and from vocabulary to comprehension strategies were not significant. The results found have important implications in the design of intervention programmes to improve reading comprehension.

Keywords: Reading comprehension; reading strategies; prior learning; vocabulary; inferences; Elementary Education.

Comprobación del modelo de comprensión lectora directo y de la mediación inferencial en alumnado español

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Resumen

El modelo directo y de la mediación inferencial (DIME) propone que la comprensión lectora es el resultado de las interacciones entre los conocimientos previos, la lectura de palabras, el vocabulario, las estrategias de comprensión y la habilidad inferencial. En este estudio se comprobó su ajuste a través del modelado de ecuaciones estructurales en una muestra de 241 estudiantes españoles de 5.º y 6.º de Educación Primaria. El modelo mostró un ajuste adecuado explicando el 60.5% de la varianza de la comprensión lectora de textos expositivos usando pruebas de dominio general para medir los componentes predictores. Los conocimientos previos fueron el componente con mayor efecto total sobre la comprensión lectora, seguido del vocabulario, la habilidad inferencial y las estrategias de comprensión. El efecto total de la lectura de palabras no fue significativo. Los efectos directos e indirectos sobre la comprensión lectora de los conocimientos previos, el vocabulario y las estrategias de comprensión fueron significativos. Los efectos directos desde los conocimientos previos hasta las estrategias de comprensión y desde el vocabulario hasta las estrategias de comprensión no fueron significativos. Los hallazgos encontrados tienen implicaciones importantes en el diseño de programas de intervención para la mejora de la comprensión lectora.

Palabras clave: Comprensión lectora; estrategias de lectura; conocimientos previos; vocabulario; inferencias; Educación Primaria.

INTRODUCTION

Reading comprehension is a highly complex cognitive activity that involves constructing a coherent mental representation of the information contained in texts (McNamara & Magliano, 2009). Its development is one of the most important tasks throughout schooling, as it is essential for accessing knowledge across different curricular areas. However, in educational practice it is not easy to design effective programmes to enhance it. Considering scientific evidence is a necessary first step, but most teachers may see this challenging for two reasons: on the one hand, they have not been trained to critically analyse published studies, and on the other, the sheer amount of information to be reviewed is overwhelming. One way to address this problem, at least partially, is to take into account component-based models of reading comprehension. These models synthesise research findings and describe the skills and knowledge that should be targeted to improve reading comprehension, as well as those that are important to assess when difficulties are found. A model that has had considerable effect due to the simplicity of its formulation and its closeness to teaching practice is the simple view of reading (SVR).

The SVR (Hoover & Gough, 1990) proposes that reading comprehension results from the interaction between two components: decoding and general language comprehension. The DIME model, although grounded in the SVR, is more complex, since in addition to decoding —referred to as word reading—and general language comprehension—represented by vocabulary— it incorporates other components: prior knowledge, inference skill, and comprehension strategies (Ahmed et al., 2016). In the educational field, having a model that integrates more variables and their interrelationships is of great interest, as it could contribute to the development of more precise intervention programmes.

The DIME model (Cromley & Azevedo, 2007) is defined as "direct" because all of its components have a direct effect on reading comprehension, and as "inferential mediation" as most of them —with the exception of word reading— also have a direct effect through inference skill. The model assumes that prior knowledge has a direct effect on reading comprehension when dealing with literal information, but also an indirect effect when the text requires the construction of inferences. Vocabulary has a direct effect on reading comprehension, since not knowing the meaning of a word hinders literal comprehension, but it also has an indirect effect, as not knowing a synonym of a word prevents establishing an inferential relationship between that word and its referent. Comprehension strategies exert both direct and indirect effects on reading comprehension, since carrying out a summary, for instance, can help construct inferences that lead to better understanding.

The first formulation of the DIME model was proposed by Cromley and Azevedo (2007). In the procedure for its construction, a literature review was conducted that included studies involving English-speaking 4th graders onwards. To establish unidirectional paths, or direct effects, they proposed the criterion that at least one experimental or quasi-experimental study should demonstrate that an intervention focused on one component of the model had an effect on another. In cases where it was not possible to establish a unidirectional path based on this criterion, studies were sought to support a bidirectional or correlational path. The authors tested the fit of four variations of the model, justified by unidirectional paths for which the evidence was weak or contradictory. Figure 1 shows the model that best fits the data from 177 English-speaking 9th graders.

Figure 1

Best-fitting model in Cromley and Azevedo (2007)
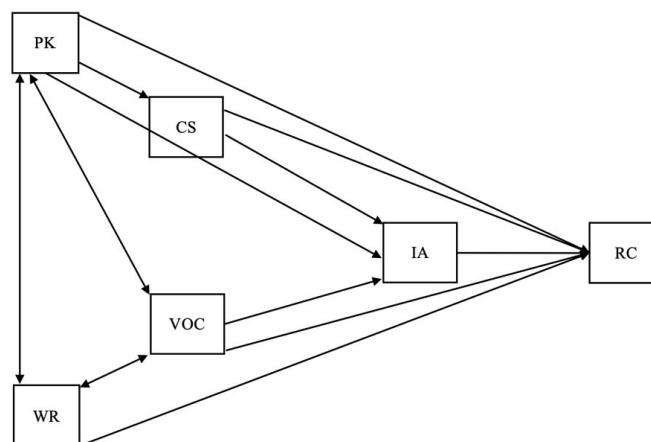
Note. PK = prior knowledge; WR = word reading; VOC = vocabulary; CS = comprehension strategies; IA = inference skill; RC = reading comprehension. Single-headed arrows represent direct effects, and double-headed arrows represent correlations.

The DIME model has been tested in Spanish following a procedure similar to that used by Cromley and Azevedo (2007). However, evidence has only been found for the unidirectional paths from comprehension strategies, inference skill, and vocabulary to reading comprehension, as well as from prior knowledge and comprehension strategies to inference skill (Martínez-Cubelos & Ripoll-Salceda, 2022).

Cromley et al. (2010) examined the best-fitting version proposed in Cromley and Azevedo (2007), comparing it with a modified version that included a new unidirectional path from vocabulary to comprehension strategies. The modified version proved to be the best fit for the data from 737 English-speaking university students. Similar results have been found in three other studies: two in English and one in German (Ahmed et al., 2016, 2022; Härtig et al., 2022).

In general, findings from previous research show that the DIME model is useful to explain reading comprehension of both narrative and expository texts, despite the significant differences between their characteristics. Expository texts are more difficult to understand and are less well remembered, as they include specialised vocabulary and subject matter (Mar et al., 2021). Results also show that the most important predictor components are prior knowledge and vocabulary. However, it should be noted that in the study by Ahmed et al. (2022), the strongest predictor was word reading, probably because the participants showed decoding difficulties.

Despite progress in the study of this model, its applicability to Spanish-speaking students has not yet been analysed. Adopting a model whose evidence is based on another language may be risky, as results may be conditioned by the characteristics of the orthographic system. In irregular systems, such as the English system, word reading shows a stronger relationship with reading comprehension, since readers require more time than in transparent systems, such as the Spanish system, to achieve high levels of reading accuracy (Florit & Cain, 2011; Ripoll-Salceda et al., 2014).

In this study, the fit of the DIME model was tested with 5th- and 6th Spanish graders. The a priori model considered was the one that showed the best fit in Cromley et al. (2010). Participants were selected from these grades because, as shown in the validation of other models such as the SVR, in the early years of primary education word reading is the variable that contributes most to reading comprehension, whereas in higher grades it is general language comprehension that makes the greatest contribution (Florit & Cain, 2011; Hjetland et al., 2017; Ripoll-Salceda et al., 2014). Since the DIME model is more complex than the SVR, testing it in higher grades allows for a more specific understanding of which variables, and to what extent, contribute to reading comprehension beyond general language comprehension.

To examine whether students' general linguistic abilities are sufficient to understand typical texts from the area of Social and Natural Sciences, a test of reading comprehension using expository texts was employed. Furthermore, the predictor components were assessed with general-domain measures, as they were not related to the content of the texts used to evaluate reading comprehension. The applicability of the DIME model to explain the comprehension of expository texts, as found in previous studies, may be conditioned by the specificity of the measures employed. In Cromley et al. (2010), all predictor components were assessed with domain-specific measures, as they were related to the content of the comprehension test text, and in Härtig et al. (2022) prior knowledge was evaluated with a domain-specific test. In research not based on the DIME model, it has been found that when domain-specific knowledge is considered, the strength of the relationship with reading comprehension is greater than when domain-general knowledge is assessed (Afflerbach, 1990; Miller & Keenan, 2009). Moreover, the teaching of domain-specific vocabulary has a direct effect on reading comprehension (Wright & Cervetti, 2017), whereas it is irrelevant when the vocabulary is domain-general (Cervetti et al., 2023).

The following objectives were established to provide evidence on these issues:

– To examine whether the DIME model can be applied to explain the reading comprehension of expository texts in Spanish 5th- and 6th graders.

–To determine the effects of the predictor components of the DIME model on reading comprehension in Spanish 5th- and 6th graders.

METHOD

Participants

The sample consisted of 122 girls and 119 boys from 5th (n = 135; M age = 10.40 years; SD = 0.52) and 6th grade of primary education (n = 106; M age = 11.43 years; SD = 0.54). The sample was drawn from four public schools in the autonomous community of La Rioja (Spain) using a convenience sampling technique: two urban schools and two rural cluster schools. Data from 11 participants were excluded because they did not have the basic skills required to complete the written assessment tests without adaptations.

Measurements

– Collective Reading Efficiency Test (TECLE, as per its Spanish acronym) (Marín & Carrillo, 1999). The test consists of 64 items, each formed by a sentence missing its last word. The participant must choose from four options the word that best completes the sentence. The time limit to complete as many items as possible was 5 minutes. One point was awarded for each correct item, with scores ranging from 0 to 64. To reduce the effect of chance guessing, the final score was estimated as the number of correct responses minus the number of errors divided by three (Domínguez-Gutiérrez et al., 2016). In the manual of the Uruguayan version, reliability measured with the test-retest method is reported as .88, and convergent validity, using a reading fluency test as the criterion variable, as .80 (Cuadro & Costa, 2019). In this study, reliability was .95 measured with Cronbach's alpha (α), .96 with McDonald's Omega (ω), .97 with the Composite Reliability index (CR), and .41 with the Average Variance Extracted (AVE). Although the AVE was below .50, reliability can be assumed to be adequate, since it has been suggested that a CR value above .70 is sufficient. AVE is considered a very strict indicator and tends to reject models with low factor loadings (Malhotra & Dash, 2011).

– General Knowledge Test (Duñabeitia et al., 2016). This test consists of 132 items in the form of short-answer open questions. Because it was validated with university students and items are organised in increasing order of difficulty, an abbreviated version with the first 41 items was used. One point was awarded for each correct response, with scores ranging from 0 to 41. In a pilot study with Spanish 6th graders, reliability measured with α was .82 (n = 56). Convergent validity, using grades in Natural Science and Social Science as criterion variables, was .48 and .29, respectively (n = 27). In this study, reliability was assumed to be adequate: α = .86, ω = .86, CR = .90, and AVE = .20.

– Vocabulary subtest of the Analytical Assessment Battery of Written Language (PEALE, as per its Spanish acronym) (Domínguez-Gutiérrez et al., 2013). This test includes 42 items, each consisting of a target word and three options. The participant must select the word whose meaning is the most similar to the target word. One point was awarded for each correct response, with scores ranging from 0 to 42. In order to reduce the effect of chance guessing, the final score was estimated as the number of correct responses minus the number of errors divided by two (Domínguez-Gutiérrez et al., 2016). This test has been used in different studies, with reliability reported between .90 and .97 with α and between .90 and .99 with the split-half method (Domínguez-Gutiérrez et al., 2016; Hernández-Sobrino et al., 2023). In this study, reliability was assumed to be adequate: α = .75, ω = .86, CR = .87, and AVE = .17.

– Reading Awareness Scale (ESCOLA, as per its Spanish acronym) (Puente et al., 2009). This is a self-report test in multiple-choice format with three options designed to assess comprehension strategies. It provides information about "how readers perceive themselves" and "how they believe they would act" in given situations. In this research, the abbreviated version 28B was administered, as the manual advises against using the full version with participants aged 10 or younger. Scores ranged from 0 to 56. The manual report's reliability of .81 (α) and convergent validity of .72 using a metacognition test as the criterion. In this study, reliability was considered poor: α = .56, ω = .56, CR = .67, and AVE = .10.

– Oral Inference Test. Since no reference or widely used test exists to assess inference skill in Spanish, this test was designed by the second author of this study. The full version comprises 38 items, each with a short statement followed by an open short-answer question. The first eight items require constructing inferences to establish reference-referent relationships, the next 11 items to identify implicit cause-effect relationships, the following 13 items to make predictions about events in the text, and the last six items to answer questions whose responses are not explicitly stated. One point was awarded for each correct answer, with scores ranging from 0 to 38. In a pilot study with 71 Peruvian 5th- and 6th graders, reliability was of .74 (α). In this study, reliability was considered poor: α = .62, ω = .63, CR = .70, and AVE = .10. Convergent validity was .46 using as the criterion variable the inferential questions of the reading comprehension subtest from the Reading Process Assessment Battery (PROLEC-SE, as per its Spanish acronym) (Ramos & Cuetos, 2005).

– PROLEC-SE (Ramos & Cuetos, 2005). This test includes two expository texts, each followed by five literal and five inferential questions. One point was awarded for each correct response, with scores ranging from 0 to 20. The manual report's reliability of .85 (α) and convergent validity of .23 using teacher ratings of students' reading ability as the criterion variable. In this study, reliability was assumed to be adequate: α = .76, ω = .77, CR = .80, and AVE = .18.

Procedure

Data were collected between March and May 2019, with prior authorisation from the Department of Education of La Rioja (Spain), the Research Ethics Committee of the University of Navarra (Spain), and the students' families. The assessment instruments were administered in groups by the principal investigator of this study in two sessions of approximately 60 minutes each.

Data analysis

Before testing the model fit, the database was inspected to identify and manage outliers. In addition, it was verified that the data met the assumptions required for path analysis. Univariate outliers were identified using the median absolute deviation, and multivariate outliers with the minimum covariance determinant (Leys et al., 2019). The assumption of univariate normality was checked by examining skewness and kurtosis coefficients; multivariate normality through Mardia's kurtosis coefficient; homoscedasticity with the Breusch-Pagan and White statistical tests; absence of multicollinearity through the variance inflation factor (VIF); and linearity through a scatterplot of residuals and standardised predicted values of the dependent variable.

Once the database assumptions were verified, a path analysis was conducted to test whether the DIME model can be applied to explain the reading comprehension of expository texts in Spanish-speaking 5th- and 6th graders. A structural equation model with observed variables was tested. Statistical analyses were conducted using SPSS Amos (version 23) software. The maximum likelihood method was employed, as it is the most commonly used when data are continuous and follow a multivariate normal distribution. To evaluate model fit, the chi-square/degrees of freedom ratio (χ^2/df), the root mean square error of approximation (RMSEA), the standardised root mean square residual (SRMR), the comparative fit index (CFI), and the Tucker-Lewis index (TLI) were considered. The model was regarded as a plausible approximation to the data when $\chi^2/df < 3$, RMSEA $\leq .08$, SRMR $\leq .08$, CFI $\geq .90$, and TLI $\geq .90$ (Kline, 2016).

In order to determine the effects of the predictor components on comprehension, the values of bidirectional paths were calculated as correlations (r), and the values of unidirectional paths, or direct effects, as standardised regression coefficients (β). This coefficient indicates the amount of change, in standard scores, that occurs in the dependent variable for each unit change in the corresponding independent variable, while holding the others constant (Kline, 2016). Indirect effects on reading comprehension—those mediated by other components—as well as total effects, defined as the sum of direct and indirect effects, were also estimated as β. Since SPSS Amos does not calculate standard errors, confidence intervals, or p-values linked to these parameters, statistical significance was determined using the bootstrapping method, setting confidence intervals at 95% and the number of bootstrap samples at 1499 (Davidson & MacKinnon, 2000).

RESULTS

Database inspection

In order to ensure that the potential presence of outliers was not due to errors in the scoring of the assessment tests, the reliability of this procedure was evaluated using data from inference skill and reading comprehension, as their scoring requires interpretation of responses. Inter-rater agreement was estimated through the intraclass correlation coefficient, yielding excellent values (.98 and .97). In addition, the database was reviewed to identify errors in data entry, and descriptive statistics were examined to detect out-of-range scores in the assessment test scales. Table 1 shows that, in all cases, the minimum and maximum scores obtained were within the expected ranges.

Table 1

Descriptive statistics

	Min. score	Max. score	*M*	*SD*
Word reading	17	64	45.01	11.58
Prior knowledge	1	32	14.29	6.32
Vocabulary	9	39	29.15	5.93

	Min. score	Max. score	*M*	*SD*
Comprehension strategies	20	53	40.96	5.20
Inference skill	13	27	21.47	2.74
Reading comprehension	0	17	7.63	3.89

NotaM = mean; SD = standard deviation.

Fifteen univariate outliers were identified and recoded to the accepted minimum and maximum scores, and six multivariate outliers were retained in the dataset, as it was confirmed through a multi-group invariance analysis that they were not problematic (Bowen & Guo, 2011). Skewness and kurtosis coefficients ranged from −0.83 to 0.23, Mardia's kurtosis coefficient was −2.5613, the p-values linked to the Breusch-Pagan and White tests were .11 and .41, respectively, and the VIF values ranged from 1.068 to 1.945. Therefore, the data met the assumptions of univariate normality, multivariate normality, homoscedasticity, and absence of multicollinearity. The assumption of linearity was also satisfied, as the residuals were randomly scattered around the horizontal line of the standardised predicted values of the dependent variable.

Applicability of the DIME model to Spanish

The findings suggest that the DIME model can be applied to explain the reading comprehension of expository texts in Spanish 5th- and 6th graders, as the fit indices met the commonly proposed cut-off criteria for model acceptance: χ^2/df = 2.6, RMSEA = .08, SRMR = .03, CFI = .90, and TLI = .95. The model accounted for 60.5% of the variance in reading comprehension.
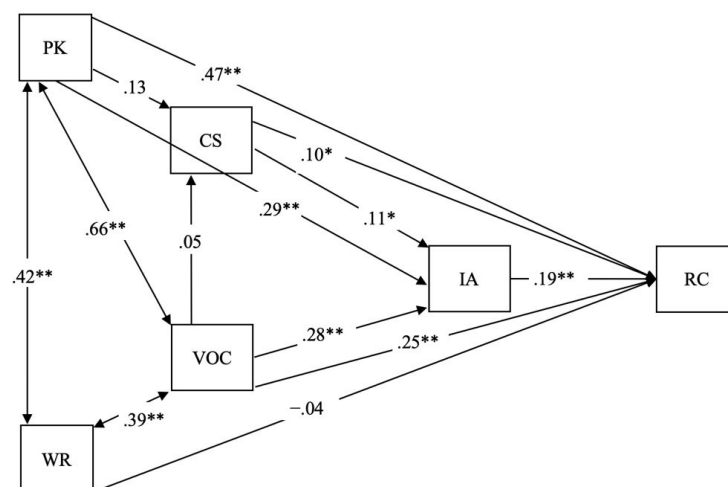
Effects on reading comprehension

The direct effects (β), linked to the unidirectional paths, on reading comprehension were significant, except for that corresponding to word reading, with values ranging from small (≥ .02 and < .15) to large (≥ .35). The indirect effects (β) were all significant, with small values (≥ .02 and < .15). The total effects (β) were also all significant, with values ranging from small (≥ .02 and < .15) to large (≥ .35) (Cohen, 1992). Table 2 provides a detailed account of the direct, indirect, and total effects. The path diagram in figure 2 displays the values of the bidirectional paths (*r*) and the unidirectional paths (β).

Table 2

Standardised effects on reading comprehension

Predictors	Direct effects	Indirect effects	Total effects
Word reading	−.04	–	–
Prior knowledge	.47[**]	.06[**]	.53[**]
Vocabulary	.25[**]	.06[**]	.31[**]
Comprehension strategies	.10[*]	.02[*]	.12[**]
Inference skill	.19[**]	–	–

Note. [**]p < .01; [*] p < .05.

Figure 2

Correlation values and direct effects

Note. PK = prior knowledge; WR = word reading; VOC = vocabulary; CS = comprehension strategies; IA = inference skill; RC = reading comprehension; ** $p < .01$; * $p < .05$. Single-headed arrows represent direct effects, and double-headed arrows represent correlations.

DISCUSSION

The fit of the DIME model was adequate, showing that the general linguistic skills of 5th- and 6th graders are sufficient to understand typical texts from the area of Social and Natural Sciences. The model explained 60.5% of the variance in reading comprehension, a result higher than that found by Ahmed et al. (2016) with path analysis (between 36% and 58%) and in Ahmed et al. (2022) in 3rd grade (57%). However, it was slightly lower than that reported by Cromley and Azevedo (2007) with the best-fitting version of their model (65.7%) and by Ahmed et al. (2022) in 4th grade (61%). In the modification by Cromley et al. (2010) (92.8%) and in Ahmed et al. (2022) in 5th grade (100%), the explained variance was substantially higher. Comparisons with the study by Härtig et al. (2022) are not possible, since no information on the percentage explained by the model is provided. These findings suggest that when domain-specific linguistic skills are considered, the strength of the relationship with reading comprehension is greater than when general-domain skills are assessed. In Cromley et al. (2010), the model explained 92.8% of the variance using only domain-specific measures, whereas in the present study it accounted for 60.5% using general-domain measures.

On the other hand, the most important total effect on reading comprehension was linked to prior knowledge. Furthermore, both its direct effect and its indirect effect, mediated by inference skill, were significant. These findings suggest that prior knowledge contributes directly to reading comprehension when the text does not require going beyond explicit information, and indirectly when inference construction is needed. A possible reason for the importance of having knowledge about the topic of the text when inferences are not required is that it allows the reader to focus attention on key ideas; in cases where inferences are necessary, it facilitates the integration of information by establishing links between seemingly disconnected parts of the text. It should be noted that in this study the direct effect of prior knowledge on comprehension strategies was not significant.

The findings by Cromley et al. (2010) were similar, since the most important total effect on reading comprehension was also linked to prior knowledge. Härtig et al. (2022) did not provide information on total effects; however, as in the present study, the direct effect of prior knowledge on reading comprehension was the most relevant. The results also partially align with those of Cromley and Azevedo (2007). In that study, prior knowledge was the second most important predictor after vocabulary.

Nevertheless, in contrast to the non-significant result obtained in the present study, in the three studies mentioned the direct effect of prior knowledge on comprehension strategies was significant.

It is reasonable to assume that prior knowledge plays an important role in the implementation of certain comprehension strategies. For example, detecting incoherent information in a text requires some knowledge of the content addressed. A possible explanation for the non-significant direct effect found in this study lies in the assessment instruments used to measure comprehension strategies and prior knowledge, as they were not related. This hypothesis is reinforced by the fact that the direct effects were significant both in Cromley and Azevedo (2007) and Cromley et al. (2010), where related tasks were used. In both studies, readers had to apply comprehension strategies to texts related to the knowledge test contents. However, this justification does not hold when considering the findings of Härtig et al. (2022), as the direct effect was significant even with an unrelated measure.

In this study, vocabulary was the second strongest predictor of reading comprehension. Both its direct effect and its indirect effect, mediated by inference skill, were significant. These findings support the hypothesis that readers need to know the meaning of words not only to understand literal information but also to give cohesion to the text by constructing inferences in which semantic relationships are established between references and referents. It should be noted that in this study the direct effect of vocabulary on comprehension strategies was not significant.

These results are consistent with those found by Cromley et al. (2010), since the most important total effect on reading comprehension was also linked to vocabulary. In Härtig et al. (2022), as in the present study, the most relevant direct effect on reading comprehension was linked to vocabulary. The results partially match those reported by Cromley and Azevedo (2007) and Ahmed et al. (2016), since in both cases vocabulary was the component with the greatest total effect.

As in this study, Ahmed et al. (2016) found that the direct effect of vocabulary on comprehension strategies was not significant at any grade level, whereas in Ahmed et al. (2022) it was significant in only one grade. These results contrast with the significant direct effects reported by Cromley et al. (2010) and Härtig et al. (2022). To date, few studies, beyond those focusing on the DIME model, have sought to explain why vocabulary is important for the use of certain comprehension strategies. However, it can be assumed that knowing the meaning of the words in a text plays a decisive role in producing a coherent summary of it. Similarly, knowing the meaning of the words in a title is necessary in order to predict its content or activate prior knowledge.

A possible explanation for the non-significant direct effect of vocabulary on comprehension strategies in the present study, as well as in Ahmed et al. (2016) and Ahmed et al. (2022), may lie in the assessment instruments used, as they were unrelated. This interpretation gains strength when considering that in Cromley et al. (2010) the effect was significant using related instruments, since the vocabulary assessed consisted of words that were part of the texts in which readers had to apply comprehension strategies. However, this explanation does not hold in light of the findings of Härtig et al. (2022), as unrelated instruments were used and the direct effect was nonetheless significant.

In this study, the third most important total effect on reading comprehension was linked to inference skill. It should be noted that this effect corresponds to the direct effect, as this component does not have mediated effects. This result is consistent with Cromley and Azevedo (2007) and Cromley et al. (2010), but not with Härtig et al. (2022), where, unexpectedly, the effect was not significant. This discrepancy could be explained by the fact that this component was measured using a test of visual analogies.

Both in this study and in that by Cromley and Azevedo (2007) and Cromley et al. (2010), the fourth predictor with the greatest total effect on reading comprehension was comprehension strategies. Moreover, both its direct effect and its indirect effect, through inference skill, were significant. These findings support the idea that comprehension strategies do not only facilitate literal understanding but also inferential comprehension. It can be argued that producing summaries, graphic organisers or rereading a section of the text when comprehension difficulties are detected allows readers to make inferences that were overlooked during the first reading.

Word reading was the only predictor of reading comprehension with a non-significant total effect. It should be noted that this effect corresponds to the direct effect, as this component does not have mediated effects. This result replicates those found by Cromley et al. (2010) and, partially, by Cromley and Azevedo (2007), since the effect was significant but the least important. However, these findings are in contrast with those of Ahmed et al. (2022), where word reading was the most important predictor in two of the three grades. The probable reason is that the students in their study were in lower educational levels than those considered in the other DIME model studies. There is ample evidence that in the early years of primary school the effect of word reading on comprehension is greater compared with other components such as inference skill, vocabulary, comprehension strategies, or general language comprehension, whereas the opposite occurs in later grades (Baker et al., 2022; Florit & Cain, 2011; Kim, 2020; Ripoll-Salceda et al., 2014). Another possible explanation for these findings is that participants in Ahmed et al. (2022) had low levels of accuracy and reading speed, which makes the relationship with reading comprehension stronger than in more proficient readers.

Limitations of the study

The findings should be interpreted with caution due to potential methodological limitations. The five predictor components may be capturing part of the variance of other variables that have been identified as important in research, such as morphological awareness, motivation, attention, working memory, or graph-phonological-semantic cognitive flexibility. The reliability estimated for the Oral Inference Test and for ESCOLA was poor. Moreover, the use of self-report measures has been questioned, as readers' perceptions of what they do not always match their actual behaviour (Cromley & Azevedo, 2006). The TECLE was used to assess word reading, since it can be administered in groups, thus requiring less time for data collection. Nevertheless, it should be borne in mind that this test includes a substantial component of reading comprehension, as selecting the correct response requires understanding the sentence.

Recommendations for future research

In future studies on the DIME model in Spanish, it is recommended that students from different educational levels beyond those considered in this study be included, as this would allow for a more complete understanding of the model's fit across ages. Performance-based tasks or think-aloud protocols should be used to address the limitations linked to self-report measures. It would also be advisable to employ different measures of word reading, since in Spanish high levels of accuracy are reached relatively quickly, but reading speed continues to improve throughout primary education. Further research should also examine whether differences arise when using narrative versus expository texts, as these show different characteristics. Finally, the use of structural regression analysis with multiple indicators for each component would be valuable in order to reduce measurement error.

Practical implications

Although word reading is known to be important for reading comprehension, the findings of this study suggest that in the later years of primary education it should not be considered a priority objective. In contrast to pedagogical approaches that focus on teaching skills for locating or processing information, pupils' repertoire of knowledge shows a strong relationship with reading comprehension, suggesting that the development of a broad general knowledge base may be an effective way to foster text comprehension.

AUTHORS CONTRIBUTION

Juan Martínez-Cubelos: Project administration; Formal analysis; Conceptualisation; Data curation; Writing - original draft; Writing - review & editing; Investigation; Methodology; Resources; Software; Supervision; Validation; Visualisation.

Juan-Cruz Ripoll-Salceda: Project administration; Formal analysis; Conceptualisation; Data curation; Writing - review & editing; Methodology; Resources; Software; Supervision; Validation; Visualisation.

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