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Print and digital reading habits and comprehension in children with and without special education needs

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ABSTRACT

Background: Text comprehension is a major obstacle for many Primary school students with special education needs (SEN). Reading episodes bring students opportunities to be exposed to new vocabulary and knowledge, potentially boosting their development of text comprehension skills.

Aims: Our study seeks to understand how reading frequency (leisure and academic) and reading medium (print and digital) contribute to the development of text comprehension during Primary school in students with and without SEN.

Methods and procedures: We tested 2289 Spanish students from fourth to sixth grade, from which 212 had an official decision of SEN. Students self-reported their reading frequency (as a measure of their reading habits) and completed a standardized text comprehension test. We employed multiple regression models with a robust maximum likelihood estimator to test associations between reading frequency and comprehension.

Outcomes and results: Students' comprehension was positively associated with their leisure print reading habits, and negatively associated with their frequency of academic digital reading. Those associations were independent of SEN status.

Conclusions and implications: Results highlight the importance of promoting leisure reading in print to all students, regardless of SEN status. In addition, caution is advised when encouraging Primary school children to use digital texts when the emphasis is on comprehending texts for acquiring knowledge.

What this paper adds

Primary school children with special education needs (SEN) have been reported to expend lower reading times for leisure and academic purposes at home. A reduced reading exposure could negatively contribute to the development of their text comprehension skills. Although some research suggests that digital texts could be particularly useful to motivate students with SEN, recent reviews of the literature have shown that students tend to comprehend slightly better print rather than digital texts. There is still a gap in the literature regarding the combined association between reading habits (leisure and academic), reading medium (print and digital) and text comprehension, particularly in Primary school students with SEN. The aim of this study was to investigate those relationships in a

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large sample of 4th to 6th grade students with and without SEN. To the best of our knowledge, this is the first study to show a negative relationship between academic digital reading habits and text comprehension, as well as a positive association between leisure print reading and comprehension. According to the study findings, those associations were present in both students with and without SEN.

1. Introduction

Text comprehension is a major obstacle for many students with special education needs (SEN). According to the European Agency for Special Needs and Inclusive Education (EASIE, 2022), students with SEN are those with disabilities or learning problems that are seen as eligible for additional educational support to meet their learning needs. Although the nature of the conditions of SEN is varied, those primary conditions (e.g. phonological deficits or intellectual disabilities) usually result in secondary consequences such as text comprehension difficulties (Lyon et al., 2003). Those limitations tend to manifest particularly between 3th-4th grade (Scarborough, 2005), which constitute a turning period in literacy practices at school, characterized by a transition from learning to read to reading to learning. Text comprehension difficulties limits students' motivation to engage in reading activities (McGeown et al., 2016), which they find particularly challenging. In turn, reduced reading exposure limits students' opportunities to be exposed to new vocabulary and knowledge, further limiting their development of text comprehension skills. In other words, reading habits can play an essential role in explaining the growing developmental gap of text comprehension skills during school years between students with SEN and those without (Matthew effect, Stanovich, 1986).

During the last two decades, educational systems around the World have experienced a quick transition in literacy practices, introducing digital devices as alternatives to classic printed texts. Digital devices are now a common tool to practice literacy activities in schools as well as at home. They have become particularly attractive for students with SEN, as they allow for quick and easy adaptations aimed to support reading, such as changing text font, size of letter space (Fälth & Selenius, 2022; Schneps et al., 2013). The closure of schools during the 2019–2020 academic year due to the COVID-19 pandemic contributed to amplifying the presence and use of digital tools to support students' learning activities (Zhou et al., 2020). According to the National Center for Education Statistics, school lockdowns had a profound impact on students' learning (Brandenburg et al., 2020; Lerkkanen et al., 2023; Van Lancker & Parolin, 2020), with a particular negative effect on students with SEN, resulting in lower graduation rates and reduced college attendance (Hussar et al., 2020). Although the benefits of digital tools in education are several, there are also important challenges that need to be considered. A major limitation is that digital texts, as compared to print text, can disrupt reading and negatively impact comprehension (so called screen inferiority effect, Salmerón et al., 2024).

The goal of this study is to bring together those two streams of research, namely reading habits (for leisure and academic reading) and reading medium (print and digital), to understand how they contribute to the development of text comprehension during the last years of Primary school in students with and without SEN. In the following, we review the literature regarding how text comprehension of students with and without SEN is related to leisure reading as well as to academic reading. When revising both research lines, we will particularly focus on the moderating effects of reading medium (print and digital) on the associations between reading habits and comprehension. Finally, we introduce one study designed to test our predictions in a sample of Spanish Primary school students (9–12 years old) with or without SEN, and discuss the results in light of the post COVID-19 pandemic programs for classroom digitalization.

1.1. Reading habits and text comprehension development

The National Institute of Child Health and Human Development (2000) has identified five fundamental reading skills: phonemic awareness, phonics, vocabulary, reading fluency, and text comprehension. The main predictors for text comprehension in children with SEN are similar to those of early readers, such as decoding instead of vocabulary or other predictors acquired at latter stages (van Wingerden et al., 2016). Fluency, as highlighted by Denckla et al. (2014), plays a crucial role in comprehension. Slower readers often exhaust their cognitive capacities on decoding the text, leaving insufficient cognitive resources for comprehension. Despite large efforts in the past to improve SEN reading comprehension, a profound reading gap remains between students with and without SEN, as documented by a recent meta-analysis (Gilmour et al., 2019). Authors synthesized studies that had assessed reading skills from students with SEN, enrolled in elementary (51.4%), middle (41.1%) or high school (7.4%). Results indicated that the average reading achievement gap between students with and without SEN was 1.2 standard deviations. Considering the average annual gains in reading from third to fourth grade, authors estimated that the reading gap resulted in 3.3 years (Gilmour et al., 2019).

Outside school, a major contributor of students' text comprehension is reading practice (Cunningham & Stanovich, 1992), also referred to as reading habits (Duncan et al., 2016). By definition, a habit is a frequent behavior that is developed by recurrent practice, usually associated with an external reward, that is maintained even after this reward is no longer present (Wood, 2017). In this line, reading habits can be promoted through daily activities, beginning in early years, such as, for example, parents' shared-reading (Cunningham & Zibulsky, 2011), and also from the formal school context through teachers' instruction (Baker et al., 2012).

Accordingly, reading habits can also depend on a specific goal pursuit (Wood et al., 2022). Reading is an action that students can engage in due to an inner pleasure drive (i.e. leisure reading) or in order to fulfill some school tasks, such as studying for a test or doing the required homework (i.e., academic reading). To focus on the reading habits that students engage in autonomously, irrespective of its purpose, research usually focuses on the out-of-school reading (Anderson et al., 1988). Thus, leisure reading (Torppa et al., 2019), also known as enjoyment reading (Wang & Guthrie, 2004) and extracurricular reading, refers to the reading the students chooses to do without any kind of explicit instruction or obligation (McKenna et al., 2012). Parallely, academic reading outside of the school represents a higher independent behavior than in-school reading. This difference can rely on the instructor's presence and supervision. While in-school reading may be primarily led by teachers and present low variability among classmates (e.g., a shared book reading

session for all students), the academic reading habits out-of-school depend on the student's commitment and motivation (Hong et al., 2004).

1.2. Leisure reading habits and text comprehension development

Previous research has evidenced the significant advantages of leisure reading habits on text comprehension at different ages (Locher & Pfof, 2020; Mol & Bus, 2011; van Bergen et al., 2023). The evidence consistently points toward a mutually beneficial relationship between reading habits and the development of text comprehension skills (Stanovich, 1986). When individuals read for leisure, they build up core linguistic skills such as new vocabulary and background knowledge, which in turn serve as a foundation for comprehending new and more challenging texts better and advancing their skills.

Reading habits and their reading-related skills is largely studied in typically developing students, but they have been rarely investigated among children with SEN, particularly after pre-school years (Rashid et al., 2005). Because readers with SEN tend to read less compared to students without SEN (He et al., 2014; Kannianen et al., 2022; Scarborough et al., 1991), partly because of insufficient decoding and fluency skills, the lack of exposure to texts may cause further cognitive deficits. School lockdowns during the COVID-19 pandemic may have increased this gap. Mete Yesil et al. (2022) observed that students with SEN reduced their literacy activities at home after the lockdown, potentially affecting their literacy development. Few studies have analyzed the association between reading habits and text comprehension in students with SEN. Of note is that most of these studies used the discrepancy model to classify their participants as students with reading difficulties. Thus, in order to properly interpret its results, it should be noted that, currently, in many countries, regulations established that the criteria for diagnosing reading difficulties must not require the use of a severe discrepancy between intellectual ability and reading achievement.

Rashid et al. (2005) explored the reading habits of 65 first-second grade students with reading disability, i.e. their scores on reading screening tests was more than one standard error of the estimate below the expected achievement based on their IQ. Students' text comprehension was not associated with their reading habits. McBride-Chang et al. (1993) analyzed the relation between reading habits and text comprehension in 36 fifth-ninth grade students with reading difficulties. These students scored at the 25th percentile or below on a standardized text comprehension test, and exhibited a discrepancy between IQ and reading achievement. Reading habits, as measured by a title recognition test, positively predicted text comprehension after controlling for other relevant variables such as word identification and vocabulary. Grant et al. (2007) studied the relation between reading habits and comprehension in an older sample of 13 undergraduate students with reading disability. Students were identified as reading disabled on the basis of a discrepancy between reading ability and general intelligence. The analysis reflected a positive association between their reading habits and text comprehension (Grant et al., 2007).

In sum, although the amount of evidence is limited, research points to a positive association between leisure reading habits and comprehension in students with SEN, particularly after fifth grade. Given that those studies were conducted before digital leisure reading became popular with the proliferation of hand-held digital devices in the 2010 s, the question if such positive association transfer to digital reading medium is still open. The fast integration of digital devices in our everyday life has also been accompanied by a change in our reading habits (Altamura et al., 2024). Digital reading devices are various, from e-books that provide static reading to tablets and smartphones that grant access to unlimited digital content (unavailable in printed sources). We can not just assume that previous effects reported for print reading habits and comprehension would simply transfer to digital reading habits, as research has documented relevant influences of reading medium. Specifically, several meta-analyses that synthesized research from thousands of participants have confirmed the existence of a "screen inferiority effect" (Clinton, 2019; Delgado et al., 2018; Furenes et al., 2021; Kong et al., 2018; Öztöp & Nayci, 2021; Salmerón et al., 2023). This phenomenon refers to the slightly higher text comprehension when people read in print compared to when they (or another comparison group) read the same text in a digital device. Researchers argue that a potential causal mechanism of screen inferiority could be rooted in our daily interaction with technologies. Thus, according to the shallowing hypothesis (Annisette & Lafreniere, 2017), the exposure to the common short and quick digital content is fostering a shallow mindset that impairs in-depth processing when reading on-screen. Such interaction could lead to reduced efficiency in cognitive resource allocation during reading, especially in demanding situations that require readers to effectively self-regulate their reading processes. This reduced efficiency may become particularly salient in the case of struggling readers due to the extra self-regulation demands imposed by reading on digital devices (Ben-Yehudah & Brann, 2019; Salmerón et al., 2021). In a study with 182 5th and 6th graders, Salmerón et al. (2021) found that lower comprehension on tablets, as compared by in print texts, was only significant in a group of struggling readers (i.e. those identified as having at least "mild difficulties" in an independent text comprehension standardized test). Reading medium differences were not observed among the group of students identified as having "normal range" or higher.

Emergent literature examining the relationship between digital reading habits and text comprehension has determined that these new reading habits do not contribute to comprehension, at least to the same extent as print reading habits. A recent meta-analysis on the topic reported almost null associations between leisure digital reading habits and comprehension (Altamura et al., 2024). Additionally, based on moderator analysis, the direction of the small relationship turned out negative for primary and middle school students. The authors also refer to the shallowing hypothesis as a possible explanation of these differences, due to the short length and fast-paced stimuli (Baron, 2021) and the low linguistic quality materials that can be commonly found in online contents (Snow, 2010). In their review, Altamura et al. (2024) highlight the research gap addressing the relationship between digital reading habits and struggling readers' comprehension. In one of the few studies that explored the association between print and digital habits of students with SEN, Kannianen et al. (2022) examined 436 sixth grade students, that included 102 students with reading or attention difficulties. Students performed an online text comprehension test and reported their reading habits (printed and digital) using a reading

frequency scale. Authors did not report the association between habits and comprehension for the group of students with difficulties. Nevertheless, they compared the habits of top performers (all typically developing students) and low comprehension performers (mostly students with difficulties). Low performers presented the lowest rates at reading longer text materials (e.g. printed books and online forums). Thus, while students with SEN tend to read less longer texts than students without SEN, those analyses can not discern if longer reading habits are associated with comprehension.

1.3. Academic reading habits and text comprehension development

As reviewed, research on out-of-school reading habits has primarily focused on leisure reading (not-school related content). However, students are also expected to read school-related content at their homes, without teachers' supervision. Engaging in independent academic reading, in the form of fiction books or textbooks, offers students further opportunities to expand their vocabulary and domain knowledge. Accordingly, variations in the frequency of academic reading could also explain differences in the development of text comprehension skills (De Naeghel et al., 2012). Contrasting with its potential for education, the association between academic reading frequency and text comprehension development during Primary school has not been studied as extensively as the relation for leisure reading (Vinterek et al., 2022).

Using large scale data from different cohorts of PIRLS and PISA, Vinterek et al. (2022) analyzed the evolution of in school reading activities of Primary and Secondary school students from 2007 to 2017. Overall, the percentage of students who read one page or more on a school regular day (regardless of the reading medium) significantly decreased from 2007 to 2017. In addition, the text comprehension gap (i.e. difference between number of high and low achievers) increased during this time period. The authors suggest that such a gap mirrored the decrease in frequency of academic reading, but no formal statistical test was conducted to back this claim. Focusing specifically in the use of ICT devices (digital academic reading) in schools, several studies have worked with PISA data in the last ten years: from 2012 (Petko et al., 2017), 2015 (Park & Weng, 2020; Saarinen et al., 2021), to 2018 (Kong et al., 2022). All these studies converge on the same pattern of results, indicating a negative correlation between ICT use for academic tasks in schools and reading comprehension outcomes. Remarkably, Salmerón et al. (2023) performed a secondary analysis of two large representative datasets of students from 4th and 8th grade, using the National Assessment of Educational Progress (NAEP) 2017 data. Frequency of use of digital tools in the language and arts classroom was negatively associated with students' text reading comprehension. Although disability status, as informed in the database, was included in the analyses as covariate, the authors did not test if such association varied across typical and disabled students.

When examining academic reading habits out-of-school, we do not find much dedicated literature, especially for print materials. One representative study could be the work of McGeown et al. (2016). These authors analyzed a sample of 791 Primary school students (aged 8–10 years old) that reported their frequency of home reading of several text types (which reflected different reading purposes), such as fictional, non-fictional (for leisure) or academic textbooks (for academic reading), and completed a standardized text comprehension test. Multiple regression analyses indicated that reading frequency had differential associations with comprehension. While fictional reading time was positively related to text comprehension, the association for non-fiction and academic textbook reading with comprehension was null. The authors suggest that such discrepancy is related to students' motivation to read: while intrinsically motivated readers tend to spend more time reading fiction for leisure, this does not transfer into higher academic reading times. In the mid-term, a bidirectional association between leisure print reading and reading motivation is observed, which is parallelly associated with reading comprehension. Studies that have considered the use of ICT to do homework at home (out-of-school academic digital reading), found similar results to the in-school patterns, exhibiting negative (Park & Weng, 2020) to almost null associations (Petko et al., 2017) in over 39 countries. Focusing on SEN differences, He et al. (2014) assessed the digital academic reading activities undertaken at home of 5063 students from 3rd to 6th grades. Students with normal or higher IQ scores that scored two SD below average in a dyslexia screening test were identified at risk for dyslexia ($n = 195$). Children from homes with stricter digital use policies were less likely to be identified as at risk for dyslexia. Children from homes that were more severe introducing policies of digital use restriction had lower probabilities to be identified as at risk for dyslexia. Nevertheless, students at risk for dyslexia declared that they use the Internet for study less often than those not identified as at risk. Thus, although the results showed a clear negative association between digital tool use at home and dyslexia, we can't attribute this to digital academic reading.

In sum, research on the relation between academic reading, especially for print and out-of-school contexts, and text comprehension development is limited, and conclusions are thus only tentative (Vinterek et al., 2022). Overall, the association between academic reading and comprehension appears to be much lower than that found for leisure reading habits. In addition, reading media of the academic texts (print or digital) may differently relate to text comprehension development. Adding to the previously mentioned screen inferiority effect (Annisette & Lafreniere, 2017) and the potential working-memory overload resulting from increased task-switching with digital devices (Saarinen et al., 2021), we must also take into account the role of motivation in shaping reading habits.

Regarding academic reading and students with SEN, previous research suggests that those students tend to be less motivated to engage in academic activities than those without SEN (Chapman, 1988; Fulk et al., 1998), and thus we should observe lower frequency of academic reading among them. Nevertheless, to the best of our knowledge, the extent to which the associations between academic reading and comprehension are present in SEN in Primary school are still an open question. Based on the research showing that the self-regulation demands imposed by digital reading may particularly overload struggling readers (Anmarkrud et al., 2018; Ben-Yehudah & Brann, 2019; Salmerón et al., 2021), we can expect that students with SEN may benefit less from academic reading, particularly when presented in digital devices, than those without.

1.4. The present study

Prior research has mostly focused on the associations of leisure reading habits and text comprehension development (Locher & Pfost, 2020; Mol & Bus, 2011; van Bergen et al., 2023), and to a lesser extent on the relations between academic reading habits and comprehension (Vinterek et al., 2022). Most of the previous research has not considered the potential influences of medium (print and digital) on such association. In addition, only few studies have specifically analyzed the relation between reading habits or academic reading frequency and text comprehension in students with SEN. Our study aims to disentangle the combined effects of leisure reading habits and academic reading in different reading medium (paper vs. digital) on text comprehension development, on a large sample of Primary school students with and without SEN. Based on the review of the literature, we propose the following hypotheses:

- H1.** . Larger positive association between text comprehension and print, rather than digital, leisure reading habits, regardless of SEN status.
- H2.** . Lower association between leisure reading habits (regardless of reading medium) and text comprehension for students with SEN, compared to those without.
- H3.** . Larger positive association between text comprehension and print, rather than digital, academic reading habits, regardless of SEN status.
- H4.** . Lower association between academic reading habits (regardless of reading medium) and text comprehension for students with SEN, compared to those without.

By including students' socio-economic status and grade level as covariates, and by controlling for students' class, we wanted to ensure that any associations identified occurred independently of these individual and group factors.

2. Method

2.1. Participants

2289 students participated in the study. Sixteen schools from the region of Valencia, Spain, collaborated in the study. The educational system in Spain is based on inclusive education principles. Children with an official decision of SEN are enrolled in mainstream classes alongside their peers for most – 80% or more – of the school week (EASIE, 2022). On average, most classes only include 2–3 students with SEN. In our sample, an exception to this rule was one school with a focus on compensatory education, in which a majority of their students had SEN associated with lack of family resources. Students were enrolled in 4th to 6th grade, which corresponds to the last three school years of primary education in Spain. 51% of them were girls. The minimum age, in fourth grade, is 9 years and the maximum age, in sixth grade, is 12 years. While students were completing the text comprehension test, the tutor assigned to each class filled out a questionnaire to indicate whether a student had an official decision regarding SEN. In such cases, the tutor specified the type of SEN, according to the categories outlined in Spanish legislation.

212 students of this sample had an official decision of SEN, representing the 9.3%. According to the EASIE (2022), an official decision of SEN in Spain needs to meet three criteria: 1) there has been an educational assessment procedure involving a multi-disciplinary team that includes members from within and external to the child's/learner's school; 2) there is a legal document that describes the support the child/learner is eligible to receive, and which is used as the basis for planning; 3) finally, the official decision is subject to a formal, regular review process. The nature of the difficulties and disabilities related to SEN of students was varied and categorized according to the national education laws. Spanish legislation categorizes students with SEN into the following categories: (1) students with SEN due to intellectual disability, sensory disability and motor disability or due to severe behavioral, communication and language disorders; these students are referred as students with "Severe and complex needs" and require and receive exceptional support from the education services ($n = 34$). Unfortunately, we do not have data on the specific diagnosis of students included in this category. Of note is that our study did not include students with visual impairment; (2) students with SEN due to attentional (i.e. Attention-Deficit/Hyperactivity disorder; $n = 20$), learning (i.e. specific learning disorder due to reading: $n = 46$, writing: $n = 2$, or mathematical difficulties: $n = 1$) or combined attentional and reading difficulties ($n = 4$) and language and communication disorders ($n = 1$), which are referred as "Communicational, attentional and learning disorders"; (3) students with SEN due to insufficient Spanish language knowledge. This was mainly the case for foreign students that recently joined the school and were still adapting and learning the language ($n = 17$); we refer to this category as "Insufficient Spanish knowledge" students. Additionally, one case was identified as having SEN due to an unfavorable socioeconomic situation. For those cases in which the teachers didn't detail the type of SEN, we categorized them as "Non-specified SEN" ($n = 56$). Lastly, there were 30 students diagnosed with "High-capacities". While the previous categories usually reflect underachievement in academic performance, high-capacities students tend to perform above what is expected from their peers without SEN (Sternberg, 1981). For this reason, we did not include the 30 students with high-capacities in the general category of students with SEN used in the subsequent analyses of the results. Therefore, the sample of "students with SEN" was finally composed of the 182 students included in the remaining categories mentioned above.

The Research Ethics Commission of the University of Valencia approved the protocol of the study (register # 1894095). APA ethical standards and the guidelines of the Helsinki Protocol were followed in conducting the study. Parents or legal guardians signed an informed consent form. Data collection took place from March to June in 2022. This study is part of a larger longitudinal study on the impact of digitalization of reading on comprehension, sustained attention and reading motivation.

2.2. Materials

2.2.1. Text comprehension test

We used the ACL tests (Avaluació de la Comprensió Lectora [Reading comprehension Assessment], [Català et al., 2001](#)) to measure students' text comprehension. ACL includes both narrative and expository texts, including short stories, poems, and non-fiction continuous and non-continuous texts. Questions intend to assess three main aspects of comprehension: literal, inferential, and evaluation. Each test consists of 8 texts, with 3 to 5 multiple-choice questions (5 alternatives) for each text. The number of questions, and therefore, the maximum score that can be obtained in each test is 28 (4th grade), 35 (5th grade) and 36 (6th grade). We calculated internal consistency using a factor analysis based on tetrachoric correlations matrix, which is a standard procedure to obtain the omega score, an indicator conceptually similar to the well-known Cronbach's alpha. High ordinal omega scores indicated very good reliability (ω ACL 4th = .92, ω ACL 5th = .90, ω ACL 6th = .91). We used the standardized values of ACL scores to obtain a homogenous and comparable variable across the three different grades. The transformation from the direct scores results in a ten-level scale common to all participants. Level 5 and 6 reflect normal text comprehension skills, while the extremes reflect severe to light reading difficulties (levels 1 to 4), and moderate to high-skill reading abilities (levels 7 to 10) ([Català et al., 2001](#)).

2.2.2. Reading habits: leisure and academic reading frequencies

In order to measure students' reading habits we created two frequency scales of leisure and academic reading. The leisure reading habits scale refers to the frequency of leisure reading practices, in which students engage in reading without being told to do so. The academic reading scale refers to the reading frequency for academic purposes, in which students' read following the teacher's requests or because they need it to study or solve homework at home. The scales were created in response to the lack of measures of reading habits in digital format ([Altamura et al., 2024](#)). Five studies were reviewed that examined the reading frequency of primary and secondary school children through self-reports in both print and digital formats ([Duncan et al., 2016](#); [Johnson, 2013](#); [McGeown et al., 2016](#); [Pfoest et al., 2013](#); [Torppa et al., 2019](#)). Measures used by international studies such as PISA 2018 ([OECD, 2019](#)) and PIRLS 2016 ([Mullis et al., 2017](#)) were also considered. In order to ask about paper and digital reading, a total of 8 items were created for each scale, half of the items asked about print format and the other half asked about digital formats or Internet use. The items from the leisure reading frequency scale referred first to print reading (Books on topics of the student interest, Fiction books, Comics or Magazines) and were followed by the digital reading activities (Books on tablet or e-book; On the Internet, to look for things of the student interest; On the Internet, to communicate with other people; On the Internet, to receive and send emails (e-mails) to relatives or friends). Following the same structure, the items of the academic reading frequency scale, referred first to print (Fiction books, School textbooks, Worksheets done in class, Notebook exercises) and then to digital activities (School textbooks on Tablet or E-book; On the Internet, to look for information to do homework; On the Internet, to look for information to understand better an issue; On the Internet, to receive and send emails (e-mails) to teachers or classmates). The specific item wording and the prompts used in each scale can be found in the [Supplemental material](#) "Reading habits frequency scales". Students answered on a 4-point scale: "Never or almost never", "Once or twice a month", "Once or twice a week", "Every or almost every day". Confirmatory factor analysis determined that both scales had a good internal consistency. The models showed good fit indices for academic ($N = 2255$, CFI = .980, RMSEA = .038 [.029, .046], SRMR = .025) and leisure ($N = 2196$, CFI = .904, RMSEA = .058 [.05, .066], SRMR = .044). Both models represented a bifactor structure, grouping items by reading medium (print or digital).

2.2.3. Control variables

Socio-economic status. As an indicator of SES we used the number of books at home that is often used for explaining socio-economic inequalities in student achievement ([Heptt et al., 2022](#)). Students answered the question "About how many books are there in your home? (Do not count magazines, newspapers, or your school books.)". There were five response options, each one was visually represented by a simple book-shelf icon with an approximate amount of books that depicted: 0–10 books, 11–25 books, 26–100 books, 101–200 books, and more than 200 books. We recoded responses in a score from 0 to 4.

Grade. We included students' grade as a control variable for differences associated with their educational level.

2.3. Procedure

The assessment took place in the students' reference classroom and took about 90 min. All tests were completed individually on printed material. First, students completed the text comprehension test, which lasted approximately 50 min. Students received the corresponding version of the test for their grade. The researchers of this study and research collaborators modeled an example to explain the test taking procedure. The remaining questionnaires were identical for all participants. Afterward all students had finished the text comprehension test, they completed the leisure and academic reading habits scales, and answered the socio-demographic questions.

3. Results

3.1. Descriptive analysis

We first analyzed the descriptive information of the main variables assessed by SEN. Specifically, we divided our total sample in three main categories: students without SEN ($n = 2077$), students with SEN ($n = 182$) and students with "high-capacities" ($n = 30$).

This division was used in subsequent analyses. Additionally, for students with SEN we included the information of the following subgroups: complex and severe SEN, communication and learning disorders, insufficient Spanish knowledge, and non-specified SEN. Due to their low number, we didn't report specific data for students with unfavorable socioeconomic status. Nevertheless, we include them in all subsequent analyses as part of the generic category "students with SEN". Lastly, we reported information from high-capacities students separately. We intentionally left out these students from the category "students with SEN" in subsequent analyses. Previous studies suggest that students with learning difficulties and those with high-capacities should be considered as distinct groups with unique needs and abilities as significant neuropsychological differences among both populations have been found (Martín-Lobo et al., 2018). Descriptive and correlational analyses were conducted using SPSS IBM software version 28.0.1.1.

Means and standard deviations for each study variable are provided in Table 1. For descriptive purposes, specific values for each item of the reading habits frequencies (academic and leisure) are provided in the supplemental material Tables A.1 and A.2. Regarding students' text comprehension levels, those without SEN show normal text comprehension level according to the standardized test norms, with an average decile of 5.53. Students with SEN present much lower levels, with average deciles ranging from 2.38 to 3.73, indicating comprehension difficulties. Finally, students with high-capacities scored well above normal level, with an average decile of 7.13. Self-reported reading frequency is reported by activity (academic or leisure) and reading medium (print or digital). Overall, students reported low levels of reading frequency regardless of activity and reading medium, with average scores ranging from "Once or twice a month" for leisure reading in print, to "Once or twice a week" for academic reading in print.

To quantify the differences in means we calculated effect sizes using Hedges' g. This measure was deemed appropriate over other options to account for the potential bias that could arise due to the unequal group sizes (Hedges, 1981). Overall, differences on reading frequency among groups were minimal, except for academic print reading, with a significant effect size ($g = 0.28$), small according to Cohen's (1988) guidelines. Specifically, students without SEN tended to read more frequently printed academic materials compared to their peers with SEN.

Before conducting the analyses to test our hypotheses we carried out bivariate correlations, differentiating by students without and with SEN, to explore the associations among the study variables (see Table 2). Overall, the pattern of correlations was similar across both groups of students, with minor differences at the level of significance test probably due to the large differences in the number of students included in each group. Frequency of leisure reading habits was only significant for students without SEN, with negative associations for digital ($r_{SWO} = -.084$) and positive for print reading ($r_{SWO} = .148$). Regarding academic reading habits, print frequency was not statistically associated with text comprehension, regardless of SEN status, but it did negatively in digital format ($r_{SWO} = -.135$, $r_{SW} = -.163$). Lastly, common to both groups, text comprehension was positively and significantly correlated to socioeconomic status ($r_{SWO} = .221$, $r_{SW} = .199$).

Finally, to further explore the associations among reading habits and text comprehension within each subgroup of SEN students, as well as the high-capacities group, we performed Spearman partial correlations between the studied variables, controlling for SES (see Table 3). Note that due to the small sample sizes in each category, these correlations should be interpreted with caution. A negative association between digital academic reading frequencies and text comprehension was observed within the subgroups "Communication and learning disorders" as well as in the "High-capacities" students. None of the other partial correlations were significant.

3.2. Main analyses

To address our hypotheses regarding the expected associations between reading habits and text comprehension, we employed multiple regression models with a robust maximum likelihood estimator (MLR) using Mplus 8.8. We used this estimator to account for non-normal distributions of observed variables (Muthén & Muthén, 1998–, 2017). In addition, we applied the *complex* option in Mplus to account for the possible dependencies that the students are nested within classrooms (for instance, some classrooms could be more digitized than in others). The cluster control allowed us to adjust for potential bias in standard errors. This modeling approach was found to be a more parsimonious way to account for the clustering than multilevel models in many practical situations, for example,

Table 1
Descriptive information and means comparison for each study variable divided by type of educational needs.

				Academic reading frequency				Leisure reading frequency				Socioeconomic indicator	
	Range	Text comprehension		Print		Digital		Print		Digital		0-4	
		1-10		0-3		0-3		0-3		0-3			
		<i>n</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>
Students without SEN ¹	2077	5.53	2.11	2.04	0.58	1.35	0.73	1.07	0.57	1.55	0.72	2.71	1.03
Students with SEN ²	182	3.27	1.98	1.88	0.65	1.41	0.79	1.05	0.55	1.65	0.75	2.39	1.16
Complex and severe SEN	34	2.38	1.91	1.92	0.62	1.48	0.78	1.03	0.72	1.73	0.84	1.75	1.24
Communication and learning disorders	74	3.40	1.89	1.94	0.65	1.42	0.77	1.07	0.52	1.69	0.68	2.63	1.06
Insufficient Spanish knowledge	17	3.06	2.11	1.73	0.64	1.57	0.82	1.07	0.41	1.70	0.79	1.94	1.20
Non-specified SEN	56	3.73	1.96	1.82	0.66	1.31	0.85	1.05	0.52	1.55	0.79	2.56	1.08
High-capacities students	30	7.13	1.72	2.10	0.53	1.33	0.53	0.98	0.60	1.63	0.59	3.23	0.82
Total sample	2289	5.37	2.19	2.02	0.58	1.35	0.73	1.07	0.57	1.56	0.72	2.69	1.05
Hedge's g [CI]: students without SEN ¹ vs. with SEN ²		1.07 [0.91, 1.23]		0.28 [0.12, 0.44]		-0.09 [-0.24, 0.07]		0.04 [-0.12, 0.19]		-0.15 [-0.30, 0.01]		0.31 [0.15, 0.46]	

Table 2
Bivariate correlations among study variables divided by students' SEN status.

	Students without SEN (n = 2077)					Students with SEN (n = 182)				
	1	2	3	4	5	1	2	3	4	5
1. Academic print reading frequency										
2. Academic digital reading frequency	.215***					.396***				
3. Leisure print reading frequency	.183***	.013				.356***	.157*			
4. Leisure digital reading frequency	.103***	.512***	-.033			.146	.424***	.054		
5. SES	.033	-.013	.245***	-.033		.081	-.037	.138	.032	
6. Text comprehension	.044	-.135***	.148***	-.084***	.221***	-.005	-.163*	.100	-.088	.199**

*** p < .001, ** p < .01, * p = <.05.

Table 3
Partial correlations between reading frequency and text comprehension, for each SEN subgroup, and the high-capacities group, controlling for SES.

Text comprehension	Academic reading frequency		Leisure reading frequency	
	Print	Digital	Print	Digital
Complex and severe SEN	.145	.096	-.037	-.009
Communication and learning disorders	-.014	-.255*	-.152	-.03
Insufficient Spanish knowledge	-.117	.495	.402	-.13
Non-specified SEN	.161	-.198	.105	-.045
High-capacities students	-.061	-.366*	.171	-.305

*** p < .001, ** p < .01, * p = <.05.

when the clustered data structure is not particularly interesting per se (McNeish et al., 2017). Finally, the missing data in text comprehension scores were addressed through the utilization of a full information maximum likelihood (FIML) estimation (n = 26, 1.1% of the sample composed of the students from the main categories “students without SEN” and “students with SEN”).

We applied five multiple regression models. The first one (main model) included all the study variables in which the four reading frequency dimensions (academic-leisure x paper-digital) acted as predictor variables for text comprehension. We used total addition of the individual items scores for each dimension, working as observable predictors. As previously mentioned, we used classroom as a cluster variable, thus we estimated the effect of the predictors while considering potential differences or similarities between classes. Additionally, we included students' SEN status, socioeconomic status (continuous variable), and grade as control variables. We introduced students' SEN status in the model as a dummy variable (0 = without SEN, 1 = with SEN). Grade level was also represented by two dummy variables, one for 5th and one for 6th grade. Each variable takes the value 1 if the participant is in the indicated grade, and 0 otherwise. To test if the prediction capacity of the four reading frequency dimensions was different for students without and with SEN we created additional models identical to the main model except for one additional variable. Specifically, we included the interaction between each reading frequency dimension and the students' SEN status, resulting in four extended models.

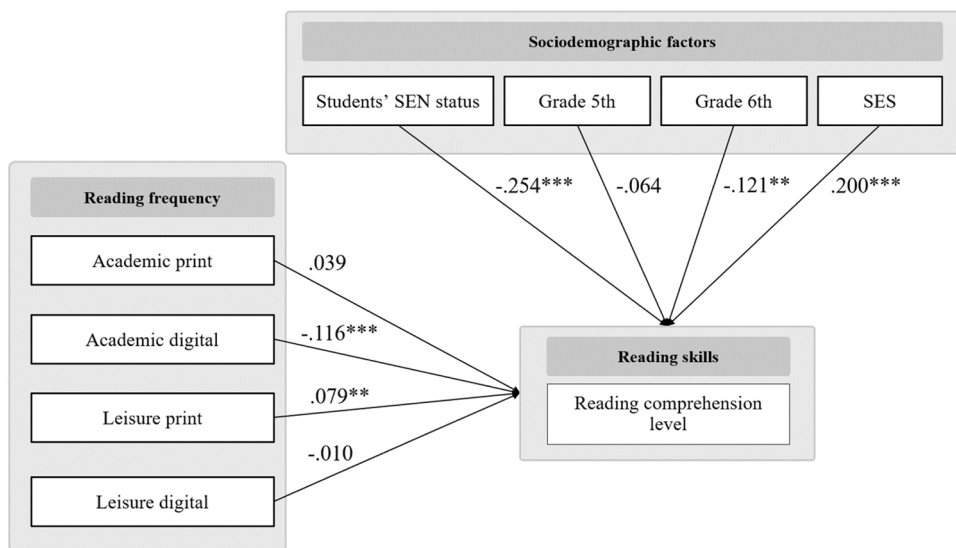


Fig. 1. Multiple regression graphic model of reading frequency and sociodemographic factors on reading comprehension, *** p < .001, ** p < .01, * p = <.05.

Results from the main model are presented in Fig. 1 and Table 4. The results reflect the predictive capacity of several variables. First, focusing on reading frequency, two contrasting activities emerged as significant predictors. While leisure print reading frequency exhibits a positive relationship with text comprehension ($\beta = .079$), academic digital reading presents a negative association with text comprehension ($\beta = -.116$). The remaining reading activities don't show significant associations. This pattern of results is in line with hypothesis 1, indicating larger associations for print -rather than digital- leisure reading and comprehension, but it is only partially aligned with hypothesis 3. As expected, the association between comprehension and academic print reading was larger than that observed for academic digital reading. But such difference was due to the unexpected negative association for academic digital reading, and a null association for print academic reading.

Next, regarding sociodemographic factors, students' SEN status was the strongest predictor. The prediction value was negative ($\beta = -.254$) indicating that, while accounting for all the other factors included in the model, students with SEN present a negative difference of 0.254 standard deviations in text comprehension, compared to their peers without SEN. Students' socioeconomic status emerged as a significant positive predictor for text comprehension ($\beta = .200$). Lastly, being enrolled in 6th grade is associated with lower text comprehension skills ($\beta = -.121$), meaning that for this sample students in the last grade of Primary school present lower normed text comprehension levels than their peers enrolled in lower grades.

Finally, we checked the possible interaction of the different reading frequency activities and the students' SEN status (hypotheses 2 and 4) by including the interaction among both factors in each model. The interaction of reading frequency and SEN status was not significant in any of the models. The four models can be found in the supplemental materials (Table A3). This pattern of results didn't align with our hypothesis of a differentiated association between reading frequency and comprehension depending on the students' SEN status. Regarding the remaining predictors, those models exhibited similar relationships akin to those observed in the main model.

4. Discussion

The present study examines how different reading habits are related to text comprehension in Primary school students with and without SEN. We have measured academic and leisure reading frequency, in both print and digital format. Using a large sample of students with SEN and controlling for students' SES and class, our findings support the expectation that the associations between comprehension and reading frequency is stronger for print than for digital reading activities. Specifically, students' comprehension is positively associated with their leisure print reading frequency, and negatively associated when it comes to academic digital reading. Contrary to our expectations, the associations are similar for students with or without SEN. In the following, we discuss our findings in light of previous research. Lastly, we will review the study's limitations and outline future research lines.

4.1. SEN and reading frequency

Overall, the results from our study evidence that the frequency in which students engage in reading activities outside school (whether for academic or for leisure reasons) tends to be low, a pattern of results that aligns with current trends (Vinterek et al., 2022) and that was amplified during school lockdowns due to the COVID-19 pandemic (Mete Yesil et al., 2022). Reading frequency tends to be quite similar regardless of SEN status, which contrasts with previous evidence (Chapman, 1988; Fulk et al., 1998; He et al., 2014; Kannianen et al., 2022; Scarborough et al., 1991). An important exception is academic reading habits in print, for which students with SEN show lower frequency times than those without SEN (Kannianen et al., 2022). This partially aligns with the premise of the Matthew effect (Stanovich, 1986), and qualifies it by showing the importance of reading medium (print or digital) on the association between reading frequency and comprehension (Altamura et al., 2024). Students without SEN tend to have a proficient reading level, allowing them to improve their skills by engaging in frequent and challenging academic reading activities. The other types of reading activities measured, leisure reading in print and digital as well as academic digital reading, may be perceived as less challenging than academic printed texts, which may explain the lack of difference in their frequency of reading among students with and without SEN.

Table 4
Multiple regression model of reading frequency and sociodemographic factors on text comprehension.

Variable	Main model		
	B	SE	β
Intercept	4.601***	0.232	
Students' SEN status ^a	-2.114***	0.159	-.254
SES	0.420***	0.047	.200
Fifth grade ^b	-0.297	0.155	-.064
Sixth grade ^c	-0.553**	0.161	-.121
Academic print reading frequency	0.037	0.024	.039
Academic digital reading frequency	-0.086***	0.021	-.116
Leisure print reading frequency	0.075**	0.022	.079
Leisure digital reading frequency	-0.007	0.018	-.010
R^2	.16		

Note. ^a 0 = students without SEN, 1 = students with SEN. ^{bc} 1 = student belongs to that grade, 0 = student does not belong to that grade.
SE= Cluster robust standard errors.

*** $p < .001$, ** $p < .01$, * $p < .05$.

Another potential explanation for the overall lack of differences in reading frequency between students with and without SEN is the rather low levels of reading at home reported by the students. For each of the four reading activities analyzed (academic or leisure, print or digital), most students stated that they read "Once or twice a month" or "Once or twice a week". Such low overall frequency may make it difficult for slight differences to arise, as heavy frequent readers in our sample may be the exception even among students without SEN. This situation urges for programs to motivate reading among Primary school students (Gkora & Karabatzaki, 2023; Melekoglu & Wilkerson, 2013; Vaknin-Nusbaum et al., 2018), an important topic which we will elaborate in the upcoming section.

4.2. Leisure reading habits and text comprehension

The regression models clearly identify that, over and beyond the influences of other types of reading activities, there is a positive association between leisure reading frequency and comprehension, which is in line with a large body of previous research (Locher & Pfof, 2020; Mol & Bus, 2011; van Bergen et al., 2020). Supporting our hypothesis, our study highlights that such positive association is specific for print, but not for leisure digital reading (Altamura et al., 2024). Based on the fact that the reading difficulties experienced by students with SEN could limit their motivation to engage in voluntary reading activities and to fully benefit from them (McGeown et al., 2016), we expected a lower association between leisure reading frequency and comprehension for those students. However, the lack of interaction between leisure reading frequencies, whether in print or digital reading medium, and SEN status on text comprehension suggest that most students, regardless of their reading competence, can benefit from frequent leisure reading. Accordingly, stimulating leisure reading habits in print for students with SEN arises as an important factor to boost their development of text comprehension skills. Encouraging children with SEN to engage in both leisure and academic reading remains a challenge. Previous efforts to achieve an improvement in the reading motivation of SEN have not been effective in comparison to the results obtained by these same interventions in students without SEN (Melekoglu & Wilkerson, 2013). It seems that, in addition to specific intervention on basic reading processes that make them feel more competent, there is a need to focus on other dimensions of reading motivation, such as reading value, curiosity, involvement, or challenge, as they differently predicted engagement with different types of reading (McGeown et al., 2016). Thus, future research should explore the extent to which reading motivation programs for students with SEN can boost their reading habits and text comprehension skills in the long term.

4.3. Academic reading habits and text comprehension

A major contribution of our study is the analysis of the relations between academic reading frequency and text comprehension during Primary school years, as this issue has received much less attention than other reading activities such as leisure reading (Vinterek et al., 2022). Our expectation for a larger association between text comprehension and academic reading in print, rather than digital, is only partially supported, as the observed difference is due to the negative correlation for academic digital reading. We observed no significant association between academic print reading and text comprehension (McGeown et al., 2016). As the frequency of academic reading is mostly led by teachers, students' motivation would not play a role in boosting reading, leaving little room for individual differences to arise. As for the frequency of academic digital reading, the overall negative association with text comprehension supports recent similar findings (Salmerón et al., 2023). This suggests that students don't fully benefit from being exposed to academic vocabulary and information by means of digital textbooks or the Internet. Moreover, this effect can't simply be explained by differences in the extent to which classrooms are digitized, as our models controlled for classroom effects. In other words, even in classrooms that don't emphasize academic digital reading, students' use of the Internet at home for academic purposes is negatively associated with their text comprehension. One could argue that this relationship could arise due to the higher academic digital reading frequency of students with SEN, as teachers may try to adapt their requests to their students' educational needs (Fernandez et al., 2020). However, descriptive data from our study challenges such view, as the self-reported frequency of academic digital reading habits in our sample doesn't differ between students with or without SEN. This situation could also explain the unexpected lack of interaction between academic reading, whether in print or digital format, and SEN status on text comprehension. As this hypothesis relies on the assumption that students without SEN are able to enrich their vocabulary and knowledge by being repeatedly exposed to academic texts, more frequent academic reading could be needed to boost their comprehension skills to a higher degree. Future research should address this possibility.

Although our study can't shed light on the causes behind the negative relation between academic digital reading and text comprehension, we suggest that students tend to associate digital reading with a superficial mindset based on their digital user experience (Annisette & Lafreniere, 2017). Such mindset, characterized by low concentration and quick shifts of attention, may prevent students from identifying and elaborating on some of the academic language they are exposed to digitally. As explained, this association is independent of students' SEN status. This is at odds with our expectations that the high self-regulation demands imposed by digital reading may make this type of reading even more disadvantageous for students with SEN, with a lower level of linguistic and comprehension competence to cope with such demands (Anmarkrud et al., 2018; Ben-Yehudah & Brann, 2019; He et al., 2014; Kanniainen et al., 2022; Salmerón et al., 2021). We can't rule out the possibility that exposure to highly interactive academic digital texts, with higher self-regulation demands, could have a particularly negative effect on students with SEN. Conversely, high quality digital academic texts with specific support for struggling students could mitigate or even reverse the negative association with text comprehension (Alqahtani, 2020; Fäth & Selenius, 2022). For example, digital tools such as text-to-speech can be used to compensate students with SEN to support early reading and writing (Fäth & Selenius, 2022). Future research should identify the text affordances of academic digital texts that could support text comprehension development.

4.4. Limitations and future research

Our study comes with certain limitations. First of all, caution is advised in interpreting the associations reported, as we collected cross-sectional data. While we have established associations between reading frequency and text comprehension, we can't assume causal relationships. To achieve a better understanding of the predictive capacity of the frequency of different reading activities, future research could employ interventions and longitudinal designs. Next, to collect data about reading habits, our participants self-reported their reading frequency using a limited-answer scale. However, self-reporting may introduce biases or inaccuracies based on participants' memory, perception, or social desirability. More objective measurements, such as diary or digital logs that can track actual reading time could offer a more precise and reliable assessment. Therefore, future studies could consider incorporating a combination of self-reported measures and objective, technology-based assessments to enhance the accuracy and validity of their results (Parry et al., 2021). Finally, the identification of SEN status was based on schools' reports. Although this was based on an official decision that legally requires an educational assessment by qualified experts, we don't have independent assessments other than the text comprehension test used as the main dependent variable in our study. Future research could include specific linguistic and cognitive assessments to corroborate our findings regarding SEN status, and to provide a fine-grained analysis of the contribution of each component on the association between reading frequency and comprehension.

5. Conclusions

Our results offer two recommendations regarding reading practices for all students, regardless of their SEN status. First, leisure reading activities should be promoted, particularly reading print books. Primary and secondary teachers should develop a strong culture of reading for pleasure in their classroom (Willingham, 2015). For this purpose, they can adopt some routines such as: give students freedom to choose for themselves the books they want to read; provide them access to a wide variety of books and teach them the skills in choosing the right text; promote everyday reading in class by giving students time to read independently; have 'book talks' at classrooms and encourage parents to find a reading routine at home. Second, caution is advised when encouraging Primary school children to use digital texts when the emphasis is on comprehending texts for acquiring knowledge. This aligns with a forward-looking shift to digital methods in education supported by evidence, recognizing the benefits of both digital and print reading (Salmerón & Delgado, 2019). It is essential for teachers and educators to discern the most suitable reading medium based on the task demands and students' skills. For example, extended periods of print reading may be more suitable for focused study, whereas digital reading with multimedia and interactive elements can improve the skills needed to search and integrate information from various sources. In sum, our study underscores the need for a more balanced and thoughtful approach to the integration of technology in education to mitigate its adverse outcomes.

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CRediT authorship contribution statement

Salmerón Ladislao: Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **Vargas Cristina:** Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Altamura Lidia:** Data curation, Writing – original draft, Writing – review & editing. **Blanco-Gandía Mari Carmen:** Investigation, Writing – original draft, Writing – review & editing. **Gil Laura:** Investigation, Writing – original draft, Writing – review & editing. **Mañá Amelia:** Investigation, Writing – original draft, Writing – review & editing. **Montagud Sandra:** Investigation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors report there are no competing interests to declare.

Data availability

Data will be made available on request.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ridd.2024.104675](https://doi.org/10.1016/j.ridd.2024.104675).

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