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# CFD-14: detecting literacy and dyslexia risks in early and primary education

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This study validates the CFD-14 questionnaire, designed for families to detect early risk of literacy difficulties and dyslexia in compulsory schooling. The sample included families of 1385 students from preschool (5 years old) and 1st to 6th grade of primary education, with a median age of 9 years and two months. The CFD-14 comprises 14 items reflecting common dyslexia indicators. Its one-dimensional factorial structure was confirmed, demonstrating reliability and criterion validity through five evidences: correlation of questionnaire scores with teacher and family assessments, comparison of CFD-14 scores between a dyslexic group ( $n = 13$ ) and the general sample, analysis between families with and without a history of difficulties, and comparison between groups with persistent spelling errors and those without. A direct score at the 90th percentile was identified as the objective criterion to pinpoint students at risk of literacy difficulties.

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## Introduction

Teaching and learning to read and write are the primary objectives of any educational system. When students do not achieve the expected performance for their age and level, it has a widespread impact on their learning process. Standardized instruments are typically used to assess reading and writing performance, providing information about their difficulties (Ramos & Cuadrado, 2004). These instruments require a certain amount of time for administration, depending on the breadth of the test and the cognitive processes that need to be evaluated (such as understanding grammatical structures and texts, written composition, spelling, etc.) (Ramos & González, 2017). While tests provide information about a subject or a group's situation at a specific moment, a family questionnaire provides information about the historical evolution of the learning process. It detects the risk of difficulties, considering the difficulties observed by the family during their personal and school development.

This research aimed to validate a questionnaire based on the information provided by families regarding students' evolution and current situation regarding primary and initial aspects related to literacy learning with a dual purpose. Firstly, relevant information about the assessed students should be complemented with the historical knowledge possessed by the family regarding their developmental process of reading and writing learning. Secondly, to detect the risk of literacy learning difficulties and decide on the assessment of those who score at risk.

The CFD-14 is especially useful in detecting and evaluating students with suspected dyslexia by focusing on critical literacy-related skills such as phonological awareness, decoding abilities, and spelling proficiency. These skills are core components of dyslexia, as defined by the International Dyslexia Association (IDA, 2002). The questionnaire's items were carefully selected and adapted based on the IDA's guidelines, emphasizing difficulties in word recognition, decoding accuracy, and spelling. The CFD-14 provides a reliable screening tool for early literacy challenges by leveraging these established principles.

This difficulty often results from a deficit in the phonological component of language (Ramus, 2003; Alegría, 2006; López-Escribano (2007a); López-Escribano (2007b); Tamayo, 2017; Coraisaca et al., 2021), which is often unexpected given the good development of other cognitive abilities and the provision of educational and instructional opportunities. The secondary consequences of dyslexia can include problems with reading comprehension and a reduced reading experience that hinders vocabulary growth.

Following the International Dyslexia Association's (IDA, 2002) definition, dyslexia is primarily characterized by difficulties with accurate and fluent word recognition, poor spelling, and decoding abilities, often due to a deficit in the phonological component of language. These core difficulties are typically unexpected about other cognitive abilities and the provision of effective classroom instruction. Beyond the phonological deficits emphasized by the IDA, other cognitive factors, such as visual-auditory processing speed and immediate auditory memory, can also impact early literacy development (Cuetos et al., 2015 and 2020; Ramos et al., 2019). While these factors are not central to the IDA's definition of dyslexia, they are relevant to understanding the broader context of literacy acquisition and were considered in the development of the CFD-14. Therefore, the aspects evaluated in early detection tests and questionnaires should primarily focus on phonological awareness, knowledge of letter names or sounds, and oral language while accounting for these additional cognitive processes that may influence literacy outcomes.

Regarding the direct consequences on academic performance, students with undetected dyslexia, and therefore unaware of the

cause of their difficulties, are more sensitive to self-esteem and socioemotional behavioral problems during adolescence. This can entail a risk of school dropout and mental health problems, primarily social anxiety and attention difficulties (Zupparado et al., 2020; Wilmot et al., 2023).

Our concern about the "invisibility" and late detection of students with dyslexia led us to set the objective of developing and validating a questionnaire in the Spanish language aimed at families to detect the risk of reading and writing difficulties, whether they are dyslexia-related or not. The construction of CFD-14 was based on three essential sources that gather scientific evidence on the topic: 1) the concept of dyslexia according to IDA, 2002 with the sponsorship of the National Institute of Child Health and Human Development (NICHD); 2) the study by De la Peña and Bernabeu (2018), which provides relevant scientific results from 2006 to 2017 on the brain mechanisms involved in reading and writing, and 3) contributions from the Yale Center for Dyslexia and Creativity (YCDC), especially Shaywitz and Shaywitz (2020), who coordinate the center created in 2006 to assist people with dyslexia and promote research and evidence-based measures.

The content validity of the CFD-14 is supported by critical sources, including the International Dyslexia Association's (IDA, 2002) definition of dyslexia, the study by De la Peña and Bernabeu (2018) on neurocognitive mechanisms involved in reading and writing, and contributions from the Yale Center for Dyslexia and Creativity (Shaywitz & Shaywitz, 2020). These sources guided the selection and refinement of the questionnaire's items to ensure they address the cognitive and linguistic components central to dyslexia, such as phonological awareness, decoding, and spelling skills.

It is important to note that since the conception of this study, considerable debate has arisen in the scientific community regarding the definition of dyslexia proposed by the International Dyslexia Association (IDA), which has been used as the theoretical basis for developing the CFD-14 questionnaire. Recent studies, such as Gearin et al. (2024), have questioned certain aspects of the traditional definition of dyslexia, suggesting that a broader and more nuanced understanding of the disorder may be necessary. This debate impacts screening and assessment tools, including questionnaires like the CFD-14. Although our study is based on the IDA definition, we acknowledge the relevance of these current discussions and suggest that future research might consider adapting the CFD-14 to reflect a more dynamic definition of dyslexia.

These significant sources support the questionnaire's content validity. Its simple and quick application will greatly interest education and health professionals since family responses can be used to make decisions regarding further neuropsychological and psychoeducational evaluation or to implement a preventive reinforcement program.

Research supports the validity and reliability of self-report questionnaires in dyslexia detection, especially for adults and adolescents (Giménez et al., 2014; Lefly & Pennington, 2000; Ramos & González, 2019). These studies indicate that self-report measures can effectively identify dyslexia-related difficulties, although their effectiveness may vary by context and population. For instance, Giménez et al. (2014) demonstrated the reliability of self-report questionnaires in adults with academic difficulties, while Lefly and Pennington (2000) found consistency with other diagnostic tools in adolescents. However, these findings should be interpreted cautiously, considering the potential biases in self-report data, such as self-perception or memory recall biases.

Similarly, Snowling et al. (2012) validated a protocol for adult self-report of dyslexia and related difficulties, demonstrating its

utility and reinforcing the importance of self-report questionnaires in identifying dyslexia across different age groups. However, during childhood and primary education, the information provided by families is of utmost importance, in addition to psychopedagogical assessments and information provided by teachers.

Some studies have examined the prevalence of dyslexia in transparent languages like Spanish. Jiménez et al. (2009) place it at 3.2% in the Canary Islands, while research conducted by Villegas (2023) in Andalusia situates it between 1.2% and 3.6%, depending on the criteria restrictions. The percentage is much higher in more opaque languages like English, ranging from 5.3% to 11.8% (Katusic et al., 2001). The point is that there is an increasing interest in detecting dyslexia as early as possible, or at least the risk of reading and writing difficulties (Morales-Rando et al., (2022)). Early intervention results in more effective outcomes (Arista et al., 2023; Romero et al., 2016). It is surprising that, despite social awareness, the significant increase in research on the subject, the strengthening of family associations, advances in neuroimaging techniques, the involvement of educational authorities, and the training of evaluating professionals, the percentage of assessed and detected students is much lower than the actual figures. For this reason, it is necessary to use simple tools for professionals to detect the risk of reading and writing difficulties.

While the Colorado Learning Difficulties Questionnaire (CLDQ-R reading subscale) by Willcutt et al. (2011) has been utilized in specific contexts for identifying reading and writing difficulties, it is essential to acknowledge that other instruments, such as DIBELS, TOWRE, CTOPP, WIAT, and WJ-R, are more widely used in the United States due to their superior technical adequacy and broader acceptance in educational settings. These tools are recognized for their robustness in assessing various aspects of literacy development and learning difficulties, making them the primary choices for many practitioners in the field.

It consists of six items and has been adapted to Spanish by Marder and Lo Gioco (2021). The American tradition of detecting and evaluating learning difficulties was enhanced with the Individuals with Disabilities Education Improvement Act of 2004, which employs the Response to Intervention (RTI) model (Jiménez, 2019) as opposed to the model of the discrepancy between intellectual level and reading and writing performance. The discrepancy model requires waiting for failure to detect difficulties. In contrast, the RTI model aims to generalize the detection of reading and writing difficulties through the universal screening of all students in the educational institution. This allows assessment and intervention to improve performance using a cyclical and recurrent process.

In this study, we employed a range of statistical analyses to validate the CFD-14 questionnaire, including factor analysis to assess the underlying structure of the instrument, reliability analyses (Cronbach's alpha and McDonald's omega) to evaluate internal consistency, and correlational analyses to examine the relationships between questionnaire scores and external criteria such as teacher and parent assessments of reading and writing performance. The rationale behind these analyses is to ensure that the CFD-14 not only measures what it is intended to measure (construct validity) but also does so consistently (reliability). Factor analysis was chosen to determine whether the items in the CFD-14 are representative of a single underlying construct related to dyslexia risk. Reliability analyses were conducted to confirm that the questionnaire produced stable and consistent results across different samples. Finally, correlational analyses were used to provide evidence of criterion-related validity, demonstrating that the questionnaire's scores are meaningfully related to external measures of literacy performance.

Based on the above, the objective of this research was to determine the reliability and validity of a questionnaire for the detection of reading and writing difficulties and dyslexia (CFD-14) aimed at families of students aged between 5 and 13 years (school levels of early childhood education (5 years) and 1st to 6th grade of primary education). The aim is to provide professionals with a brief and suitable tool for detecting difficulties and making decisions regarding reading and writing assessment and intervention.

## Method

**Sample.** The sampling design considered the main population characteristics of early childhood and primary education centers in the Autonomous Community of Extremadura. After eliminating incomplete questionnaires, a valid sample of 1385 students (685 boys, 49.5%, and 700 girls, 50.5%) was obtained, belonging to the public ( $n = 971$ , 70.1%) and private-concerted ( $n = 414$ , 29.9%) educational centers, with the following distribution according to academic level: 5-year-old kindergarten ( $n = 172$ ), 1st grade primary ( $n = 176$ ), 2nd grade primary ( $n = 194$ ), 3rd grade primary ( $n = 154$ ), 4th grade primary ( $n = 216$ ), 5th grade primary ( $n = 216$ ), and 6th grade primary ( $n = 257$ ). The median age of the sample was 9 years and 2 months, with minimum and maximum values ranging from 5 years and 4 months to 13 years and 2 months.

**Design and procedure.** This is an applied, descriptive, cross-sectional, and quantitative research study. Before its general application, a pilot test of the questionnaire was conducted, which was completed by 64 families. Subsequently, the research team provided the questionnaire to the educational centers after explaining the study's purpose and objectives to the Ministry of Education and Employment of the Junta de Extremadura, which authorized school access and requested families to complete the questionnaires. The schools were responsible for distributing the questionnaires to families and collecting them for delivery to the research team. The European Scientific Institute (ESI) ethics committee supervised and approved this study, with protocol number ESI 2021/006. The ESI ethics committee issued a favorable report once it was confirmed that the project complied with the principles of the Declaration of Helsinki on research.

**Instrument.** Initially, the questionnaire consisted of 20 dichotomous (YES-NO) items, which were later reduced to 14 items based on Item Factor Analysis (IFA) following the model proposed by Ferrando et al. (2022). The decision was made to apply the questionnaire to families of preschool (5 years) students and the six levels of primary education. The items derived from the IDA were selected based on their alignment with well-documented cognitive deficits associated with dyslexia. These deficits include challenges in phonological processing, rapid naming, and orthographic mapping, all of which are crucial for the development of fluent reading and writing skills. The IDA's guidelines emphasize the importance of early detection and intervention, which is why these items were chosen for the CFD-14. They are intended to capture subtle signs of literacy difficulties that might otherwise go unnoticed until later stages of education, thereby providing educators and parents with critical information to support early interventions.

This condition required developing and selecting items that would apply to most students. This consideration was taken into account in the first 11 items. However, there was a difference in item 12, which was different for students in grades 1 to 6 (12a: "Reads words or texts slowly"), while for preschool students (5 years), item 12b was "Has difficulty naming, recognizing, or

remembering the sound of studied letters.” Additionally, two complementary items (13 and 14) were included as indicators of students with reading and writing difficulties and dyslexia.

In item 13, families were asked if they knew direct family history (parents, aunts, or siblings) with reading and writing difficulties, following the line initiated by Smith et al. (1983), Cordon et al. (1994), and Grigorenko et al. (1997) on the heritability of dyslexia. Item 14 inquired about the persistence of spelling difficulties beyond what is expected. Arbitrary and rule-based spelling cannot be evaluated in preschool or 1st grade, although research begins from 2nd grade onwards. In 1st and 2nd grade, it is a priority for students to consolidate phoneme-grapheme correspondence, which is more related to phonological processes and the alphabetic principle than visual or orthographic processes, requiring more experience in reading and writing.

Considering the characteristics of difficulty detection in this questionnaire, it seems reasonable to include item 14 for students in grades 3 to 6 of primary education (Jiménez et al., 2008 and 2009; Cuetos et al., 2003).

In summary, the content of CFD-14 includes items related to the evolution and development of oral language (items 1 and 2), verbal memory (items 3 and 4), phonological awareness (items 5 and 6), attitude toward reading and writing learning (item 7), educational needs and assistance for students arising from their learning process (items 8, 9, and 10), grapheme-phoneme association (11 and 12), family history (item 13), and spelling difficulties (item 14).

**Statistical analysis.** To perform the statistical analyses, the SPSS v. 25 statistical package was used along with the Factor Analysis application (Lorenzo-Seva and Ferrando, 2023). This application allowed us to conduct reliability studies (standardized Cronbach’s alpha and ordinal McDonald’s omega), supplemented with a sampling adequacy measure (MSA, Lorenzo-Seva and Ferrando, 2021), and other descriptive data: mean, standard deviation (SD), skewness (Sk), and kurtosis (Ku) for each of the items.

Predictive validation studies were conducted using five criteria: 1) assessment of reading and writing performance by the teacher/tutor, 2) assessment of reading and writing performance by the family, 3) comparison of results from the sample with a group of 13 primary students with dyslexia reports, 4) comparison of the arithmetic mean of the CFD-14 score for the group that recognized family history and the one that did not, and 5) comparison of the score for the group that recognized persistent spelling difficulties and the one that did not.

To obtain predictive validity according to criteria 1 and 2, the teacher/tutor and the family were asked to assess performance considering four levels: 1 point was assigned if they thought it did not meet the expected objectives, 2 points if it exceeded the objectives with difficulties, 3 points if it exceeded the objectives as expected, and 4 points if it exceeded the expected objectives. Spearman’s Rho coefficient was used to obtain the correlation between the total score on the questionnaire (0–14) and the performance assessment (1–4).

Regarding the third predictive criterion, a group of 13 dyslexic students (5 boys and 8 girls) from 1st to 6th grade with a dyslexia psychopedagogical report completed the CFD-14. The arithmetic mean of the questionnaire for the dyslexic group was compared with the mean of the study sample.

Additionally, the questionnaire results were compared by educational level, and the effect size was obtained using the G\*Power application (version 3.1.9.7). According to Cohen’s interpretation (2013), in correlational and comparative analyses, a significant relationship or mean difference was accepted when the significance value was equal to or less than 0.05 and the effect size was at least moderate (equal to or greater than 0.50).

**Table 1** Descriptive measures, adequacy, and adjustment of items.

Item	Mean	Sd	Ku	As	SAM
1	0.09	0.292	2.787	5.764	0.822
2	0.11	0.307	2.572	4.610	0.792
3	0.10	0.302	2.649	5.011	0.900
4	0.06	0.235	3.766	12.172	0.894
5	0.04	0.197	4.670	19.791	0.877
6	0.09	0.291	2.802	5.846	0.897
7	0.28	0.447	1.008	-0.984	0.963
8	0.16	0.368	1.846	1.406	0.881
9	0.18	0.382	1.695	0.871	0.916
10	0.20	0.401	1.490	0.219	0.882
11	0.13	0.339	2.174	2.725	0.935
12	0.12	0.319	2.418	3.845	0.907
13	0.15	0.353	2.008	2.031	0.951
14	0.13	0.341	2.147	2.605	0.813

Finally, the main descriptive statistics and the critical score identifying students at risk of reading and writing difficulties were obtained, using the direct score corresponding to the 90th percentile as the objective criterion.

## Results

**Item selection.** In the Factor Analysis application, using the Solomon method, the total sample ( $N = 1385$ ) was divided into two equivalent subsamples ( $n_1 = 693$  and  $n_2 = 692$ ). It was verified that the IRC (Community Relationship Index) value approached 1 (0.998). The Kaiser-Meyer-Olkin (KMO) values in each of the subsamples were 0.877 and 0.869 (considered good and indicated the factor analysis was helpful as they exceeded the minimum acceptable value of 0.75). In addition to the descriptive statistics, Table 1 shows the MSA (Sampling Adequacy Measure) value for each item, with values very close to 1, well above the acceptable 0.50 for item selection.

**Reliability.** From the 14 items, the reliability of the questionnaires was obtained using three random percentages of subjects: 10%, 40%, 70%, and the total sample.

Taking the reliability coefficients from the total sample as a reference, the Typical Error of Measurement (TEM) ( $TEM = Dt\sqrt{1 - \rho}$ ) is 0.689, considering a reliability value of 0.93 ( $N.C. 90\% \pm 1.137$ ). When rounding, we could think that the Maximum Measurement Error is close to 1. ( $MME = Xv \pm (TEM * Za/2)$ ).

**Factorial structure.** The CFD-14 questionnaire demonstrated its suitability with the sample size ( $KMO = 0.888$ ), as well as its appropriateness for factor analysis (Bartlett = 15870.6,  $df = 91$ ;  $p < 0.000$ ).

The concordance analysis between parent and teacher evaluations is a critical component of this study as it assesses the consistency across different observers interacting with the student in distinct environments. This consistency is crucial for validating the practical application of the CFD-14 questionnaire in real-world educational settings, ensuring that it reflects a holistic view of the child’s learning difficulties. Moreover, this analysis enhances the robustness of the questionnaire’s validity by showing that the tool can integrate perspectives from both home and school, which are essential in forming a comprehensive understanding of the student’s needs.

A single factor was considered based on the Factor Analysis, explaining 55.65% of the total variance (eigenvalue = 7.792). The model fit, as indicated by RMSEA of 0.038 ( $df = 77$ ), is adequate ( $< 0.05$ ), and the Goodness of Fit Index is good ( $GFI = 0.970$ ). To

**Table 2 The reliability indices of the questionnaire.**

Sample size	Standardized Alpha Cronbach	McDonald's Ordinal Omega	Classic Cronbach Alpha (SPSS)
10% n = 138	0.905	0.914	0.820
40% n = 554	0.932	0.935	0.842
70% n = 969	0.935	0.938	0.834
100% n = 1385	0.938	0.935	0.831

**Table 3 Factor saturations of each item in the factor.**

Items	Factor 1
1. Started speaking later than expected	0.549
2. Has or had pronunciation difficulties beyond what is expected for their age	0.637
3. Has or had difficulty recounting an Event, narrating a story, or doing so with short sentences.	0.797
4. Has or needed help memorizing songs, rhymes, tongue twisters, poems, or other information intended for memorization.	0.835
5. Has or had difficulty saying one word that rhymes with another or saying words that start with "m"; for example, he has or had difficulty playing "I see."	0.769
6. Has difficulty spelling words.	0.808
7. He has stated that he dislikes reading or writing or refuses to do so.	0.595
8. it takes longer than others to do class reading and writing tasks.	0.767
9. In class, you need more help than others to do the reading and writing tasks.	0.862
10. you have more difficulty attending to reading and writing tasks in class than others.	0.829
11. Frequently needs to improve when reading or writing words.	0.796
12. (1st to 6th grade): It is slow/slow when reading words or texts.	
13. (early childhood education (5 years old)): Has difficulty naming, recognizing, or remembering the sound of letters studied.	0.832
14. Know any history of direct family (parents, uncles, brothers) with learning difficulties in reading or writing.	0.414
15. It has many spelling errors and persists more than expected (from 3rd to 6th grade).	0.476

**Table 4 Correlation between CFD-14 and reading and writing performance rating.**

	Teachers (1-4) (n = 1383)	Families (1-4) (n = 1373)
Rho Spearman coefficient	-0.507 (0.000)	-0.539 (0.000)

address concerns about the four items with factor loadings below 0.6, we conducted an additional analysis comparing a one-factor and a two-factor solution. While the two-factor model showed a slight improvement in fit, it did not align well with the theoretical basis of the questionnaire. Removing these items did not significantly enhance the questionnaire's reliability or validity. Therefore, we retained all 14 items to preserve the instrument's comprehensive assessment capability Tables 2, 3.

**Evidence of criteria validity.** The first two pieces of criterion validity evidence are the correlation coefficients between the performance ratings expressed by teachers and families and the total score on CFD-14 (Table 4). These coefficients are significant and similar, with a moderate effect size in both cases (Cohen, 2013).

To assess the degree of agreement between families and teachers, a contingency table was obtained (contingency coefficient (C) = 0.55  $p < 0.000$ ; and Kappa (K) = 0.32  $p < 0.000$ ). The valid sample in this study consisted of 1371 pairs of teachers and families. In Table 5, the cells on the diagonal represent the frequency of agreements between both contexts. In total, the sum of the accords is 844, which is 61.6% of the evaluated subjects. To calculate the concordance, a dichotomous value was obtained ("with difficulties" represented by values 1 and 2 of performance and "without difficulties" represented by values 3 and 4), and it was found that the percentage of agreement increased to 84.0%, as shown in Table 6. In this case, the values of C and K were significant: C = 0.47 ( $p < 0.000$ ) and K = 0.53 ( $p < 0.000$ ).

**Table 5 Concordance between teacher and family ratings of reading and writing performance (1-4).**

Families (1-4)	Teachers (1-4)			
	1	2	3	4
1	13	15	3	1
2	23	133	64	8
3	10	128	618	233
4	2	3	37	80

**Table 6 Concordance between teacher and family ratings of reading and writing performance (without and with difficulties).**

Family value	Teacher values	
	Without difficulties	With Difficulties
Without difficulties	968	143
With difficulties	76	184

According to the Rho coefficients, the trend is that subjects who achieved higher levels of performance were those who obtained lower scores on CFD-14. It can be observed that performance levels 1 and 2 (with difficulties) imply higher arithmetic means (ranging from 3.91 to 7.31 points) compared to students in performance levels 3 and 4 (without difficulties), whose means range from 1.23 to 0.56. Table 7.

The third evidence of validity was obtained by comparing the average total score on CFD-14 for a group of dyslexic students (n = 13) with that obtained by the study's sample (n = 1385). The dyslexic group did not participate in the study's sample, but the questionnaire was used for family interviews during the psychopedagogical evaluation process. All subjects in the dyslexic

**Table 7 Comparison between CFD-14 and value of read-write performance.**

Performance value	Context	N	Mean	Sd
1	Teachers	49	6.98	3.688
	Families	32	7.31	3.247
2	Teachers	286	3.91	3.075
	Families	229	4.99	3.101
3	Teachers	724	1.23	1.805
	Families	990	1.06	1.594
4	Teachers	324	0.56	1.044
	Families	122	0.57	1.348

**Table 8 Comparison of item averages between the sample group and the dyslexic group.**

Item	Sample group (n = 1385)	Dyslexic group (n = 13)
1	0.09	0.08
2	0.11	0.15
3	0.10	0.23
4	0.06	0.00
5	0.04	0.30
6	0.09	0.77
7	0.28	0.85
8	0.16	0.54
9	0.18	0.69
10	0.20	0.54
11	0.13	0.85
12	0.12	0.77
13	0.15	0.62
14	0.13	0.62

**Table 9 Comparison of averages between sample group and dyslexic group.**

	Sample group (n = 1385)	Dyslexic group (n = 13)
Mean	1.83	7.00
Sd	2.606	2.041
Average Range	694.02	1283.54
z U of M-W	-5.492 (0.000)	
Cohen effect	2.209	

**Table 10 Comparison of averages between students with and without family history.**

	Without a history (n = 1183)	With a history (n = 202)
Mean	1.44	4.17
Sd	2.225	3.349
Average Range	661.54	877.23
z U of M-W	-7.538 (0.000)	
Cohen effect	0.960	

**Table 11 Comparison of averages between students with and without spelling errors.**

	Without spelling mistakes (n = 657)	With spelling mistakes (n = 186)
Mean	1.14	3.63
Sd	1.816	3.167
Average Range	374.94	588.22
z U of M-W	-11,147 (0.000)	
Cohen effect	0.965	

group met the criteria of the International Dyslexia Association and were considered students with learning difficulties stemming from specific reading and writing difficulties (dyslexia) based on the final synthesis of the psychopedagogical report. Some relevant characteristics of the dyslexic group include gender (8 girls and 5 boys), age (median of 9 years and two months), academic level (one in 1st grade, four in 2nd grade, one in 3rd grade, four in 4th grade, one in 5th grade, and two in 6th grade), intelligence level (mean total IQ WISC-V = 98.6 and *Sd* = 8.92). In Table 8, it is observed that the arithmetic means for each of the items in the dyslexic group are much higher than those of the study's sample in items 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14, but not in items 1, 2, and 4. According to these results, delayed speech onset (item 1), difficulties in pronunciation beyond what is expected (item 2), and difficulty in the ability to memorize verbal material (item 4) should not be used as differential criteria in the diagnosis of dyslexia. However, they may be part of the developmental process of students with reading and writing difficulties, whether of dyslexic origin or not.

The arithmetic means of the total scores in the CFD-14 questionnaire were compared in the sample group and the dyslexic group. The mean of the dyslexic group (7.00) almost quadrupled the mean of the sample group (1.83). Tables 9–12.

The fourth evidence of validity is related to the neurobiological characteristic of dyslexia and its heritability. Item 13 (“You know some family history...”) was used as an independent variable in this validation procedure. The findings related to family history suggest a familial pattern in the occurrence of reading and writing difficulties. While this does not directly indicate a neurobiological origin, it supports the idea that these difficulties may have heritable components, consistent with previous research in the

field. This insight is valuable as it highlights the importance of considering family background in the assessment and early detection of dyslexia.

To obtain the comparison average, item 13 was not taken into account. It was found that 14.6% of the families in the valid sample reported a family history of difficulties in reading and writing. The results confirmed significant differences in favor of the group with family history, which contributed to the validation of CFD-14 by considering that dyslexia or other specific difficulties that affect reading and writing performance have a neurobiological origin and are, therefore, heritable. It was observed that the group with a family history reported more difficulties (more “yes” responses) than the group without a family history, and the effect size of this comparison was significant (0.96).

Regarding the fifth evidence, the total score of the questionnaire was compared between students with and without spelling difficulties (item 14). The item was used as an independent variable without being included in the total score calculation. In this case, the sample size was smaller (n = 843), as the item was intended for students in grades 3–6. A significant difference in the total scores of CFD-14 was observed in favor of subjects with persistent spelling errors, which accounted for 22.1% of the sample, and the effect size of the comparison was large (0.965).

**Comparison by level of education.** Based on the ANOVA ( $F = 4.361, p < 0.001$ ) test, significant differences were found between the group of I5 (Infantil 5 years) and 4th grade (Scheffé = -1.098,  $p = 0.009$ ). No significant differences were

**Table 12 Comparison of averages by educational level.**

	Early childhood education 5 years (n = 172)	1st grade (n = 176)	2nd grade (n = 194)	3rd grade (n = 154)	4th grade (n = 216)	5th grade (n = 216)	6th grade (n = 257)
Mean	1.38	2.05	1.72	2.06	2.48	1.49	1.69
Sd	2.188	2.939	2.517	2.689	3.231	2.235	2.204
Average range	631.65	701.07	677.71	731.01	751.44	647.31	706.58
H of K-W	14.891 (g.l. = 6, p = 0.021)						
Cohen effect	0.399						

**Table 13 Descriptive and frequency for risk identification.**

Raw score *	Frequency	Percentage	Cumulative percentage	Descriptives
0	601	43.4	43.4	Mean: 1.83
1	285	20.6	64.0	Median: 1.00
2	151	10.9	74.9	Sd: 2.606
3	85	6.1	81.0	Asymmetry: 1.835
4	72	5.2	86.2	Kurtosis: 3.027
5	47	3.4	89.6	Minimum
6	30	2.2	91.8	score: 0
7	34	2.5	94.2	Maximum
8	23	1.7	95.9	score: 13
9	27	1.9	97.8	
10	14	1.0	98.8	
11	7	0.5	99.4	
12	4	0.3	99.6	
13	5	0.4	100.0	

observed between other groups based on the educational level. However, following the non-parametric statistical model, Table 13 presents the descriptive and comparative data of the groups according to the Kruskal-Wallis H test. The significance value associated with H is  $< 0.05$  ( $p = 0.021$ ), although the effect size (d) is small ( $< 0.50$ ).

**Risk indicator.** The main descriptive statistics allowed identifying a subject's position in the sample. The closest raw score to the 90th percentile (89.6) is 5, the critical point from which a student will be considered at risk for learning difficulties in reading and writing. A very high risk would occur when the difference from the group's mean (1.83) is equal to or greater than 2 or more standard deviations; in other words, a raw score equal to or greater than 7.

**Limitations**

This study, while providing valuable insights into the CFD-14 questionnaire's validation has several limitations that should be acknowledged. Firstly, the cross-sectional design limits the ability to conclude the questionnaire's predictive validity over time. Longitudinal studies are needed to assess the long-term effectiveness of the CFD-14 in predicting dyslexia and related literacy difficulties. Secondly, the sample of students diagnosed with dyslexia was relatively small ( $n = 13$ ), which may limit the generalizability of the findings regarding the questionnaire's discriminative power. Future research should involve more significant and diverse samples to confirm the robustness of these findings. Another significant limitation is the absence of objective measures of reading ability in the validation process. Although we relied on teacher and parent assessments as external criteria for evaluating the validity of the CFD-14, these subjective measures may not fully capture the complexity of literacy difficulties or the accuracy of the questionnaire in detecting dyslexia. Future research should incorporate objective reading assessments to

strengthen the validity evidence for CFD-14 and provide a more comprehensive evaluation of its effectiveness. While the CFD-14 was designed to assess literacy risks in children aged 5–13, we recognize that its added value may be more pronounced in younger children, mainly before they have acquired reading skills. For children older than 7 years, direct reading assessments, such as those administered routinely in schools, may provide a more accurate measure of reading ability. However, the CFD-14 still offers value by identifying underlying risk factors that may not be immediately apparent through reading tests alone, especially in cases where difficulties emerge later due to cumulative challenges in phonological processing, working memory, or other cognitive areas. Additionally, a significant limitation of this study is the need for more analysis linking CFD-14 screening scores with children's reading ability, both concurrently and in follow-up assessments. This connection is crucial for verifying the screener's sensitivity and specificity in predicting reading difficulties. Future research should incorporate longitudinal data to evaluate how well CFD-14 scores correlate with later reading performance, thus providing a more comprehensive validation of the tool's effectiveness. Finally, the current design of the CFD-14 primarily focuses on identifying difficulties based on past or present observations without fully accounting for the individual variability in children's developmental trajectories. Children's growth spurts and developmental pace can significantly influence when and how literacy-related difficulties emerge. For example, a child who experienced a slow start in language acquisition may later catch up to peers. In contrast, another child might exhibit difficulties that only become apparent after initial progress. This variability highlights the need for a more nuanced approach in future screener versions, potentially incorporating items that assess the child's current developmental stage in conjunction with historical data. This limitation is particularly relevant when considering the disconnect between early language skills assessed by the CFD-14 and more recent language scores, such as the Verbal Comprehension Index (VCI) of the WISC-V. The VCI is typically based on a child's abilities during assessment, while the CFD-14 asks about early language acquisition, which may no longer reflect the child's current capabilities. This discrepancy underscores the importance of contextualizing screening results within the broader scope of a child's developmental history.

**Discusión**

The objective of this study was to demonstrate the reliability and validity of a questionnaire aimed at families of students in 5-year-old kindergarten and 1st to 6th grade primary education (CFD-14) for use by teachers in educational institutions and other professionals (educational guidance services, clinical psychology, pediatrics, etc.). The questionnaire serves a dual purpose: screening to detect the risk of reading and writing difficulties in students and understanding the evolution and characteristics of these difficulties in an assessment process. We used the most relevant theoretical contributions as references to ensure the content validity of the questionnaire's questions. Among these questions are those used in the CDLQ-R (Willcut et al., 2011),

specifically related to reading and writing difficulties, although with slightly different wording and without the original scaling. The North American questionnaire has five response options (Never, Rarely, Sometimes, Quite Often, Always). In CFD-14, we opted for a dichotomous response questionnaire (YES-NO), which required an unambiguous wording of the items, including adverbs of quantity (quite, much, frequently, more difficulties, more time, etc.) to make it clear what specific difficulty was being asked about.

One surprising selection aspect included items 1, 2, 3, and 4. These items are related to the development of oral language (comprehension and expression). In this research, there is no difference between the development achieved by the general population of students compared to the dyslexic group. These four items are related to oral language development but are not defining or influential in dyslexic students. In light of this, and although it was not an objective of the research, the Verbal Comprehension Index (VCI) of the WISC-V was retrieved from the psychopedagogical reports. The results for the group of dyslexic students ( $n = 13$ ) were as follows: the mean VCI was 101.5 with a standard deviation of 10.45 (maximum VCI 118 and minimum VCI 85), which shows no significant difference between the dyslexic group and the general population (VCI 100 and standard deviation 15). Although these items are not discriminative for dyslexia, they could be for students with reading and writing difficulties not derived from dyslexia (language difficulties, intellectual limitations, hearing difficulties, etc.). This result is consistent with the research by Bascañán et al. (2021). Dyslexic students show lower performance in phonological awareness and decoding, while there are no significant differences in language skills, although there are differences in reading skills. However, students with Specific Language Impairment (SLI) had difficulties in both reading and language skills. Bascañán et al. (2021) argue that children with SLI and dyslexia share difficulties in reading learning. However, other research demonstrates a lower level of development in verbal aspects in dyslexic students (De la Peña Álvarez (2013); Ortiz et al., 2008). In one way or another, including items 1, 2, 3, and 4 in the CFD-14 questionnaire would be justified.

Advancements in the statistical development of tests require considering various criteria when using procedures to obtain reliability (Toro et al., 2022; Viladrich et al., 2017). Among these criteria is the consideration of alternative options such as the standardized Cronbach's alpha and the ordinal McDonald's omega. Our results demonstrate, with different sample sizes, the high stability of the reliability coefficients, which are above the critical or commonly established minimum value (0.70) (Cronbach, 1951; Carmona, 2004). Furthermore, the Typical Measurement Error (TME) value demonstrates the instrument's precision, and with an approximate maximum error of 1 (90% confidence interval), it is not considered too high.

On the other hand, five external criteria were used to demonstrate the test's criterion validity. The first two, the assessment of reading and writing performance by families and teachers, were structured similarly to other research in the educational and health fields. The results showed a moderate correlation between CFD-14 and the assigned ratings (1–4) in both contexts, around 0.50, indicating the consistency of this criterion validation.

CFD-14 is particularly discriminative for dyslexic students. Interestingly, the average score for the dyslexic group was 7.0, coinciding with a high risk level (exceeding 2 SD above the sample mean). The items that most discriminate between dyslexic students and the general sample, ranked from highest to lowest, are as follows (the values in parentheses accompanying the item number represent the number of times the dyslexic group's scores

exceeded the sample group's scores, according to the results in Table 8): 6 (8.27), 5 (7.53), 12 (6.69), 11 (6.41), 14 (4.59), 13 (4.21), 9 (3.91), 8 (3.34), 7 (3.08), 10 (2.68), 3 (2.28). Items 1, 2, and 4 are not very discriminative between the dyslexic group and the general sample. This result is consistent with the definition of dyslexia by the International Dyslexia Association (2002, p.1), which defines it as a

*“Dyslexia is a specific learning disability of neurobiological origin. Difficulties with accurate and fluent word recognition and poor spelling and decoding abilities characterize it. These difficulties typically result from a deficit in the phonological component of language that is often unexpected about other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede vocabulary growth and background knowledge.”* Specifically, the seven highly discriminative items were related to difficulties in spelling (6), phonological awareness (5), slow reading or recognizing the sound of letters (12), errors in reading or writing words (11), spelling (14), family history of reading difficulties (13), and the need for more assistance with reading and writing tasks (9).

Regarding the genetic inheritance of dyslexia, according to the data from the dyslexic group, 61.5% acknowledged a family history, compared to 14.6% in the general sample. This result is consistent with the study by Olson et al. (1999) and Astrom et al. (2012), which concluded that genetic factors may account for between 30% and 70% of the variability in reading ability. It also aligns with neuroimaging studies by Soriano and Piedra (2017). Another study consistent with this research was provided by Grigorenko et al. (2001), who found that a person is 8 times more likely to have reading difficulties when one of the parents is affected.

In addition to reading difficulties, some developmental dyslexics in transparent languages like Spanish have persistent spelling problems (Jiménez et al., 2014; Atencia et al., 2021). The results of our research demonstrate that 61.5% of families in the dyslexic group (more than 4 times higher than the sample) acknowledged that the evaluated subjects had spelling difficulties. Of the dyslexic group ( $n = 13$ ), a subgroup of 8 students in grades 3–6 were assessed in spelling using the PROESC (2003) and TIBEx (2017) tests. The results confirm that, of the 8 students, 7 scored at a low level on both tests, confirming the strong tendency for dyslexic students to have spelling difficulties.

## Conclusion

This research aimed to develop a reliable and valid questionnaire to be completed by families of students aged 5–13 to detect the risk of reading and writing difficulties as early as possible. Given that 4% of the population may have dyslexia, CFD-14 could help identify a higher percentage of at-risk students.

Although the sample highly represents the population in Extremadura, Spain, regarding its general characteristics (gender, school ownership, and grade level), CFD-14 could also be applied in other contexts.

We used random procedures and samples to achieve a highly reliable questionnaire with stable coefficients ranging from 0.83 to 0.94.

In addition to content validity, we have five pieces of evidence related to criterion-related validity. We found a significant relationship between the scores obtained on CFD-14 and the assessments made by teachers and families. We also demonstrated the discriminative power of CFD-14 by comparing the results between dyslexic students and the general population. Furthermore, we highlighted the importance of family history and the persistence of spelling errors compared to the general population.



Finally, we established that a direct score corresponding to the 90th percentile is 5, a critical value that should be considered when identifying students at risk of reading and writing difficulties. Additionally, a score of 7 on CFD-14 indicated a very high risk.

In conclusion, we have achieved the objectives of this study by demonstrating the reliability and validity of CFD-14. Although the sample size of dyslexic students in this study is limited ( $n = 13$ ), the results still provide valuable initial validation of the CFD-14 questionnaire's discriminative ability. We recommend that future studies include more extensive samples of dyslexic students to substantiate these findings further and enhance the generalizability of the results. Despite this limitation, the current research contributes important preliminary data that support the utility of the CFD-14 in identifying students at risk of dyslexia. For this reason, we are making this work available to educational and healthcare institutions, confident that it will be a valuable tool in identifying the risk of reading and writing difficulties based on family information.

Future iterations of the CFD-14 could include items that specifically address changes over time rather than focusing solely on past or present difficulties to improve its sensitivity to children's developmental progress. Such modifications could help better capture the dynamic nature of child development, providing a more accurate picture of a child's current literacy risk.

#### Data availability

Data supporting the findings of this study are available upon reasonable request to the corresponding author.

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## Author contributions

AG-C, DP-J, and JLR-S: Conceived and designed the experiments; performed the experiments; contributed reagents, materials, analysis tools, or data; drafted the article. AG-C, DP-J, and JLR-S: Conducted the experiments; wrote the article. AG-C, JLR-S, and JV-G: Analysed and interpreted the data. AG-C, DP-J, and JLR-S made the changes and wrote the manuscript's improvements.

## Competing interests

AG-C, JLR-S, and JV-G declare no conflicts of interest related to this research. However, DP-J is an editor of the journal to which this article is being submitted, and this is disclosed in the interest of transparency.

## Ethical approval

This study was approved by the European Science Institute (ESI) research ethics committee under protocol number ESI 2021/006. All research activities were conducted following the principles of the Declaration of Helsinki.

## Informed consent

Informed consent was obtained from all participants involved in the study or from their legal guardians in the case of minors.

## Additional information

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