Knowledge About Dyslexia in Arabic: A Cross-disciplinary Factor Analytic Study

Arab Journal of Applied Linguistics
e-ISSN 2490-4198
Vol. 08, No. 02, 2023, 39-74

http://www.arjals.com

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Abstract

Dyslexia is the most common learning disability. Knowledge about dyslexia is thus essential for its prevention and early identification. Despite recent advances in dyslexia grounded in the science of reading and the science of teaching reading, it remains unclear the extent to which different professionals who work with children diagnosed with dyslexia actually know about the disorder. This study examines the knowledge of professionals working with children with dyslexia in Lebanon. We administered a 29-item online Qualtrics survey to 175 professionals including speech-language pathologists, special educators, and psychologists. Using exploratory factor analysis in the exploratory structural equation modeling framework, we compared one-, two-, and three-factor models and selected the one factor solution as optimal. Results indicate that the instrument is valid as a measure of dyslexia knowledge in this population. Furthermore, participants held both correct knowledge and misconceptions about dyslexia. We conclude with limitations, recommendations for future research and practice.

Keywords: Dyslexia, Dyslexia knowledge, Arabic, Science of Reading, Science of Teaching Reading, Exploratory Factor Analysis, Exploratory Structural Equation Modeling, Professional Development

Introduction

One cannot give what one does not possess is the main idea behind the *Peter Effect* (Applegate & Applegate, 2004), which refers to the story of the Apostle Peter, who said he was unable to give money to a beggar because he himself did not have it. This construct was re-introduced in a study that examined the knowledge of reading teachers and their teaching candidates, showing that teachers can only teach their students what they know (Binks-Cantrell et al., 2012). As such, teachers with reduced knowledge of reading and reading disorders will engage in teaching practices that reflect that knowledge and have teaching candidates with similarly limited knowledge of reading and its disorders, who enter the workforce being ill equipped to teach reading. Teacher knowledge is thus the quintessential element in developing good readers and preventing reading disabilities, including dyslexia.

The connection between teacher knowledge and student outcomes is well established with studies spanning typical (Denton & Mathes, 2003; Moats & Foorman, 2003; Morrison et al., 2005; Rupley, 2011) and atypical (Al Otaiba & Lake, 2007) development. Several investigations have recently addressed dyslexia knowledge of literacy professionals in both developed and underdeveloped countries (Gwernan-Jones & Burden, 2010; Serry & Hammond, 2015; Kumas & Yidirim, 2023; Peltier et al., 2022; Wadlington & Wadlington, 2005; Washburn et al., 2011; Washburn et al., 2013) focusing on monolingual and bilingual student populations (Yin et al., 2019) where dyslexia

identification and resources are either emerging or already available. Less is known, however, regarding teacher knowledge about dyslexia in various nonwestern countries such as the ones in the Middle East, where awareness about dyslexia is emerging, albeit sparse, and the resources needed for early identification and intervention are minimal or nonexistent (Elbeheri, 2022).

In this article, we examine the knowledge of professionals about dyslexia in the Middle Eastern country of Lebanon. First, we begin with a definition of dyslexia and its current understanding in Arabic. Second, we provide a brief overview of the available research on teacher knowledge of dyslexia including the various methodologies used in previous studies. Lastly, we shed light on the Lebanese context of the study, underscoring the economic resources and development as well as language use that shape the assessment of and intervention in dyslexia.

Dyslexia in Arabic

Dyslexia is a specific learning disability that is neurobiological in origin characterized by inaccurate or dysfluent word reading and phonological difficulties that are persistent in nature, leading to difficulties with accurate and /or automatic word reading and spelling (Kearns et al., 2019; Vellutino et al., 2004). The general understanding of dyslexia remains poor, however, likely due to widespread myths and misconceptions about the disorder (Gaab, 2017), coupled with lack of training of teachers and professionals in the science of

reading (Moats, 2020). This has led to inaccuracies regarding what constitutes the disorder, negatively impacting its identification, assessment, and treatment. Consequently, the lack or incomplete knowledge about dyslexia can stunt the advancement of the scientific understanding of the condition (Goldenberg, 2020) with a cascading effect that prevents children and families' access to quality assessment and intervention.

Dyslexia in the Arab world has been the focus of research in recent years with most of the work targeting children and adolescents with or at risk for reading disabilities (Elbeheri, 2021; Mahfoudhi et al., 2011). Much less research has been dedicated to professional development and understanding the nature and impact of teacher or professional knowledge about dyslexia.

The manifestation of dyslexia in Arabic is thought to be shaped by various characteristics of the Arabic language, including its diglossic nature and orthography and visual complexity of the script that seem to affect the contribution of the various language components to the severity of the disorder. Diglossia is a sociolinguistic phenomenon in which two forms of the language co-exist and are used for various communicative purposes: Spoken Arabic (SPA) is used for everyday communication, and Modern Standard Arabic (MSA) is used for reading, writing, religious sermons, and other formal contexts (Ferguson, 1959). These forms differ across the language components including syntax, phonology, and morphology (Holes, 2004) and pragmatics (Abu-Rabia, Share, &

Mansour, 2003). Young children do not use MSA systematically until they enter school and receive formal education in Arabic, which has thus been dubbed by some to be similar to learning a second language (Ayari, 1996). Consequently, children do not master grapheme-phoneme correspondence until later childhood and tend to demonstrate more difficulties if their dialect of Arabic is linguistically different from MSA (Saeigh-Haddad, 2007).

Another consistent source of difficulty in reading Arabic is its dense orthography. Arabic varies in its orthographic depth and can be read in two scripts—vowelized (with short vowels or diacritics) and unvowelized (without short vowels or diacritics). Letter similarity constitutes another challenge for Arabic readers, whereby certain Arabic letters that represent different speech sounds share the same shapes but differ only in the number of dots (diacritics). During the early years of formal schooling, children learn to read vowelized scripts in many (though not all) Arab countries and educational systems, which provide a one-to-one grapheme to phoneme mapping (Taha, 2016), and only transition to the unvowelized script as they become better readers (Mahfoudhi et al., 2020) in Third (Farran et al., 2012) grade or higher. Children who read Arabic have been found to be slower in identifying letters due to the complexity of the orthography.

Developmental dyslexia symptoms in Arabic have been associated with varying degrees of orthographic depth, suggesting that vowelized words are read with high accuracy compared to unvowelized words (Abu-Rabia & Siegel, 1995). However, there is

evidence to support the converse, indicating that dyslexic readers demonstrate slow and inaccurate reading when presented with vowelized script.

Teacher Knowledge about Dyslexia

Considering the extant research on dyslexia and the evidence base surrounding its remediation, it is expected that teachers who have deep and thorough knowledge of dyslexia grounded in the science of reading have students with better outcomes that cut across various components of structured literacy, including basic language constructs such as phonemic awareness, phonics, vocabulary, and the alphabetic principle (Moats, 2020).

Current review of research addressing the knowledge of teachers about dyslexia reveals studies with diverse methodologies, addressing subtopics such as nature of dyslexia, common myths and misperceptions, evidence-based interventions, and perceived confidence and responsibility for working with and teaching students.

White et al. (2020) used the Knowledge and Insights of Dyslexia Survey (KIDS) to measure knowledge and beliefs of responsibility towards individuals with dyslexia of preservice education majors (EM) and non-education majors (NEM) students (n=243). The survey measured knowledge relating to the origins, prevalence, characteristics, and treatment of dyslexia. The results revealed no significant differences between the two groups in knowledge of dyslexia. However, all participants demonstrated reduced

knowledge of dyslexia with persistent myths and misconceptions on the topics of evidence-based treatments and the core components of good instruction.

Similarly, Washburn et al. (2011) examined novice teachers' knowledge of basic language concepts and dyslexia using a survey that measured knowledge of phonological awareness, phonemic awareness, phonics and morphology. The dyslexia knowledge portion utilized items from previous dyslexia knowledge surveys by Washburn et al. (2007; 2008), measuring knowledge and perceptions of the nature of dyslexia including commonly known myths about dyslexia. Qualitative analyses were conducted using a constant comparative approach and resulted in various themes for dyslexia with five overarching categories: Language/Literacy, Behavior, Cognition, Misconceptions, and other characteristics.

In a recent study, Peltier et al. (2022) examined dyslexia knowledge among 524 teachers in a midwestern state in the U.S. using the Dyslexia Knowledge Questionnaire-2 which consists of 37 Likert scale items that assess conceptions participants held as scientific conceptions, misconceptions, or uncertain. Using descriptive statistics, with percent of responses within each knowledge category, the results indicated that teachers have a complicated conception of dyslexia. Moreover, dyslexia-specific training and self-confidence, but not teaching experience, were the best predictors of dyslexia knowledge in this group of teachers.

Yin et al. (2019) investigated early literacy knowledge of dyslexia of teachers from well-developed regions versus less well-developed regions (*n*= 516) in Mainland China using a survey that consists of 29 items with answer choice of "yes", "no", and "I don't know". These items measured knowledge of dyslexia in three domains: general information, symptoms/diagnosis, and treatment, and were adapted or modeled after items in other surveys (20 items by Soriano-Ferrer et al. 2016, and 9 items by Washburn et al., 2014). Using analysis of variance (ANOVA), the teachers from less well-developed regions scored generally significantly less in their knowledge about dyslexia than their counterparts from well-developed regions. Results of the regression analysis showed that prior exposure to children with dyslexia explained a significant amount of the variance in Chinese teachers' knowledge about dyslexia. Findings suggest the need for teacher training to increase the knowledge of teachers about dyslexia in a country where general teacher knowledge is poorer compared to other well-developed countries. This is the situation in Lebanon, which is the context of the present study.

Context in Lebanon

Lebanon is considered a developing country where Arabic is used as the main language. It is part of the Middle East and North Africa (MENA) region—an area of the Arab world that has long struggled with poor literacy rates. The Lebanese context is ideal to examine because *illiteracy* has been reported in the MENA region for decades, with a pronounced

increase of 30% in illiteracy rate from the 1970s, and only 75% of the population is reported to be able to read and write (UNESCO, 2019). Furthermore, the MENA region is witnessing a high rate (59%) of *learning poverty*—the percentage of 10-year-old children who are unable to read and understand a text at their grade level in their first language (Gregory et al, 2021). Related to this, the *diglossic natur*e of Arabic is, as mentioned earlier in the paper, another source of reading difficulty for learners. Arabic spoken (amiya) and written (fusha) varieties differ across the language components, rendering mapping of oral language onto written language less straightforward, thus negatively impacting children's linguistic representations needed for reading (Farran et al., 2012), and implicated in dyslexia.

In addition to diglossia, Arabic is almost always taught and used along with (code switching) and together with (code mixing) French and (or) English languages; it is rarely taught as the only language in schools, often infused with another language like French or English within a bilingual context (Esseli, 2014). While not unique to Lebanon, the COVID-19 pandemic has exacerbated the learning crisis in the MENA region, directly and negatively impacting the conditions under which Arabic teaching and learning take place. Moreover, many Arab countries are war-stricken (Abdesslem, 2017), thereby thwarting the services that students receive, and limiting access to quality education, likely resulting in a pronounced *learning loss* (Engzell et al., 2021). Notably, these identified variables interact in complex ways to exert cascading effects, impeding the

knowledge of professionals about dyslexia. As such, examining teacher/professional knowledge about dyslexia is especially important in the case of Lebanese Arabic.

Related to professional knowledge, it would be important to contextualize this work in the current system in Lebanon, where pronounced gaps in economic development and education resources exist (The World Bank, 2021). This seems to impact both public awareness as well as specialized training about dyslexia across sectors (public versus private) and disciplines (general education teachers, special education teachers, speech-language pathologists (SLPs), psychologists), leading to paucity of knowledge among professionals who specialize in and work directly with individuals with dyslexia.

While knowledge about dyslexia has been central to many recent investigations in English, much of the work has focused primarily on teachers, with little or no consideration of the knowledge of other key professionals who work closely with children with dyslexia, such as special education teachers and SLPs. Moreover, the methodologies used in previous research have been qualitative, descriptive, or solely examined manifest, observed, variables, without consideration of the latent constructs that may elucidate the interrelationships that exist among the observed variables.

The Present Study

This study aims to address this gap by examining the knowledge of professionals who work with children with dyslexia in Lebanon, including special education teachers and

SLPs. Such knowledge is likely to exert a direct influence on what to focus on and how to teach reading and prevent or minimize reading disabilities. We thus sought to answer the following research questions:

Research Question (RQ) 1. What is early literacy professionals' level of knowledge about dyslexia?

Hypothesis 1. Given the apparent gaps in economic development and education resources in Lebanon, we predict that professionals from various disciplines may show paucity of knowledge due to lack of public awareness and specialized learning or training about dyslexia.

Research Question (RQ) 2. What common dimensions(s) or area(s) of correct understandings or misconceptions underlie the data?

Hypothesis 2. Based on the available research evidence, we predict that Lebanese professionals may show more knowledge on symptoms of dyslexia, which is at the behavioral level, than on aspects that need research-based knowledge such as nature, cause, and remediation of dyslexia.

Research Question (RQ) 3. Does knowledge about dyslexia vary based on participants' occupation and demographic characteristics?

Hypothesis 3. Based upon previous research, we anticipate significant variations based on professional training, prior exposure to children with dyslexia, and professionals' knowledge about dyslexia.

Instrumentation

The survey instrument consists of 29 items (Yin et al., 2020), including 20 items taken from Soriano-Ferrer (2016) and nine taken from Washburn et al. (2014) that reflect universally agreed upon understandings and misunderstandings of dyslexia across world languages. The survey is comprised of three subscales measuring (1) general domain (items 1-14), which addresses nature, causes, and misconceptions about dyslexia; (2) symptoms and diagnosis of dyslexia (items 5-21); and (3) treatment of dyslexia (items 22-29). The items elicit responses using "true", "false", and "I don't know" answer choices to capture the difference between misconceptions and lack of knowledge of professionals. Items are scored using a "0" for incorrect or wrong information and "1" for correct answers, with a maximum possible score of 29. With respect to the instrument's psychometric properties, it has good internal consistency with Cronbach's alpha of .88 for the entire survey. As for the three individual domains, internal consistency was found to be moderate as shown in Cronbach's alpha of .74 (general information), .77 (Symptoms and diagnosis of dyslexia), and .74 (treatment of dyslexia). Overall, the instrument is supported by evidence of validity for measuring teacher knowledge about dyslexia. Furthermore, we added a demographics section to collect information about the professionals' education level, age, area of practice and specialty.

Participants

The sample consisted of 175 participants aged between 20 and 48 (*M*=24, *SD*=6.89). The great majority of the sample reported working in Lebanon at the time of the survey (*n*=149, 85.1%). Most participants reported working with individuals with dyslexia (*n*=146, 83.4%). A proportion of 30.8% (*n*=54) reported being an SLP, whereas 10.85% (*n*=19) reported non-SLP occupations. A proportion of 26.3% (*n*=46) had a master's degree, 16.6% (*n*=29) reported having a bachelor's degree, 1.1% (*n*=2) reported having a doctoral degree, and 65.7% (*n*=115) did not report their educational level. Some participants reported practicing in Beirut (*n*=29, 16.6%), Mount Lebanon (n=16, 9.1%), the northern region (n=15, 8.6%), the southern region (*n*=11, 6.3%), other regions (n=4, 2.3%), or Bekaa (n=1, 0.6%), whereas others (*n*=116, 66.3%) did not report their location.

Data Analysis

RQ1 Descriptive Analyses

Prior to data analysis, we examined missing values, which had a completely random distribution (Little's MCAR $\chi^2_{(121)}$= 91.790, *p*= .978) and were imputed using the expectation-maximization algorithm. The first research question was addressed by calculating response frequencies for all survey items. Specifically, we examined the number and percentages of "true" and "false" ratings to identify the most prevalent knowledge and misconceptions about dyslexia.

RQ2: Factor Analysis

The second research question was addressed by employing exploratory factor analysis (EFA) within the exploratory structural equation modeling framework (ESEM) to identify the common area(s) of correct understandings or misconceptions underlying the data. EFA is a statistical technique used to identify the underlying latent factors that explain the interrelationships among a set of observed variables. It aims to uncover the underlying structure of a dataset by reducing the dimensionality and identifying the key factors that account for the observed covariation (Hair, Black, Babin, & Anderson, 2019). Within the exploratory structural equation modeling (ESEM) framework, EFA estimates the factor loadings and factor correlations while allowing for correlated residuals among the observed variables. ESEM combines the strengths of both factor analysis and structural equation modeling, providing a more flexible and accurate representation of the data structure and allowing the computation of goodness of fit indices (Marsh, Morin, Parker & Kaur, 2014). We estimated and compared models with a different number of factors and selected the optimal solution based on the interpretability of the factor solution and goodness of fit indices.

Model fit to the data was assessed using the following indices: (1) chi-square (χ^2), (2) chi-square/degrees of freedom (χ^2/df), (3) comparative fit index (CFI), (4) tucker-lewis index (TLI), (5) standardized root mean square residual (SRMR), (6) root mean square error of approximation (RMSEA) and it 90% confidence interval (CI). Chi-square is a

goodness-of-fit statistic that compares the observed covariance matrix to the expected covariance matrix based on the fitted model. A non-significant chi-square value indicates a good fit between the model and the data (Kline, 2015). The chi-square divided by its degrees of freedom provides a normalized value of the chi-square statistic. A lower χ^2/df ratio indicates a better fit between the model and the data (Hu & Bentler, 1999). The CFI measures the relative improvement in fit by comparing the target model to a baseline or null model. Values closer to 1 indicate a better fit, with 0.95 or higher often considered indicative of good fit (Bentler, 1990). The TLI, also known as the Non-Normed Fit Index (NNFI), assesses the relative fit the target model compared to a baseline model. Values close to 1 indicate a better fit, with 0.95 or higher often considered indicative of good fit (Tucker & Lewis, 1973). The SRMR measures the average discrepancy between the observed and predicted covariances or correlations. Lower SRMR values indicate a better fit, with values below 0.08 generally considered indicative of good fit (Hu & Bentler, 1999). The RMSEA represents the average discrepancy between the model-implied and observed covariances, adjusted for model complexity. Lower RMSEA values indicate a better fit, with values below 0.06 generally considered indicative of good fit (Steiger, 1990).

The selection of an optimal factor model was followed by measuring the internal consistency of the identified factor(s) using Cronbach's coefficient alpha, and the calculation of factor scores. Factor scores refer to the estimated scores or values that

represent an individual's standing on a latent factor or construct derived from factor analysis. These scores are computed based on the observed variables' factor loadings and the individual's responses on those variables. They provide a way to quantify and interpret an individual's level on a latent variable of interest (Bollen, 1989; DiStefano, Zhu, & Mindrila, 2009)

RQ3: Demographic Comparisons

The third research question was addressed by investigating the relationship between factor scores and the demographic characteristics of the participants. Specifically, we investigated the relationship between participants' factor scores and reported age by calculating a polyserial correlation coefficient and its *p* value. Further, we compared factor scores by occupation (speech related versus non-speech related) using the Mann-Whitney U test. This procedure, also known as the Wilcoxon rank-sum test, is a nonparametric analysis used to determine whether there is a significant difference between the medians of two independent groups. It is commonly used as an alternative to the independent samples t-test when the assumptions of normality and equal variances are violated or when dealing with non-normally distributed data or groups disproportionate in size (Mann, & Whitney 1947).

Additionally, we compared factor scores by geographical region and by educational level using the independent samples Kruskal-Wallis test. This nonparametric procedure used determines whether there are significant differences among three or

more independent groups in terms of their medians. It is an extension of the Mann-Whitney U test for multiple groups. The test is appropriate when the assumptions of normality and equal variances are violated or when dealing with non-normally distributed data or groups disproportionate in size. The Kruskal-Wallis test works by ranking the combined data from all groups and calculating a test statistic based on the ranks. The test statistic follows a chi-square distribution with degrees of freedom equal to the number of groups minus 1. A significant result indicates that at least one group differs significantly from the others (Kruskal & Wallis, 1952).

Results

RQ1: Descriptive Analyses

The correct statements marked by most participants as "true" were (a) "Dyslexia is a learning disability that affects language processing" (47.9%, *n*=92), and (b) "Individuals with dyslexia have difficulty with decoding/word recognition" (45.8%, *n*=88). The incorrect statements with the highest percentages of "false" ratings were "Dyslexia is a disability specific to the English language" (46.9%, *n*=90), "People with dyslexia have below-average intelligence" (44.8%, n=86), "I think dyslexia is a myth, a problem that does not really exist" (44.3%, *n*=85), and "Multisensory instruction has been shown to be an ineffective teaching method for treating dyslexia" (44.3%, *n*=85).

On two items, the number of incorrect responses exceeded the number of correct responses. The item "Eye tracking exercises are effective in remediating dyslexia-caused difficulties" (false) was incorrectly rated as "true" by 31.3% (*n*=60) and "false" by only 12.0% (*n*=23) of the sample. Similarly, the item "Seeing letters and words backwards is a characteristic of dyslexia" (false) was rated "true" by 30.2% (*n*=58) and "false" by 16.7% (*n*=32) of participants. These items revealed two misconceptions about dyslexia.

The correct statements rated most often as "false" were "Most children with dyslexia usually have emotional and/or social problems" (17.2%, n=33), "Dyslexia is hereditary" (17.2%, n=33), and "Students who have reading disabilities without an apparent cause (e.g., intellectual disabilities, absenteeism, and inadequate instruction) are referred to as dyslexic (16.7%, n=32). Nevertheless, the number of incorrect responses did not exceed the number of correct responses on these items. Table 1 reports the number and percentages of "true" and "false" ratings for all survey items.

Table 1.

Survey Response Distribution

			Response Distribution	
	Item (Correct response)		True	False
Q4	Dyslexia is a neurologically based disorder. (True)	*N*	83	25
		%	43.20%	13.00%
Q5	Dyslexia is a learning disability that affects language processing. (True)	*N*	92	16
		%	47.90%	8.30%
Q6	Students who have reading disabilities without an apparent cause (e.g., intellectual disabilities, absenteeism, and inadequate instruction) are referred to as dyslexic. (True)	*N*	76	32
		%	39.60%	16.70%
Q7	Children can outgrow dyslexia. (False)	*N*	26	72
		%	13.50%	37.50%

Q8	Dyslexia can be caused by a literacy-poor home environment (e.g., parents not reading to their children). (False)	*N*	17	82
		%	8.90%	42.70%
Q9	Dyslexia is more frequent in males than in females. (True)	*N*	77	21
		%	40.10%	10.90%
Q10	One of the major reasons for dyslexia-caused difficulties is due to visual problems. (False)	*N*	26	67
		%	13.50%	34.90%
Q11	Certain medications have been found to be effective in treating dyslexia. (False)	*N*	9	82
		%	4.70%	42.70%
Q12	Dyslexia is a disability specific to the English language. (False)	*N*	3	90
		%	1.60%	46.90%
Q13	Most children with dyslexia usually have emotional and/or social problems. (True)	*N*	59	33
		%	30.70%	17.20%
Q14	Dyslexia is hereditary. (True)	*N*	58	33
		%	30.20%	17.20%
Q15	Dyslexia refers to a relatively chronic condition that usually cannot be completely overcome. (True)	*N*	67	25
		%	34.90%	13.00%
Q16	The brains of people with dyslexia are different from those of people without dyslexia. (True)	*N*	75	16
		%	39.10%	8.30%
Q17	I think dyslexia is a myth, a problem that does not really exist. (False)	*N*	6	85
		%	3.10%	44.30%
Q18	Generally, children with dyslexia have problems with phonological awareness (e.g., the ability to hear and manipulate sounds in language). (True)	*N*	84	6
		%	43.80%	3.10%
Q19	Seeing letters and words backwards is a characteristic of dyslexia. (False)	*N*	58	32
		%	30.20%	16.70%
Q20	Individuals with dyslexia have difficulty with decoding/word recognition. (True)	*N*	88	3
		%	45.80%	1.60%
Q21	Dyslexia is characterized by difficulties in learning to read fluently. (True)	*N*	85	4
		%	44.30%	2.10%
Q22	Children with dyslexia generally tend to be poor spellers. (True)	*N*	81	7
		%	42.20%	3.60%
Q23	People with dyslexia have below-average intelligence. (False)	*N*	3	86
		%	1.60%	44.80%
Q24	Applying an individual reading test is essential in diagnosing dyslexia (True)	*N*	81	8
		%	42.20%	4.20%
Q25	Modeling fluent reading is often used as a teaching technique. (True)	*N*	56	30
		%	29.20%	15.60%
Q26	Multisensory instruction has been shown to be an ineffective teaching method for treating dyslexia. (False)	*N*	2	85
		%	1.00%	44.30%
Q27	Children with dyslexia can be helped by using colored lenses/colored overlays (False)	*N*	42	44
		%	21.90%	22.90%
Q28	Eye tracking exercises are effective in remediating dyslexia-caused difficulties. (False)	*N*	60	23
		%	31.30%	12.00%

Q29	Techniques involving repeated reading of material (e.g., words, sentences, or texts) help to improve reading fluency. (True)	*N*	72	12
		%	37.50%	6.30%
Q30	Giving students with dyslexia accommodations, such as extra time on tasks, shorter spelling lists, and special seating close to the teacher, is unfair to other students. (False)	*N*	13	71
		%	6.80%	37.00%
Q31	Most teachers receive specific training to work with dyslexic children. (False)	*N*	31	53
		%	16.10%	27.60%
Q32	Students with dyslexia need structured, sequential, direct instruction in basic skills and learning strategies. (True)	*N*	76	8
		%	39.60%	4.20%

RQ2: Factor Analysis

The underlying factor structure was examined by estimating and comparing models with one, two, and three factors. Models with two and three factors had multiple cross-loading items and factor loadings were low. The one factor solution had high factor loadings on most items and was selected as optimal. Items Q13 (Most children with dyslexia usually have emotional and/or social problems - True), Q28 (Eye tracking exercises are effective in remediating dyslexia-caused difficulties - False), Q25 (Modeling fluent reading is often used as a teaching technique - True), Q29 (Techniques involving repeated reading of material (e.g., words, sentences, or texts) help to improve reading fluency - True), and Q6 (Students who have reading disabilities without an apparent cause (e.g., intellectual disabilities, absenteeism, and inadequate instruction) are referred to as dyslexic - True) had loadings below .3 and were sequentially removed. The final solution included only items with loadings above .3. This solution had a very good fit to the data ($\chi^2_{(252)}$= 345.355; χ^2/df=1.37 ,CFI=0.966, TLI=0.957, SRMR=0.071), RMSEA(90%CI)=0.046 (0.033;0.058).

The internal consistency of the items included in the one-factor solution was α=.776. They had factor loadings between .303 and .936 and all loadings were statistically significant (Table 2). The item with the highest loading (the marker item) was "Certain medications have been found to be effective in treating dyslexia", loading=.936), followed by "Giving students with dyslexia accommodations, such as extra time on tasks, shorter spelling lists, and special seating close to the teacher, is unfair to other students", loading =.907). The majority of respondents correctly rated these statements as "false" (Table 1). The item with the lowest loading was "Dyslexia is more frequent in males than in females" (loading=.303), which was correctly rated by most participants as "true". Table 2 lists the items included in the final one-factor solution and the standardized factor loadings, standard errors, *t*-statistics and *p* values.

The items with the higher loadings are the most representative for the identified factor of dyslexia knowledge/misconceptions and most indicative of specialized knowledge about dyslexia. In contrast, items with lower loadings are less relevant indicators of specialized knowledge about dyslexia and may be indicative of more common knowledge. Notably, the item "Seeing letters and words backwards is a characteristic of dyslexia - False" had a negative factor loading. Although this item was recoded, the factor loading is negative because the proportion of individuals providing incorrect responses on these items exceeds the proportion of individuals who responded correctly thus revealing a widespread misconception about dyslexia.

Table 2.

Standardized Model Results

Variable	Item	Estimate	S.E.	Estimate/ S.E.	Two-Tailed *p* Value
Q11	Certain medications have been found to be effective in treating dyslexia. (False)	0.936	0.066	14.238	0.000
Q30	Giving students with dyslexia accommodations, such as extra time on tasks, shorter spelling lists, and special seating close to the teacher, is unfair to other students. (False)	0.907	0.053	17.091	0.000
Q8	Dyslexia can be caused by a literacy-poor home environment (e.g., parents not reading to their children). (False)	0.879	0.054	16.401	0.000
Q20	Individuals with dyslexia have difficulty with decoding/word recognition. (True)	0.878	0.034	25.656	0.000
Q21	Dyslexia is characterized by difficulties in learning to read fluently. (True)	0.877	0.067	13.019	0.000
Q17	I think dyslexia is a myth, a problem that does not really exist. (False)	0.869	0.068	12.766	0.000
Q12	Dyslexia is a disability specific to the English language. (False)	0.818	0.038	21.368	0.000
Q23	People with dyslexia have below-average intelligence. (False)	0.818	0.038	21.368	0.000
Q18	Generally, children with dyslexia have problems with phonological awareness (e.g., the ability to hear and manipulate sounds in language). (True)	0.795	0.111	7.140	0.000
Q31	Most teachers receive specific training to work with dyslexic children. (False)	0.784	0.053	14.861	0.000
Q7	Children can outgrow dyslexia. (False)	0.743	0.066	11.275	0.000
Q27	Children with dyslexia can be helped by using colored lenses/colored overlays (False)	0.735	0.052	14.134	0.000
Q16	The brains of people with dyslexia are different from those of people without dyslexia. (True)	0.653	0.060	10.839	0.000
Q10	One of the major reasons for dyslexia-caused difficulties is due to visual problems. (False)	0.622	0.102	6.111	0.000
Q22	Children with dyslexia generally tend to be poor spellers. (True)	0.540	0.096	5.652	0.000
Q19	Seeing letters and words backwards is a characteristic of dyslexia. (False)	-0.509	0.109	-4.657	0.000
Q26	Multisensory instruction has been shown to be an ineffective teaching method for treating dyslexia. (False)	0.500	0.085	5.914	0.000

Q5	Dyslexia is a learning disability that affects language processing. (True)	0.490	0.118	4.149	0.000
Q15	Dyslexia refers to a relatively chronic condition that usually cannot be completely overcome. (True)	0.487	0.081	6.030	0.000
Q32	Students with dyslexia need structured, sequential, direct instruction in basic skills and learning strategies. (True)	0.426	0.087	4.913	0.000
Q14	Dyslexia is hereditary. (True)	0.406	0.079	5.133	0.000
Q24	Applying an individual reading test is essential in diagnosing dyslexia (True)	0.396	0.108	3.666	0.000
Q4	Dyslexia is a neurologically based disorder. (True)	0.382	0.108	3.549	0.000
Q9	Dyslexia is more frequent in males than in females. (True)	0.303	0.088	3.432	0.001

RQ3: Demographic Comparisons

Results showed that the distribution of factor scores did not differ significantly by occupation (test statistic=551.5, asymptotic p=.628). Similarly, factor scores did not vary significantly by educational level (test statistic$_{(2)}$=2.730, asymptotic p=.255) or geographical area (test statistic$_{(5)}$=3.678, asymptotic p=.597). Further, the correlation between age and factor scores was not statistically significant (r=.172, p=.139). These results show that factor scores measuring knowledge and misconceptions about dyslexia do not vary significantly across demographic groups.

Discussion

This study investigated professional knowledge about dyslexia across disciplines, with a focus on SLP, special education, and psychology professions. The results indicated a wide range of responses that speak to the diversity of knowledge about dyslexia in Lebanon across multiple disciplines.

Our first research question asked "*What is early literacy professionals' level of knowledge about dyslexia?"* We predicted that professionals across the disciplines we examined may demonstrate paucity of knowledge, which is associated with lack of public awareness and specialized learning and training about dyslexia in Lebanon. Our hypothesis was partially supported, as our results revealed adequate knowledge as well as misconceptions about dyslexia. Both correct statements marked by most participants (Questions 2 and 20) and incorrect statements marked with the highest percentages of false ratings (Questions 12, 17, 23 and 26) indicate that participants possess some knowledge about dyslexia, coupled with misconceptions (Questions 28 and 19). Around 30% of the participants indicated that individuals with dyslexia see letters backward and eye-tracking remediation can be effective for treating dyslexia, reflecting misunderstandings of the neurobiological origin of dyslexia. Moreover, participants did not realize that dyslexia is hereditary. Knowing this can be clinically relevant, as one of the most cost-effective and efficient screening methods involves asking parents about any family history of dyslexia. Research suggests dyslexia is highly heritable, affecting up to

50% of individuals with a first-degree relative who has dyslexia (Pennington, 1991). Therefore, the likelihood and severity of dyslexia increase when both parents are affected (Wolff & Melngalailis, 1994). Together, these patterns of results speak to the lack of public understanding of dyslexia and/or the diversity in the preparation of professionals who work with children with dyslexia in Lebanon.

Our second research question asked, **"***What common dimensions(s) or area(s) of correct understandings or misconceptions underlie the data?"* Based on the available research evidence, symptomatology, and behavioral manifestations of the disorder, we predicted that Lebanese professionals may possess more knowledge related to symptoms of dyslexia than to aspects that need research-based knowledge such as nature, cause, and remediation of dyslexia.

Our study shows that, for the population investigated, knowledge and misconceptions about dyslexia represent a unitary construct without distinct dimensions. Although we hypothesized that knowledge and misconceptions about dyslexia may be categorized into distinct factors (e.g., symptoms, causes, remediation, etc.), our results did not support this prediction, showing that only one factor underlies the data. Contrary to Yin et al (2020), This unique factor implies that knowledge and/or misconceptions about dyslexia is a homogeneous construct and does not vary by topic.

However, replicating the study with a different sample would provide evidence of external validity for the one factor solution.

Results based on factor analysis provided information on the items that are the most representative indicators of knowledge and misconceptions about dyslexia. Representative items of dyslexia knowledge include those that address characteristics of dyslexia itself such as difficulties with decoding or word recognition, reading fluency, phonological awareness, and spelling (factor loadings 0.878, 0.877, 0.795, and 0.540, respectively). Notably, items that are most representative of misconceptions about dyslexia were items that address medications as treatment for dyslexia (factor loading 0.936), literacy-poor home environment and poor intelligence as causal factors (factor loadings 0.879 and 0.818, respectively), and dyslexia is a myth, specific to the English language, caused by a vision problem and seeing letters backwards (factor loadings 0.936, 0.869, 0.818, and 0.622, respectively). These topics must be central to future work investigating knowledge of professionals who work with children with dyslexia.

Additionally, the study provided information on the psychometric properties of the data collection instrument. Factor analytic results provide evidence of reliability and construct validity. Moreover, the final factor solution had a high internal consistency as measured by Cronbach's α coefficient. These results inform further research using the same data collection instrument.

Our third research question explored "*Does knowledge about dyslexia vary based on participants' occupation and demographic characteristics*?" Although we anticipated significant variations based on professional training, prior exposure to children with dyslexia, and professionals' knowledge about dyslexia, the scores on the factor measuring knowledge and misconceptions about dyslexia did not differ across demographic groups. This finding suggests that the general knowledge level may be reduced, consistent with the overall awareness about dyslexia. Alternatively, this finding could also be related to the fact that the majority of professionals in our sample consisted of SLPs, and that this pattern may be reflective of this group of professionals. Future replication of the study would corroborate whether the current results are discipline-specific or representative of the knowledge of professionals in Lebanon.

Overall, our findings differ from Yin et al., (2020) in that their study relied on the use of three domains, in which all survey items must fit. In this study, our emphasis was on latent variables that underlie the data, allowing the unraveling of constructs as data are analyzed, as opposed to focusing solely on manifest variables. Moreover, the factors with highest loadings can be used to guide designing of interventions that target the most critical items that represent knowledge about dyslexia.

Limitations

This study has some limitations. These include the uneven representation of disciplines within the sample, as illustrated by the majority being SLPs and the remaining group

consisting mainly of special education professionals and psychologists. Having a more diverse sample in the future with a comparable number of participants from each discipline, as well as other disciplines, would help bolster our findings and guide interdisciplinary professional development initiatives aimed at training those who work with children with dyslexia in Lebanon. Another limitation is the study's small sample size. Recruitment of a larger number of participants would permit use of other statistical analytic techniques that are suitable for large samples.

Recommendations and Future Directions

The results of this study indicate the need for examining general as well as discipline-specific professional preparation for individuals working with children with dyslexia. Furthermore, continued professional training in reading science and dyslexia might be beneficial when working with children with dyslexia to ensure that all professionals, including teachers, are well equipped to teach their students about reading and dyslexia. After all, we can only teach what we know (Applegate & Applegate, 2004; Binks-Cantrell et al., 2012).

Lastly, given the fact that there is no cure for dyslexia, future investigations that adopt a risk-resilience model (Catts & Petscher, 2022) that considers the multifactorial causal basis of dyslexia are warranted. Central to this model is an interdisciplinary focus on screening and early identification of dyslexia, coupled with simultaneous training of

professionals in the science of reading and the science of teaching reading, and measuring the knowledge of professionals across disciplines using larger samples that are representatives of various sectors and geographic regions. This could prove to be ideal in preventing future reading difficulties (Catts & Hogan, 2021) and offsetting the impact of dyslexia for all children.

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