

Evaluative Study of Executive Function (Planning) and Difficulties in Handwriting and Spelling among Students with Writing Learning Disabilities

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Abstract:

This investigation seeks to appraise executive function (specifically planning abilities) and to identify the presence of handwriting and spelling challenges among fourth-grade students diagnosed with writing learning disabilities. Furthermore, it explores the intricate association between the executive function of planning and the observed handwriting and spelling abilities within the sampled cohort. To fulfill the objectives of this research, the study adopts a descriptive correlational approach, utilizing a purposively selected sample of 34 students, aged between 9 and 11 years, who exhibit writing learning disabilities. The study employs several diagnostic tools, including:

- _ A specialized assessment form developed by the researchers to evaluate indicators of writing learning difficulties, focusing on handwriting and spelling.
- _ The Columbia Mental Maturity Scale.
- _ Fathi El-Zayat's Diagnostic Assessment Scale for Writing Difficulties.
- _ Rey's Complex Figure Test "A".
- _ Amina Sadkawi's Tests for Handwriting Difficulties and Dysgraphia.

The findings of the study are as follows:

- _ A significant 91.2% of the participants demonstrate notable disruptions in their executive function (planning), whereas 8.8% display moderate levels.
- _ Handwriting challenges are substantial among 58.8% of the students, with an additional 20.6% facing dysgraphia.
- _ The study identifies severe spelling difficulties in 44.1% of the sample, with dyslexia affecting 35.3%.
- _ Statistical analysis reveals a significant correlation between disruptions in planning function and the incidence of handwriting difficulties.
- _ Conversely, the relationship between planning function disruptions and spelling difficulties does not reach statistical significance.

1. Introduction/Problem Statement:

Writing learning disabilities are recognized as a specific subset of academic learning disabilities, characterized by an individual's writing skills falling significantly below the expected level for their age and cognitive capabilities. These learning disabilities encompass distinct challenges in recognizing and producing written symbols, leading to severe impediments in acquiring this skill and considerable difficulties in text comprehension and the assimilation of knowledge necessary for future educational success (Hawla, 2008).

The American Psychological Association (APA) prefers the term "writing weakness" over "writing learning disabilities" to denote these difficulties in written expression. Students afflicted with writing learning disabilities frequently display writing that is slow, illegible, and poor in quality, alongside prevalent spelling errors and issues with sentence structure (IGI Global, 2022, p. 635).

The primary school phase is critical in a student's educational journey as it lays the essential groundwork for acquiring literacy skills—reading and writing—which are vital for academic achievement. Writing, as one of the most intricate forms of communication, requires mastery to effectively engage with various communication methods. It entails the linear articulation of spoken sounds or ideas and the transference of concepts into written text, adhering to a linguistically agreed-upon system.

The process of writing is inherently cognitive, demanding significant intellectual effort and deliberation. Students often face a multitude of challenges as writing amalgamates various skills including expressive writing, spelling, and handwriting. The latter, handwriting, is essentially an art form that involves forming letters through cognitive and kinesthetic mechanisms to guide a writing instrument (pen), facilitating the formation and connection of letters, and managing the transitions from right to left and vice versa (Ahmed, 2008, p. 20).

Spelling is another skill that children typically acquire after mastering the basic techniques of correct writing. It involves the precise and accurate representation of words as standardized by linguists, necessitating the mastery of specialized skills essential for correct word writing (Abdel Khafaji, 2017, p. 174).

Given the multifaceted nature of the writing skill, the associated difficulties are varied and include challenges in handwriting, spelling, and expressive writing. Handwriting issues often manifest as deformities in letter shapes, inconsistencies in letter size, improper spacing between words, tilting of writing lines, variations in pen pressure, reversals of segments or words, and incorrect sequencing of letters in words (Al-Ayib, 2018, p. 169).

Spelling difficulties are defined by Rania Refaat (2008) as the inability of students to apply spelling rules correctly, resulting in errors caused by unclear mental representations of words. These errors become significant barriers to students' educational advancement and progression to subsequent academic stages (Dawood, 2012).

The skills of handwriting and spelling are underpinned by several additional capabilities including proper body positioning, organization and coordination of writing tasks, precise movements, exacting control of the writing instrument, and visual-motor coordination. These processes are orchestrated by what are commonly referred to as executive functions (Belkheir&Nouani, 2022).

These functions constitute a suite of cognitive abilities that the brain utilizes to execute most tasks, overseeing and managing all cognitive activities. McCloskey (2013) describes executive functions as a broad psychoneurological construct representing a group of neural mechanisms that sequence, direct, and coordinate various aspects, including the organizational processes necessary for selecting, initiating, executing, and supervising cognitive, emotional, behavioral, and some motor and sensory functions (Barkley, 2012, p. 6).

These include cognitive flexibility, inhibition, working memory, and planning, with the latter being one of the more sophisticated cognitive processes that effectively organizes and coordinates multiple tasks. Planning involves setting goals, determining the most efficient methods, identifying the necessary tools, and outlining the steps required before executing any task (Al-Adl, 2016, p. 98).

Any dysfunction or impairment in these executive functions can lead to learning difficulties, as explored in Fonseca's (2020) study, particularly those pertaining to writing learning difficulties. Mykle Bust (1960) highlighted that difficulties in remembering motor sequences for writing letters and words, as well as challenges in organizing the motor activities necessary for copying or writing from memory, are linked to disruptions in these executive functions (Suleiman, 2010).

In this academic discourse, an array of studies robustly illustrates a nexus between executive functions and writing learning disabilities. Notably, BRASSARD's (2017) research delineates a correlational relationship between executive functions and written production, underscoring the pivotal role of executive functions in the development of writing skills.

Similarly, the study by Belkheir&Nouani (2019) confirms a correlational relationship between executive functions and writing difficulties. Moreover, Rodriguez's (2018) research pinpoints a specific impairment in the planning function among students afflicted with writing learning disabilities.

Despite the proliferation of these insights, there remains a noticeable scarcity in both Arabic and international literature specifically targeting the relationship between the planning aspect of executive functions and writing learning difficulties, with the majority of existing studies broadly addressing executive functions in relation to general writing or all learning difficulties.

This study seeks to bridge these gaps by focusing explicitly on the relationship between the executive function of planning and the specific areas of handwriting and spelling among fourth-grade primary students diagnosed with writing learning disabilities.

The problem addressed by the current study is encapsulated by the following central question:

- Is there a correlational relationship between executive function (planning) and handwriting and spelling among students with writing learning difficulties?

This overarching inquiry gives rise to several sub-questions:

1. Do fourth-grade primary students with writing learning difficulties suffer from a disruption in executive function (planning)?
2. Do fourth-grade primary students with writing learning difficulties suffer from difficulties in handwriting?
3. Do fourth-grade primary students with writing learning difficulties suffer from difficulties in spelling?
4. Is there a correlational relationship between executive function (planning) and handwriting difficulties among fourth-grade primary students with writing learning difficulties?
5. Is there a correlational relationship between executive function (planning) and spelling difficulties among fourth-grade primary students with writing learning difficulties?

2. Study Hypotheses:

2.1 Main Hypothesis:

- There is a correlational relationship between executive function (planning) and handwriting and spelling among students with writing learning difficulties.

2.2 Sub-Hypotheses:

1. Fourth-grade primary students with writing learning difficulties suffer from a disruption in executive function (planning).
2. Fourth-grade primary students with writing learning difficulties suffer from difficulties in handwriting.
3. Fourth-grade primary students with writing learning difficulties suffer from difficulties in spelling.
4. There is a correlational relationship between executive function (planning) and handwriting difficulties among fourth-grade primary students with writing learning difficulties.
5. There is a correlational relationship between executive function (planning) and spelling difficulties among fourth-grade primary students with writing learning difficulties.

3. Study Objectives:

3.1 Main Objective:

- To elucidate the nature of the relationship between executive function (planning) and handwriting and spelling among fourth-grade primary students with writing learning difficulties.

3.2 Sub-Objectives:

- To ascertain whether these students suffer from a disruption in executive function (planning).
- To determine if these students exhibit difficulties in handwriting.
- To assess if these students face challenges in spelling.
- To explore the correlational relationship between executive function (planning) and handwriting difficulties among these students.
- To investigate the correlational relationship between executive function (planning) and spelling difficulties among these students.

4. Study Significance:

The academic significance of this study is underpinned by its focus on critical variables such as executive function (planning), handwriting, spelling, and writing learning difficulties:

- The distinctiveness of integrating executive function (planning) with handwriting and spelling in the context of students with writing learning difficulties renders this study an original contribution to the field.
- This research represents a novel addition to the scholarly discourse on writing learning difficulties.

The practical implications of this study are manifold:

- It introduces innovative tests (handwriting and spelling tests crafted by Amina Sadkawi) which have not been previously published, thereby providing valuable tools for students and practitioners.

- The findings are poised to enhance students' writing capabilities by improving the planning function, ultimately fostering higher academic achievement.
- The insights gained from this study will enable specialists and educators to develop and implement therapeutic programs tailored for students with writing learning difficulties.

5. Definitions of Study Terms:

5.1 Executive Functions:

Executive functions encompass a suite of cognitive capabilities that guide individuals in executing purposeful actions amidst competing alternatives. These functions represent the innate capacity of individuals to adapt their responses appropriately to changes in goals within the context of processing information (Belkheir&Nouani, 2021, p.217).

The American Psychological Association (2015) characterizes executive functions as advanced cognitive processes essential for planning, decision-making, problem-solving, and executing a coherent sequence of actions to fulfill a specified objective.

Clementa (2016) highlights the critical role of executive functions in academic success, as they facilitate forward planning, restrain impulsive responses, sharpen focus, and leverage past experiences to aid students across various academic disciplines (Sabri& Abu Arab, 2021, p.114).

5.2 Executive Function (Planning):

Planning as an executive cognitive function enables individuals to conceive and regulate a sequence of actions aimed at achieving a specific objective. It acts as an organizational system wherein an individual discerns the gap between the current situation and the desired goal, thereby crafting a pathway to resolve the issue (Mohsen &Essam El Din, 2016, p.29).

This function involves the identification and arrangement of necessary steps and resources—skills, materials, or personnel—required to realize the set goal. Furthermore, it encompasses the ability to order these steps logically to solve problems or accomplish objectives effectively, thus enhancing the individual's capacity to envisage future actions and adapt strategies to formulate efficacious plans and control impulsive behavior (Shehata, 2019, p.49).

5.3 Planning Function Disorder:

This disorder is characterized by challenges in structuring a sequence of actions aimed at achieving a goal. It manifests across several dimensions, including:

- Sustaining focus on the goal.
- Engaging in pre-planning and evaluating various strategies to achieve or validate the goal.
- Selecting the most suitable plan.
- Initiating and adapting the execution of the selected plan to accommodate unforeseen events and modifications necessary for reaching the predefined objective (Degiorgioc et al., 2011, pp.22-23).

Operational Definition:

The metric used is the score achieved by fourth-grade primary students with writing learning difficulties on the Rey Complex Figure Test.

5.4 Handwriting:

Handwriting is a motor skill that involves the drawing or tracing of letters, driven by precise and harmonious coordination of planning, programming, and executing the formation of letters (Baudry, 2012, p.18).

Abdel Bari describes handwriting as a motor and artistic skill through which a writer conveys ideas clearly, swiftly, and aesthetically to others. Fadlallah further defines it as a universally recognized geometric drawing composed of circles, curves, dots, and straight lines, conforming to the geometric shapes established by scholars for letter formation (Attal, 2013, p.152).

5.5 Handwriting Difficulties:

Defined by Newman as a condition characterized by challenges and disorders affecting hand-produced lines and scripts, often stemming from neurological impairments. These difficulties commonly present in isolation but are frequently associated with other linguistic disorders such as dyslexia, aphasia, dyscalculia, and attention deficit hyperactivity disorder, with or without hyperactivity (Al-Firmawy, 2006).

Handwriting difficulties manifest as a dysfunction in manual writing, evidenced by deviations from the line, inconsistencies in letter sizes, and erratic spacing between words.

Operational Definition:

The measure utilized is the normative score obtained by fourth-grade primary students with writing learning difficulties on Amina Sadkawi's test for dysgraphia and handwriting difficulties.

5.6 Spelling:

Spelling involves the systematic depiction of words through the linear alignment of spoken sounds, represented using symbols that allow a reader to pronounce these words as originally intended, adhering to the linguistic rules established by experts.

Shehata (1984) conceptualizes spelling as a distinct linguistic system that addresses the specifics of word connection or separation, the addition or omission of letters, variations in the use of the hamza, the feminine 'ha', and 'ta' letters, as well as the appropriate application of sun and moon letters (Al-Shebil, 2017, p.110).

This skill necessitates the transformation of audible, comprehensible sounds into written symbols (letters), ensuring that these symbols are correctly positioned within words to maintain clarity of pronunciation and convey the intended meaning effectively (Jouber&Okali, 2022, p.37).

Moreover, it encapsulates the ability to accurately and meticulously draw words in a manner that is unanimously agreed upon by linguists, alongside mastering specific skills required for precise writing (Abdel Khafaji, 2017, p.174).

5.7 Spelling Difficulties:

Spelling difficulties are characterized by a student's reduced capacity to accurately apply spelling rules within their writing. These difficulties are typified by errors such as adding or omitting letters, incorrectly connecting or separating words, substituting letters, and reversing the order of similar type letters.

Often, these challenges stem from the absence of a clear mental representation of the word in the student's mind, affecting both typical learners and those with learning difficulties (Dawoud, 2012, pp.326-327). Consequently, spelling difficulties involve the struggle to convert heard sounds into their corresponding written symbols, while adhering to the established linguistic rules.

Operational Definition:

This is represented by the standard score obtained by fourth-grade primary students with writing learning difficulties on Amina Sadkawi's test for dyslexia and spelling difficulties.

5.5 Writing Learning Difficulties:

Defined by Mohamed Kamel (2006), writing learning difficulties encompass the myriad challenges students encounter, including the inability to retain and connect ideas, difficulties in grammatical and morphological formulation, poor handwriting and its coherence, incorrect spelling, or improper perception of spaces between letters and words.

These factors collectively contribute to the difficulty in reading what has been written, thereby significantly impacting academic achievement (Sabri& Abu Arab, 2021, p.112).

Writing difficulties are also associated with imaging shortcomings or a lack of coordination between visual perception and motor function. Some affected students may not hold the pen correctly, while others may struggle specifically with certain letters. These issues can also be linked to directional confusion or motivational difficulties (Abu Asaad, 2015, p.20).

Operational Definition:

This is reflected in the standard score achieved by fourth-grade primary students on Fathi El-Zayat's Diagnostic Assessment Scale for Writing Learning Difficulties.

6. Field Study

6.1 Method:

In alignment with the objectives of the current study, which aim to diagnose handwriting and spelling difficulties, as well as executive function (planning) issues, through a battery of tests, and to explore the relationship between executive function (planning) and handwriting/spelling among students with writing learning difficulties, the researchers have elected to employ a descriptive correlational methodology.

Such studies are deemed descriptive research as they delineate the existing conditions or scenarios, markedly differentiating from the facts and phenomena examined in other types of research. The primary objective of these studies is to unearth the relationships between variables or phenomena,

grounded on data collection aimed at discerning if and to what extent a relationship exists between two or more variables (Al-Naimi et al., 2015).

6.2 Pilot Study:

A pilot study is an integral part of every research endeavor, irrespective of its objectives and methodological underpinnings. It serves as an exploratory study that sets the stage for the main investigation, aiming to familiarize researchers with all procedural aspects, define the boundaries of the study, manage its variables, and derive the primary sample for subsequent detailed examination.

6.2.1 Objectives of the Pilot Study:

The researchers aim to achieve the following through the pilot study:

- Design a form to detect indicators of writing learning difficulties (handwriting and spelling) and calculate its psychometric properties.
- Define a sample of writing learning difficulties.
- Detect writing learning difficulties.

6.2.2 Boundaries of the Pilot Study:

A. Temporal Boundaries:

The pilot study spanned from March 19 to April 13, 2023, including the spring break from March 23 to April 9, 2023.

B. Spatial Boundaries:

The pilot study was conducted in the following primary schools:

- SaïdMaatar School located in the third administrative district of Park Afouraj, Batna.
- Mustapha Bousjada School located in the third administrative district of Park Afouraj, Batna.
- Omar Maajouj School located in the third administrative district of Hay El Bustan, Batna.
- Ismail Mokhtari School located in the second district of Hay Sonatiba, Batna.

C. Human Boundaries:

Teachers and students of the fourth primary year and principals of primary schools.

6.2.3 Sample of the Pilot Study:

The pilot study sample encompasses distinct groups, ensuring a comprehensive approach to the research:

A. For Teachers:

The study includes twelve Arabic language teachers for the fourth primary year, of whom eight are female and four are male. This diverse group of educators provides varied insights into the teaching dynamics and student interactions specific to this educational stage.

B. For Students:

The broader community from which the pilot study draws consists of primary school students in the fourth year, aged between 9 and 11. Among the participating schools, each typically has three classes, except for Maajouj School, which comprises four classes. This sums up to a total of thirteen classes across all schools. The comprehensive student body numbers 449, with a gender distribution of 217 females and 232 males.

Table (1): Original community of the pilot study.

Schools	Total Students	Males	Females
SaïdMaatar	106	56	50
Mustapha Bousjada	93	52	41
Omar Maajouj	146	66	80
Ismail Mokhtari	104	58	46
Total	449	232	217

➤ **Characteristics of the Pilot Study Sample:**

Table (2): Represents the characteristics of the pilot study sample.

Students	Frequency	Percentage
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Males	71	69.60%
Females	31	30.40%
Total	102	100%

The selected pilot study sample from this community totals 102 students, comprising 71 males and 31 females. This selection reflects a demographic distribution where males constitute 69.60% and females 30.40% of the sample, offering a foundational perspective for subsequent analyses of the data.

6.2.4 Tools of the Pilot Study:

For rigorous and effective research, a carefully selected array of tools and methods is essential. These instruments are pivotal in gathering robust and relevant data that align with the study's objectives. Employed in the pilot study were:

A. Interviews:

Interviews serve as a crucial data acquisition method, capturing a wide range of dimensions including psychological, health, social, and educational aspects of the research sample. This approach involves an extensive review of the students' academic and medical histories and includes detailed discussions with teachers to obtain in-depth insights into the students' academic performance and their personal learning environments.

Interviews are defined as "a dialogue, conversation, or directed discussion between the researcher and an individual or a group, aimed at eliciting information that reflects specific realities or perspectives essential for the researcher in light of the study's objectives" (Kandilji, 2019, p.239).

B. Teacher-Directed Writing Learning Difficulties Indicator Assessment Form (Handwriting/Spelling):

This tool, developed by the researchers, is a critical component of the Diagnostic Rating Scale for Learning Difficulties. It specifically targets writing challenges and is incorporated into the broader Learning Disabilities Diagnostic Rating Scale (LDDRS) created by Fathi El-Zayat (2008) for use by parents and teachers to methodically assess writing difficulties (El-Zayat, 2008).

6.2.4 Pilot Study Results:

The implementation of the pilot study procedures yielded significant findings:

A. Results of the form assessing indicators of writing difficulties (handwriting/spelling) across all schools:

The application of the Teacher-Directed Writing Learning Difficulties Indicator Assessment Form provided pivotal insights. This tool effectively mapped out the prevalence and characteristics of writing difficulties among the students involved in the study, setting a preliminary stage for more targeted interventions and a deeper analysis in the main study phase.

Table (03): Summary of Results from the Writing Difficulties Indicator Assessment Form (Handwriting/Spelling)

Schools	Number of Students	Moderate Degree	Severe Degree	No Difficulties
SaïdMaatar	19	13	0	6
Mustapha Bousjada	28	12	4	12
Ismail Mokhtari	29	14	10	5
Omar Maajouj	26	20	2	4

The initial cohort for the pilot study was composed of (102) students, recognized for showing signs of writing difficulties (handwriting/spelling). This group included (59) students categorized with moderate difficulties, (16) with severe difficulties, and (27) students showing no significant indicators of writing learning difficulties.

Following the administration of the "Columbia" intelligence test, further refinement of the sample was conducted. This included the exclusion of (7) students identified with mental retardation and (1)

student with behavioral and social challenges, based on thorough reviews of their school records and detailed discussions with their teachers and principals.

The application of Fathi El-Zayat's Diagnostic Rating Scale for Writing Difficulties thereafter identified 43 students experiencing a range of writing learning difficulties, from mild to severe.

Upon reaching the necessary sample size of (34) students for the conclusive phase of the pilot study, the researchers made a selective exclusion of those with mild writing difficulties and some with moderate difficulties. The composition of the sample at this final stage is detailed in the following table:

Table (04): Summary of Results from the Diagnostic Rating Scale for Writing Difficulties

Sample Members	Moderate Degree	Severe Degree
Males	14	10
Females	8	2
Total	22	12

These methodical procedures have effectively delineated the primary study sample, highlighting a group of students with pronounced writing learning difficulties for further examination in the main study.

6.3 Main Study Procedures:

The main study marks the second scientific phase, advancing from the theoretical groundwork to the practical and field dimensions of the research. This phase is pivotal, involving extensive data gathering, rigorous analysis, and the extraction of factual insights concerning the study variables and their interrelations.

During this phase, the students were deeply engaged with all aspects of the study, which included a comprehensive overview of its scope, the tools utilized, and the rigorous testing of its hypotheses, all conducted in strict adherence to the prescribed methodology.

6.3.1 Boundaries of the Main Study:

A. Time Boundaries:

The main study was conducted from April 10 to April 26, 2023.

B. Spatial Boundaries:

The research was executed in several primary schools, notably:

- SaïdMaatar School, in the third administrative district of Park Afouraj, Batna.
- Mustapha Bousjada School, in the third administrative district of Park Afouraj, Batna.
- Omar Maajouj School, in the third administrative district of Hay El Bustan, Batna.
- Ismail Mokhtari School, in the second district of Hay Sonatiba, Batna.

C. Human Boundaries:

The focus was on fourth-grade primary students aged between 9-11 years.

6.3.2 Sample of the Main Study:

The researchers utilized a purposive sampling technique, selectively choosing students post the exclusion of those with mental retardation. Given the time constraints and having achieved the required sample size, the study intentionally excluded students with mild and some with moderate writing difficulties.

Consequently, the final study sample consisted of (34) fourth-grade primary students identified with writing difficulties, with (22) experiencing moderate difficulties and (12) facing severe difficulties. The distribution of the sample, based on the degree of writing learning difficulty, is meticulously structured as follows:

Table (05): Distribution of Sample Members by Degree of Writing Learning Difficulty

Sample Members			Moderate Degree		Severe Degree	
Frequency	Percentage		Frequency	Percentage	Frequency	Percentage
Males:	24	70.58%	14	41.18%	10	29.41%
Females:	10	29.42%	8	23.52%	2	5.89%
Total:	34	100%	22	64.70%	12	35.30%

6.3.3 Tools of the Main Study:

In every scientific research endeavor, a meticulously chosen array of tools and methodologies is indispensable for amassing a comprehensive set of data that is relevant and valuable to the study's theme. These tools encompass:

A. Rey Complex Figure Test:

First developed in 1942 by André Rey in Geneva, this diagnostic instrument is employed to evaluate non-verbal memory by probing various cognitive processes such as planning, organizational skills, and problem-solving strategies, in addition to motor functions in individuals who may have experienced brain damage (Stéphane, 2002). The Rey Complex Figure is characterized by:

- **Absence of Inherent Meaning:** This characteristic diminishes any potential bias in interpretation.
- **Transferability Across Contexts:** It can be seamlessly adapted to various settings.
- **Complex Geometric Structure:** This engages the examinee's analytical and organizational cognitive abilities, thereby facilitating a deeper assessment of their cognitive prowess (Rey, 1959, p.3).

B. Tests for Handwriting and Spelling Difficulties by Researcher Amina Sadkawi:

In 2017, researcher Amina Sadkawi devised two distinct tests; one focused on assessing handwriting difficulties and dysgraphia, and the other on spelling difficulties and dyslexia. These tests are anchored in the neuropsychological theoretical framework of the writing and spelling model proposed by Young & Ellis (1988).

This model is especially adept at providing a precise neuropsychological diagnosis and elucidation of handwriting and spelling difficulties. It meticulously considers the unique characteristics and nuances of Arabic handwriting and spelling (Sadkawi, 2017). The model outlines:

- **Handwriting Stages:** Starting with the graphemic buffer processing, transitioning to the allographic system, advancing to the motor programs for writing, and culminating with the visual analysis stage necessary for copying from a visually presented model.
- **Spelling Stages:** Divided into two pathways; the phonological route begins from the auditory analysis system, leading directly to the phoneme-grapheme conversion system, and then to the graphemic buffer. The lexical route starts from the auditory analysis system, progresses through the phonological lexicon for input, which either directly or via the semantic system and the orthographic lexicon for output, reaches the graphemic buffer, also known as the orthographic output lexicon (Refer to Appendix Number 06).

6.3.4 Statistical Methods:

The statistical analysis of the data gathered in this study was conducted using:

- **SPSS (Statistical Package for the Social Sciences) Version 22.**
- **Standard Deviation T-test.**
- **Pearson Correlation Coefficient.**
- **Cronbach's Alpha Coefficient.**

6.4 Presentation and Analysis of Results:

The results of the study will be presented and analyzed based on the established hypotheses.

6.4.1 Presentation and Analysis of the First Hypothesis:

Hypothesis Text:Fourth-grade primary students with writing learning difficulties suffer from a disruption in executive function (planning).

This hypothesis was evaluated by calculating the frequencies and percentages of the sample members' scores in the Rey Complex Figure Test. The following table illustrates the distribution of the results:

Table (06): Frequencies and Percentage Rates of Sample Members' Scores in the Rey Complex Figure Test 'A'

Sample	Frequencies	Percentage
Severe Planning Disorder	31	91.2%
Moderate Planning Disorder	3	8.8%
Total	34	100%

This table reveals that a significant majority of the sample students, 91.2%, experience severe planning disorders, while the remaining 8.8% exhibit a moderate disorder in planning function.

6.4.2 Presentation and Analysis of the Second Hypothesis:

Hypothesis Text:Fourth-grade primary students with writing learning difficulties suffer from difficulties in handwriting.

To validate this hypothesis, an analysis was conducted by calculating the frequencies and percentages of the sample members' scores from the Handwriting and Dysgraphia Test developed by Amina Sadkawi. The data obtained is succinctly summarized in the table below:

Table (07): Frequencies and Percentage Rates of Sample Members' Scores in the Handwriting and Dysgraphia Test

Sample	Frequencies	Percentage
Mild Handwriting Difficulties	7	20.6%
Severe Handwriting Difficulties	20	58.8%
Dysgraphia	7	20.6%
Total	34	100%

From these results, it is evident that the percentages of students suffering from mild handwriting difficulties and dysgraphia are identical, each representing 20.6% of the sample, while a significant 58.8% of the sample experiences severe handwriting difficulties.

6.4.3 Presentation and Analysis of the Third Hypothesis:

Hypothesis Text:Fourth-grade primary students with writing learning difficulties suffer from difficulties in spelling.

To substantiate this hypothesis, the frequencies and percentages of the sample members' results in the Spelling Difficulties and Dyslexia Test by Amina Sadkawi were meticulously calculated. The results are presented in the following table:

Table (08): Frequencies and Percentage Rates of Sample Members' Scores in the Spelling Difficulties and Dyslexia Test

Sample	Frequencies	Percentage
Mild Spelling Difficulties	7	20.6%
Severe Spelling Difficulties	15	44.1%
Dyslexia	12	35.3%
Total	34	100%

The analysis reveals that 20.6% of the sample students encounter mild spelling difficulties, while a more substantial 44.1% suffer from severe spelling difficulties, and 35.3% are affected by dyslexia.

6.4.4 Presentation and Analysis of the Fourth Hypothesis:

Hypothesis Text: There is a correlational relationship between executive function (planning) and handwriting difficulties among fourth-grade primary students with writing learning difficulties.

To evaluate this hypothesis, Pearson's correlation coefficient for large parametric samples was employed to ascertain the nature of the relationship between executive function (planning) and handwriting difficulties within the study sample. The results are encapsulated in the following table:

Table (09): Pearson Correlation Coefficient Results between Sample Members' Scores in the Rey Complex Figure Test and the Handwriting and Dysgraphia Test

Variables	Correlation Coefficient	Significance Level
Planning Function	0.363*	0.05
Handwriting Difficulties		

The results indicate a statistically significant correlation between the planning function disorder and handwriting difficulties among the sample, evidenced by a Pearson correlation coefficient of 0.363, significant at the 0.05 level. This substantiates a significant correlational relationship between planning function disorder and handwriting difficulties among the sampled fourth-grade primary students with writing learning difficulties.

6.4.5 Presentation and Analysis of the Fifth Hypothesis:

Hypothesis Text: There is a correlational relationship between executive function (planning) and spelling difficulties among fourth-grade primary students with writing learning difficulties.

To test this hypothesis, Pearson's correlation coefficient was used for large parametric samples to determine the nature of the relationship between executive function (planning) and spelling difficulties among the study participants. The results are presented in the following table:

Table (10): Pearson Correlation Coefficient Results between Scores of Sample Members in the Rey Complex Figure Test and the Spelling Difficulties Test

Variables	Correlation Coefficient	Significance Level
Planning Function	0.188	Not Significant
Spelling Difficulties		

The data derived from this table reveals that the Pearson correlation coefficient between the results of fourth-grade primary students with writing learning difficulties in the Rey Complex Figure Test and their scores in the Spelling Difficulties

Test is not statistically significant. Thus, it is deduced that there is no statistically significant correlational relationship between planning disorder and spelling difficulties among the students studied.

6.5 Interpretation and Discussion of Hypotheses Results:

6.5.1 Interpretation and Discussion of the First Hypothesis Results:

First Hypothesis Text: Fourth-grade primary students with writing learning difficulties suffer from a disruption in executive function (planning).

The statistical analysis of the results revealed that:

- A substantial 91.2% of fourth-grade primary students with writing learning disabilities suffer from severe dysfunction in the planning function.
- Additionally, 8.8% of these students experience a moderate dysfunction in the planning function.

To the researchers' knowledge, there is a scarcity of studies addressing planning dysfunction among students with writing learning difficulties, as most studies have generally focused on executive

function disorders in individuals with writing difficulties. Some of these studies' results partially align with those of the current study.

For example, the studies by Belkhir and Nouani (2019), Nathan & Anne Michelle (2010), and Brassard (2017) partially agree with the current findings, aiming to explore the impact of executive function disorders on the writing process and the emergence of writing learning difficulties, concluding that students with writing learning difficulties indeed suffer from executive function disorders.

Furthermore, the results of the current study also align with those of Ghada Ahmed et al. (2020), Abu Arab and Sabri (2021), and Rodriguez (2018), which acknowledge that students who struggle with writing learning difficulties also suffer from a dysfunction in the planning function.

According to the theoretical literature, Flower & Hayes (1981) describe planning as "an internal and abstract representation of the knowledge that must be utilized for text generation." Writing and the planning function share many anatomical regions such as Broca's area (Brodmann areas 44/45), Exner's area (Brodmann area 6), and the primary motor cortex (Brodmann area 4) (Matthew, 2020, p. 274).

Therefore, the widespread prevalence of planning dysfunction among students with writing learning difficulties can be attributed to neurological dysfunction in brain regions common to both planning and writing.

6.5.2 Interpretation and Discussion of the Second Hypothesis Results:

Second Hypothesis Text:Fourth-grade primary students with writing learning difficulties suffer from difficulties in handwriting.

After statistical analysis, it was found that:

- A significant 58.8% of fourth-grade primary students with writing learning difficulties suffer from severe handwriting difficulties, and 20.6% of them experience dysgraphia along with minor difficulties.

In the researchers' knowledge, studies addressing the prevalence of handwriting difficulties and dysgraphia are rare, and if they exist, they seldom mention prevalence rates. The current study agrees with Amina Sadkawi's (2017) findings, which identified a significant prevalence of handwriting difficulties and dysgraphia in the clinical setting in Algeria, and Saber Ahmed's (2009) study, which concluded that a considerable percentage of students suffer from handwriting difficulties and problems.

According to Siham El Ayeb (2018), handwriting difficulties manifest as deformities in letter shapes, varying letter sizes and spacing between words, wavering writing lines, inconsistent pressure levels during writing, reversal of syllables or words, and incorrect letter sequencing in words. These symptoms are characteristic of students with writing learning disabilities.

Since handwriting is a fundamental skill of writing and an art of letter formation, this rationale can explain the widespread prevalence of handwriting difficulties among students with writing learning difficulties.

6.5.3 Discussion and Interpretation of the Third Hypothesis Results:

Third Hypothesis Text:Fourth-grade primary students with writing learning difficulties suffer from difficulties in spelling.

After statistical analysis, the largest proportion of students with writing learning difficulties, 44.1%, suffer from significant spelling difficulties, followed by 35.3% who experience dyslexia along with minor spelling difficulties.

These results align with those of Hassan Shehata (1978), Hassan Nasser (1993), Mahmoud Said (1997), which found that learning difficulties are significantly prevalent among primary school students (Fakawi, 2009). They also align with Amina Sadkawi's (2017) study, which found that spelling difficulties and dyslexia are widespread in the clinical setting in Algeria.

In the scientific literature, Rania Refaat defines spelling difficulty as "a weakness in students' ability to apply spelling rules in correct writing, and it is that error in spelling words caused by an unclear image of the word in the student's mind (whether typical or with learning difficulties), resulting in incorrect spelling and thus posing an obstacle in their educational progression" (Dawoud, 2012, pp. 326-327).

This difficulty appears in:

- _ Confusion and inability to distinguish between visually similar letters and letters that are close in articulation.
- _ Omission of some letters in a word (e.g., "headphone" vs. "watch").
- _ Confusion between sun and moon letters.
- _ Slowness in writing (Dawoud, 2012, pp. 328-329).

These manifestations are characteristic symptoms of students with writing learning difficulties, and since spelling is a key skill of writing and an integral part of it, this explains the prevalence of spelling difficulties among fourth-grade primary students with writing learning difficulties.

6.5.4 Discussion and Interpretation of the Fourth Hypothesis Results:

Fourth Hypothesis Text: There is a correlational relationship between executive function (planning) and handwriting difficulties among fourth-grade primary students with writing learning difficulties.

The statistical analysis revealed a statistically significant positive correlation between the executive function of planning and handwriting difficulties in fourth-grade primary students with writing learning disabilities.

According to the researchers' knowledge, there are no studies that have specifically investigated the relationship between handwriting difficulties and dysfunction in the planning function among students with writing disabilities. However, several studies have examined the relationship between handwriting difficulties and other cognitive and executive functions.

For instance, the study by Saber Ahmed (2009) found a strong correlation between dysgraphia and working memory, and Amina Sadkawi's study (2017) identified disturbances in selective visual attention, working memory, long-term visual memory, and visuomotor integration as primary causes of dysgraphia and handwriting difficulties.

Given that the brain regions responsible for the planning function are distributed across the inferior parietal cortex, the frontal region, and the motor cerebral cortex—where handwriting activity regions are also located, this explains the correlational relationship between handwriting and the planning function.

6.5.5 Discussion and Interpretation of the Fifth Hypothesis Results:

Fifth Hypothesis Text: There is a correlational relationship between executive function (planning) and spelling difficulties among fourth-grade primary students with writing learning difficulties.

The statistical analysis showed that there is no statistically significant correlation between the executive function of planning and spelling difficulties in fourth-grade primary students with writing learning disabilities. No direct link was found between planning dysfunction and spelling difficulties.

However, spelling might be associated with other components of cognitive and executive functions. In the theoretical literature, researcher Sidqawi (2017) mentioned that spelling difficulties could be attributed to deficiencies in fundamental functions that facilitate language acquisition and usage, such as attention and memory.

She noted that a lack of phonological awareness, lexical abilities, and attentional capacities are among the primary causes of spelling difficulties, resulting in challenges in the holistic recognition of words, or their automatic, precise imaging.

Despite the shared neurological centers between spelling and planning, no correlational relationship was found between them, which can be explained by the involvement of other cognitive and executive functions to a greater extent in the spelling skill, such as phonological awareness, semantic memory, long-term visual memory, and working memory. Sidqawi's study (2017) concluded that disturbances in these functions are the causes of dyslexia and spelling difficulties.

Conclusion:

Building upon a meticulous theoretical analysis of the study's core concepts and through a detailed presentation and interpretation of results within the theoretical framework and in relation to prior research, this investigation has unearthed several novel findings. These findings, previously unexplored according to the researchers' knowledge, have substantially enriched the academic discourse.

The research has demonstrated a significant prevalence of handwriting and spelling difficulties, as well as a dysfunction in the executive function of planning among fourth-grade primary students with learning disabilities in writing. There exists a statistically significant positive correlation between the

executive function of planning and the quality of handwriting among students with writing learning disabilities.

This suggests that students experiencing difficulties in planning are likely to struggle with producing clear and well-organized handwriting. Importantly, the study found no direct correlation between the planning function and spelling abilities, indicating that other cognitive and executive functions have a more pronounced impact on spelling skills.

These findings emphasize the critical importance of developing and enhancing the planning function in students with writing learning difficulties. Improvements in this area could lead to better handwriting quality and increased writing accuracy.

Effective strategies might include integrating targeted exercises and activities that bolster the planning function into both curricular and extracurricular programs. Additionally, providing tailored support and guidance to students with writing learning difficulties could significantly boost their academic achievement and enhance their self-confidence.

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