

Advancing Natural Language Processing For Adaptive Assistive Technologies In Reading And Writing Disabilities

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Abstract

The present research endeavors to explore the application of Natural Language Processing (NLP)-driven assistive technologies in the context of individuals afflicted with reading and writing impairments within the Kingdom of Saudi Arabia. By employing both descriptive and inferential statistical analyses, we aim to explore the disparities in reading and writing proficiencies among students afflicted with dyslexia and dysgraphia. Additionally, we endeavor to investigate their inclinations towards Natural Language Processing (NLP)-based assistive technologies. The present study encompasses a cohort of 150 individuals, comprising 100 students diagnosed with dyslexia and an additional 50 individuals diagnosed with dysgraphia. The findings indicate a lack of statistically significant disparities in the reading and writing proficiencies exhibited by both cohorts. Nevertheless, it is worth noting that the inclinations towards NLP-driven assistive technologies manifest a pronounced predilection for the utilization of text-to-speech functionalities, word prediction algorithms, and language simplification tools. The discoveries emphasize the imperative for tailored methodologies in the creation and execution of adaptive assistive technologies for individuals who experience challenges in reading and writing.

Keywords: Natural Language Processing, assistive technologies, reading disabilities, writing disabilities.

Introduction

The pervasive learning difficulties known as dyslexia and dysgraphia, colloquially referred to as reading and writing disabilities, respectively, exert a substantial impact on a considerable segment of the global populace. In the Kingdom of Saudi Arabia, the presence of disabilities presents a significant challenge for individuals aspiring to obtain education and actively engage in societal activities. In a scholarly investigation conducted by Al-Sayyad et al. (2019), it was revealed that the occurrence of reading disabilities among school-age children in Saudi Arabia spans a spectrum of 5% to 17.7%. In a parallel vein, Alshumrani et al. (2020) unveiled a noteworthy discovery, revealing a prevalence rate of 7.3% for dyslexia within the esteemed population of university students within the nation. Furthermore, a study conducted by Alqahtani, (2018) revealed that the prevalence of dysgraphia among school-aged children in Saudi Arabia is approximately 6.6%.

The significance of acknowledging and attending to reading and writing disabilities resides in their inherent capacity to exert enduring effects on an individual's scholastic, interpersonal, and affective welfare. Extensive research has revealed that the absence of intervention for reading disabilities can result in a notable decline in academic performance and exert a profound influence on an individual's self-worth (Shaywitz et al., 2003; Snowling & Melby-Lervåg, 2016). In addition, it is important to acknowledge that individuals with writing disabilities may encounter obstacles in their ability to communicate effectively, thereby imposing constraints on their educational and professional prospects (Berninger et al., 2006; Wagner et al., 2011).

The utilization of assistive technologies has exhibited considerable potential in mitigating the obstacles encountered by individuals grappling with reading and writing disabilities. Numerous scholarly investigations have delved into the efficacy of assistive technologies in augmenting the proficiency of individuals in the domains of reading and writing. An illustrative

example can be found in the study conducted by Healy et al. (2015), wherein they showcased the advantageous effects of employing text-to-speech technology as a means to enhance reading comprehension among students with dyslexia. In a similar vein, the research conducted by Abdulla et al. (2018) shed light on the favorable outcomes stemming from the utilization of word prediction technology as a means of bolstering individuals with dysgraphia in their writing endeavors.

In order to augment the efficacy of assistive technologies, there has been a notable surge in scholarly investigations focusing on the latest developments in Natural Language Processing (NLP). This burgeoning field of study has garnered significant attention across diverse sectors such as education and healthcare. Natural Language Processing (NLP) represents a prominent facet of the expansive field of artificial intelligence, empowering machines with the remarkable ability to comprehend and manipulate human language. This profound capability serves as a catalyst for seamless and effective communication between individuals and computer systems, fostering a harmonious synergy between these two distinct entities. Within the realm of reading and writing disabilities, Natural Language Processing (NLP) possesses considerable promise in the advancement of sophisticated, adaptable, and tailored assistive technologies that effectively address the unique requirements of individuals.

Extensive scholarly investigations have been conducted to delve into the seamless incorporation of Natural Language Processing (NLP) within assistive technologies. The efficacy of Natural Language Processing (NLP) algorithms in aiding individuals with reading disabilities has been substantiated by notable research studies. For instance, Liu et al. (2020) have successfully employed text-to-speech conversion algorithms, while Lobanov et al. (2019) have effectively utilized automatic speech recognition algorithms for this purpose. In addition, it has been observed that the utilization of natural language processing (NLP) methodologies, such as those proposed by Harrer et al. (2017) for language simplification and by Devlin et al. (2019) for sentiment analysis, holds great potential in augmenting written expression for individuals afflicted with dysgraphia.

In spite of the notable progress made in the field, the utilization of natural language processing (NLP) driven assistive technologies to address reading and writing disabilities in Saudi Arabia has yet to be extensively investigated. The primary objective of this research endeavor is to bridge the existing void by delving into the present condition of Natural Language Processing (NLP)-based assistive technologies within the confines of Saudi Arabia. Furthermore, this study endeavors to discern the potential obstacles and prospects that lie ahead, thereby paving the way for their further development and progress.

The comprehension of the distinctive linguistic and cultural elements inherent in Saudi Arabian Arabic empowers researchers and developers to customize natural language processing (NLP) tools in order to effectively cater to the specific requirements of individuals residing in the region (Bouamor et al., 2018). In addition, it is imperative to emphasize the significance of collaborative endeavors among researchers, educators, and developers in order to facilitate the seamless integration and successful implementation of natural language processing (NLP)-based assistive technologies within educational environments (Woodcock & Sideridis, 2020).

The discoveries unearthed by this investigation possess the potential to make a substantial impact on the realm of assistive technology advancement, thereby enhancing the quality of life for individuals grappling with reading and writing impairments within the borders of Saudi Arabia. By harnessing the recent advancements in Natural Language Processing (NLP), scholars and policymakers have the potential to devise groundbreaking strategies that foster inclusiveness, enhance accessibility, and facilitate academic achievement for individuals facing disabilities.

Research Objective

The primary aim of this research endeavor is to propel the domain of Natural Language Processing (NLP) towards the enhancement of adaptive assistive technologies designed to address reading and writing disabilities prevalent in the context of Saudi Arabia.

Literature Review and Previous Studies

The use of assistive technology to fully help people who have difficulties reading and writing because of disability has been the subject of much study. Healy et al.'s (2015) study shows that text-to-speech software may help dyslexic pupils improve their reading comprehension. According to recent research (Abdulla et al., 2018), word prediction software may be a helpful tool for people with dysgraphia while they are writing. Screen reading software and optical character recognition (OCR) technologies have made printed documents much more accessible to those with reading problems (Tsiakoulis et al., 2018). Assistive solutions for people with reading problems have effectively integrated Natural Language Processing (NLP) algorithms. Text-to-speech conversion is only one example of how algorithms might help make reading easier for those with visual impairments or other disabilities. Researchers Liu et al. (2020) found that using text-to-speech technology based on Natural Language Processing (NLP) improved reading fluency and comprehension for those with dyslexia. Reading aids that use Automatic Speech Recognition (ASR) technology have benefited from the incorporation of Natural Language Processing (NLP). This cutting-edge method allows people to communicate their ideas aloud and have them accurately translated into text (Lobanov et al., 2019).

In the sphere of assistive technology for people with writing challenges, the study of Natural Language Processing (NLP) has shown to be useful. To improve the efficacy and accuracy of written communication, predictive text and autocorrection capabilities have emerged in response to the proliferation of NLP algorithms (Mehmood et al., 2018). People with dysgraphia may benefit from using grammar and style suggestion models since they provide immediate feedback and improve the overall quality of written work (Foltz et al., 2020). Natural language processing (NLP) researchers have been exploring language simplification methods in an effort to help people with reading impairments understand what they are reading. Harrer et al. (2017) conducted a groundbreaking investigation into the field of text simplification algorithms with the hope of illuminating their effectiveness in facilitating the reading and understanding of complex written content. The major goal of using these strategies is to make texts easier to read for those with reading difficulties by reducing their syntactic and lexical complexity.

Individuals with reading difficulties as a result of a disability may now get compassionate support thanks to the use of Natural Language Processing (NLP) methods. Devlin et al. (2019) pioneered a new approach to natural language processing with their pioneering idea of an emotionally intelligent reading assistant. Using sentiment analysis, this state-of-the-art technology analyzes the underlying emotional context of written words in order to provide users with insightful, personalized recommendations and guidance. The developers of these cutting-edge tools set out to help people with reading impairments feel better about themselves while reading. Bouamor et al.'s (2018) landmark study emphasized the critical need of including cultural and linguistic characteristics in the design phase of NLP-based assistive technology. Researchers emphasized the need of adapting natural language processing (NLP) models and algorithms to the specifics of Saudi Arabian Arabic to ensure peak performance and improve usability.

Woodcock and Sideridis (2020) emphasized the necessity of promoting cooperation between academics, educators, and developers in the use of NLP-based assistive technology within pedagogical settings. The attendees had an in-depth discussion on the nuances and benefits of combining these technologies. They also stressed the need of investing in one's own professional growth and training in order to fully realize the potential of Natural Language Processing (NLP) technologies in the classroom. The development of assistive technology based on natural language processing (NLP) places a premium on privacy and security. Researchers have stressed the need of enforcing stringent privacy standards to protect users' personal information in the context of assistive technology programs (Lee et al., 2020). The maintenance of confidence and the protection of the ethical use of Natural Language Processing (NLP) technologies depend critically on the maintenance of data confidentiality and the giving of informed permission.

While much of the existing literature is focused on natural language processing (NLP) tools for English speakers, major efforts have been made to develop NLP-based assistive tools for Arabic speakers. Al-Sabbagh et al.'s (2020) ground-breaking research presented a stunning Arabic text-to-speech system designed for those with visual impairments. Natural language processing has enormous potential, and this study emphasizes

its important role in empowering Arabic-speaking people with impairments. It is crucial to undertake assessment studies to determine the effectiveness of Natural Language Processing (NLP)-based assistive technology. Malandrakis et al.'s (2019) ground-breaking work aims to empirically investigate the usability and acceptance of a state-of-the-art natural language processing (NLP)-based writing support application. The study highlighted the necessity of a user-centric strategy and iterative development approaches in developing effective and user-friendly assistive technologies based on Natural Language Processing (NLP).

When it comes to assistive technology based on Natural Language Processing (NLP), the addition of accessibility features is crucial. Speech input and output interfaces, as well as adaptable user interfaces, are crucial for making technology usable by people with disabilities, claim Kim et al. (2021). The flexibility of these interfaces to work with a wide variety of devices and operating systems means they can better meet the requirements of people with a wide range of impairments. One of the most important factors in turning scientific findings into real, usable solutions is the building of productive relationships between researchers and developers. To ensure that NLP-based assistive technologies effectively cater to the unique requirements and preferences of individuals with reading and writing disabilities, developer participation in the design and development process is crucial (McLoughlin et al., 2019).

Natural language processing (NLP) has shown its adaptability by finding uses outside of the traditional sphere of educational assistance technology. Several areas of education have begun to use this technology, including automated essay grading, feedback generating, and intelligent tutoring systems. Heilman et al. (2010), found that using this technology in these ways improved educational results.

Methods

The present quantitative study employed a rigorous methodology encompassing systematic data collection and meticulous analysis in order to effectively accomplish the research objectives at hand. The primary objective of this study was to assess the efficacy of assistive technologies utilizing Natural Language Processing (NLP) in addressing reading and

writing disabilities prevalent in Saudi Arabia. The study's sample consisted of individuals who were carefully chosen from a diverse range of educational institutions and organizations that specifically catered to individuals with reading and writing disabilities.

The study enlisted a diverse cohort of 150 individuals, encompassing students grappling with dyslexia and dysgraphia, esteemed educators, and seasoned professionals specializing in the realm of special education. The selection of participants was contingent upon their voluntary inclination to partake in the study, as well as their accessibility throughout the designated timeframe for data collection.

The acquisition of data was accomplished through a synergistic blend of surveys and performance-based assessments. The participants were graciously invited to partake in surveys aimed at elucidating their personal encounters with prevailing NLP-driven assistive technologies. The objective was to glean insights into their inclinations, as well as gauge the perceived efficacy of said technologies in ameliorating their challenges in the realms of reading and writing. The evaluation of participants' reading and writing abilities was conducted through the implementation of performance-based assessments. These assessments encompassed a range of tasks, including reading comprehension exercises and writing samples. The primary objective was to gauge the influence of NLP-based tools on the participants' aptitude in reading and writing.

The participants were acquainted with a diverse range of assistive technologies rooted in Natural Language Processing (NLP) that have been specifically developed to address challenges related to reading and writing disabilities. The repertoire of technologies encompassed various innovative tools, such as text-to-speech conversion, word prediction, language simplification, sentiment analysis, and grammar correction mechanisms. Every individual involved in the study was granted the opportunity to utilize state-of-the-art technological resources on appropriate devices, with a strong emphasis placed on their active engagement with these tools throughout the designated research duration.

The empirical data obtained from the administered surveys and performance-based assessments were subjected to rigorous analysis utilizing advanced statistical software. To provide a comprehensive overview of the participants' responses and performance scores, we conducted an analysis of descriptive statistics. This involved calculating key measures such as the mean, standard deviation, and frequency distributions. These statistical indicators allowed us to summarize and quantify the data, enabling a deeper understanding of the participants' overall performance. The utilization of inferential statistics, including t-tests and analysis of variance (ANOVA), was employed to discern and evaluate the disparities in outcomes among distinct cohorts of participants.

Results

Table 1. Descriptive Statistics for Participants' Age:

	Mean	Standard Deviation	Minimum	Maximum
Participants	24.8	3.5	18	34

The tabular representation provides a comprehensive overview of the descriptive statistics pertaining to the age distribution among the participants. The study encompassed a cohort of individuals whose average age was determined to be 24.8 years, exhibiting a degree of variability with a standard deviation of 3.5 years. The age range of the participants spanned from 18 to 34 years, encompassing a diverse cohort that included both youthful individuals embarking on their adult journey and seasoned individuals with a wealth of life experience.

Table 2. Participants' Gender Distribution:

	Frequency	Percentage
Male	70	46.7%
Female	80	53.3%

The presented tabular representation exhibits the categorization of participants according to their respective genders. Among the cohort of 150 individuals who partook in the study, a gender distribution analysis reveals that 70 participants identified as male, constituting approximately 46.7% of the overall sample. Conversely, the remaining 80 individuals identified as female, representing approximately 53.3% of the sample population.

Table 3. Participants' Experiences with NLP-based Assistive Technologies:

	Mean	Standard Deviation	Minimum	Maximum
Reading Ability	4.2	0.9	2	5
Writing Ability	3.8	0.7	2	5

The presented table showcases the average and standard deviation of participants' self-reported aptitude in reading and writing skills, measured on a 5-point scale ranging from 1 denoting "extremely deficient" to 5 signifying "exceptional." The collective evaluation of participants regarding their reading proficiency yielded an average rating of 4.2, accompanied by a standard deviation of 0.9. These statistical findings suggest that the participants possess a commendable level of reading competence, ranging from moderate to high. In terms of writing proficiency, the sample population exhibited a mean score of 3.8, accompanied by a standard deviation of 0.7. These statistical measures suggest a marginally below-average level of writing ability within the group.

Table 4. Participants' Preferences for NLP-based Assistive Technologies:

	Frequency	Percentage
Text-to-Speech	120	80.0%
Word Prediction	95	63.3%
Language Simplification	80	53.3%
Sentiment Analysis	55	36.7%
Grammar Correction	45	30.0%

The presented tabular data provides a comprehensive overview of the frequency and corresponding percentage of participants who expressed a preference for various Natural Language Processing (NLP)-based assistive technologies. Among the array of technological options presented, text-to-speech emerged as the undisputed frontrunner, garnering an overwhelming majority of 80.0% among the participants. The utilization of word prediction emerged as the second most favored technological advancement, garnering a notable preference rate of 63.3% among the participants. Subsequently, language simplification garnered a respectable preference rate of 53.3%, followed by sentiment analysis at 36.7%, and grammar correction at 30.0%.

Table 5. Comparison of Reading Abilities between Students with Dyslexia and Dysgraphia:

	Mean (Dyslexia)	Mean (Dysgraphia)	t-value	p-value
Reading Ability	4.1	3.9	1.36	0.178

The tabulated data showcases a comprehensive juxtaposition of the average reading proficiencies exhibited by students afflicted with dyslexia and those grappling with dysgraphia. The findings of the study revealed that students diagnosed with dyslexia exhibited a mean reading ability score of 4.1, whereas their counterparts with dysgraphia demonstrated a slightly lower mean reading ability score of 3.9. Based on the obtained t-value of 1.36, it can be inferred that there exists a modest disparity in the average reading proficiencies between the two examined groups. With a p-value of 0.178, the evidence suggests that the observed difference lacks statistical significance when evaluated against the commonly accepted threshold of 0.05.

Table 6. Comparison of Writing Abilities between Students with Dyslexia and Dysgraphia:

	Mean (Dyslexia)	Mean (Dysgraphia)	t-value	p-value
Writing Ability	3.7	4.0	-1.54	0.125

The table showcases a comprehensive analysis of the average writing proficiencies among students afflicted with dyslexia and students grappling with dysgraphia. The average writing proficiency among students diagnosed with dyslexia was found to be 3.7, whereas their counterparts with dysgraphia exhibited a slightly higher mean score of 4.0. The obtained t-value of -1.54 indicates a modest disparity in the average writing proficiencies exhibited by the two distinct groups. With a p-value of 0.125, the observed difference fails to achieve statistical significance at the conventional threshold of 0.05.

Table 7. Comparison of Reading and Writing Abilities within the Dyslexia Group:

	Mean (Reading)	Mean (Writing)	t-value	p-value
Dyslexia (n=100)	4.1	3.7	2.11	0.037

The tabular representation showcases a comparative analysis of the average reading and writing proficiencies among individuals within the dyslexia cohort. The findings of the study revealed that students diagnosed with dyslexia exhibited an

average reading ability score of 4.1, whereas their writing ability score averaged at 3.7. The obtained t-value of 2.11 indicates a noteworthy disparity in the levels of reading and writing proficiencies among individuals within the dyslexia cohort. The obtained p-value of 0.037 provides compelling evidence to support the claim that the observed difference is statistically significant, adhering to the widely accepted significance threshold of 0.05.

Discussion

Differences in reading abilities

The analysis of descriptive statistics has unveiled intriguing findings regarding the reading abilities of students with dyslexia and dysgraphia. Specifically, the mean reading ability for students with dyslexia was determined to be 4.1, whereas students with dysgraphia exhibited a slightly lower mean reading ability of 3.9. Nevertheless, the inferential analysis of statistical data revealed that there was no substantial evidence to support a significant disparity in the average reading proficiencies between the two cohorts ($t = 1.36$, $p = 0.178$). The present findings indicate that, with regards to their reading proficiencies, there appears to be a lack of significant disparity between the cohort of students diagnosed with dyslexia and their counterparts diagnosed with dysgraphia.

The existing body of research has produced varying results when examining the disparities in reading proficiencies among students diagnosed with dyslexia and dysgraphia. In a notable study conducted by Berninger et al. (2006), it was observed that students afflicted with dyslexia and dysgraphia demonstrated discernible variations in their struggles with reading. Specifically, individuals with dyslexia encountered more pronounced obstacles in the realm of phonological processing, while those with dysgraphia encountered difficulties primarily in the domains of handwriting and spelling. In contrast, Shaywitz and colleagues (2007) posited that there exists a potential convergence between dyslexia and dysgraphia, wherein the fundamental cognitive impairments underlying these conditions may exhibit similarities, thereby resulting in shared challenges in the domain of reading.

The absence of substantial disparities in reading proficiencies among students diagnosed with dyslexia and dysgraphia, as

observed in our research, suggests the necessity for a more intricate comprehension of the fundamental elements that contribute to these learning disabilities. Additional investigation is warranted to explore alternative variables that have the potential to impact reading proficiency in individuals afflicted with dyslexia and dysgraphia. These variables encompass cognitive processes and instructional strategies, which may exert a significant influence on the aforementioned individuals' reading capabilities.

Significant differences in writing abilities

Based on the analysis of descriptive statistics, it is evident that students afflicted with dyslexia exhibited an average writing ability of 3.7, whereas their counterparts with dysgraphia demonstrated a slightly higher mean of 4.0. Nevertheless, upon conducting inferential statistics analysis, it was determined that the disparity in average writing proficiency between the two cohorts did not exhibit any substantial statistical significance ($t = -1.54$, $p = 0.125$). The results of this study indicate that, akin to the domain of reading proficiency, there appears to be a lack of significant disparity in writing aptitude among students diagnosed with dyslexia and those diagnosed with dysgraphia within our selected cohort.

The existing body of research pertaining to the disparities in writing proficiencies among individuals diagnosed with dyslexia and dysgraphia has produced incongruous findings. As exemplified by the research conducted by Berninger et al. (2006), it was observed that students with dysgraphia displayed pronounced challenges in the domains of handwriting and spelling, thereby potentially exerting a notable influence on their overall writing proficiency. On the contrary, Willcutt et al. (2005) found that the impairments in written expression observed in individuals with dyslexia and dysgraphia did not exhibit a significant disparity when accounting for factors such as IQ and reading proficiency.

The findings of our study indicate that there is a notable absence of substantial disparities in writing proficiency among students diagnosed with dyslexia and dysgraphia. This observation implies that these two cohorts may encounter shared obstacles when it comes to conveying their thoughts through written means. This elucidates the significance of

taking into account a diverse array of writing proficiencies, encompassing penmanship, orthography, and composition, when evaluating the writing aptitude of individuals grappling with reading and writing impairments. Further investigation is warranted to delve into the intricate cognitive and neuropsychological mechanisms implicated in the manifestation of writing impairments. This pursuit aims to foster a more comprehensive comprehension of the shared characteristics and distinctive features between dyslexia and dysgraphia.

Preferences for NLP-based assistive technologies

The findings from the analysis of descriptive statistics unveiled that the NLP-based assistive technology that garnered the highest level of preference among the participants was text-to-speech, with a significant majority of 80.0% expressing their favor. Following closely behind was word prediction, which was favored by 63.3% of the participants. Language simplification emerged as the next preferred technology, with 53.3% of participants indicating their inclination towards it. In contrast, sentiment analysis and grammar correction received comparatively lower levels of preference, with 36.7% and 30.0% of participants favoring them, respectively. The results of our study suggest that students who experience challenges in reading and writing tend to exhibit a preference for technological tools that aid in deciphering text and producing written content with simplified structures.

The findings of our study are consistent with prior investigations on the utilization of Natural Language Processing (NLP) assisted technologies. In a notable study conducted by Hwang et al. (2018), it was discovered that individuals facing challenges in reading exhibited a distinct inclination towards the utilization of text-to-speech technologies. This preference stemmed from the inherent ability of such technologies to offer auditory assistance, thereby facilitating comprehension. The utilization of word prediction tools has garnered positive feedback from individuals who face challenges in writing, as these tools effectively aid in the process of text generation by providing helpful suggestions.

The conspicuous inclination towards the utilization of text-to-speech technology, as observed in our research, may be

indicative of its remarkable efficacy in augmenting reading comprehension and mitigating challenges associated with deciphering written text. The widespread utilization of word prediction tools indicates that students who encounter challenges in writing greatly value the assistance provided in generating textual content and mitigating spelling inaccuracies. The aforementioned discoveries underscore the significance of offering a diverse array of natural language processing (NLP) aided technologies that address various challenges encountered in the realms of reading and writing. It is imperative to consider individual preferences and requirements when developing such assistive tools.

In summary, the outcomes derived from the examination of descriptive and inferential statistics provide valuable insights into the parallels and distinctions pertaining to the aptitudes in reading and writing among individuals afflicted with dyslexia and dysgraphia. Although no notable disparities were detected between the aforementioned cohorts, it is imperative to acknowledge the intricate intricacies inherent in these disabilities and the multifarious elements that exert influence over the aptitude for reading and writing. Moreover, the inclinations towards Natural Language Processing (NLP)-driven assistive technologies offer valuable insights into the distinct requirements and predilections of individuals afflicted with reading and writing impairments. The discoveries made in this study hold significant implications for the advancement and execution of adaptive assistive technologies within the context of Saudi Arabia. These findings underscore the criticality of employing personalized strategies that effectively tackle the multifaceted obstacles encountered by individuals with reading and writing disabilities.

Conclusion

The primary objective of this research endeavor was to explore the application of Natural Language Processing (NLP)-derived assistive technologies in addressing reading and writing impairments prevalent in the context of Saudi Arabia. By employing both descriptive and inferential statistical analyses, we embarked upon an investigation into the disparities in reading and writing proficiencies among students afflicted with dyslexia and dysgraphia. Additionally, we sought to ascertain

their predilections towards Natural Language Processing (NLP)-based assistive technologies.

The findings of our study unveiled that, within the confines of our sample, discernible disparities in the realms of reading and writing proficiencies were not observed between students afflicted with dyslexia and dysgraphia. This observation implies a conceivable convergence in the fundamental challenges encountered by individuals with both of these distinct forms of disabilities. The aforementioned discoveries underscore the imperative of cultivating a more intricate comprehension of the elements that contribute to challenges in reading and writing. This is crucial in order to formulate precise and tailored interventions.

Moreover, the inclinations towards NLP-driven assistive technologies were evidenced by students with impairments in reading and writing, who exhibited a predilection for technological solutions such as text-to-speech functionality, word prediction algorithms, and language simplification tools. The aforementioned discoveries underscore the significance of offering a diverse array of assistive technologies that are tailored to meet the unique needs and preferences of individuals. These technologies serve as valuable tools in aiding individuals with decoding, comprehension, and the production of written content.

This study makes a valuable contribution to the realm of adaptive assistive technologies by offering profound insights into the distinct requirements and inclinations of individuals in Saudi Arabia who experience challenges in reading and writing. The results underscore the significance of employing tailored methodologies in the creation and execution of natural language processing (NLP) assisted technologies. Through the implementation of targeted interventions, specifically designed to cater to the multifaceted obstacles encountered by individuals grappling with reading and writing disabilities, we can effectively augment their educational endeavors. This proactive approach not only enriches their scholastic encounters but also instills within them the confidence and resilience necessary to surmount the hindrances impeding their academic pursuits.

Further investigation is warranted to gain a more profound understanding of the intrinsic cognitive and neuropsychological mechanisms that underlie reading and writing disabilities. This research should aim to explore supplementary factors that could potentially impact individuals' proficiencies in these particular areas. Furthermore, it would be advantageous to undertake longitudinal investigations and interventions to assess the efficacy of Natural Language Processing (NLP)-based assistive technologies in enhancing reading and writing proficiencies over an extended duration.

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