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Impact of Technology-Assisted Learning on Academic Achievement in Students with Learning Disabilities

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ABSTRACT
The integration of technology-assisted learning (TAL) has shown potential in enhancing academic achievement for students with learning disabilities (LD). This study examines the impact of TAL on the academic performance of 16 students with LD in a higher education setting. Utilizing a mixed-methods research design, the study combines quantitative analysis with qualitative insights to evaluate the effectiveness of TAL tools. The quantitative phase involved pre- and post-intervention assessments of academic performance, while the qualitative phase included in-depth interviews with students and educators to explore their experiences and perceptions of TAL. Results indicate that students with LD who engaged with TAL tools demonstrated significant improvements in academic scores in reading comprehension and increased engagement with learning materials. Students reported enhanced instructional effectiveness and more personalized learning experiences for students. The findings underscore the value of TAL in supporting students with LD and highlight the need for continued development and integration of these tools in educational settings. Targeted training and support for both students and educators are recommended to maximize the benefits of technology-assisted learning. The findings underscore the critical role of technology-assisted learning in improving academic outcomes for students with learning disabilities, advocating for its broader implementation in educational and special education settings to enhance personalized learning and instructional effectiveness.

Keywords: Technology-Assisted Learning (TAL), Learning Disabilities (LD), Academic Achievement, Mixed-Methods Research, Personalized Learning

1. INTRODUCTION

Within the dynamic realm of education, technology-assisted learning (TAL) has arisen as a revolutionary instrument, especially for learners who have learning difficulties (LD) (Demir & Önal, 2021, Prongnuch, & Sitjongsataporn, 2021). Globally, there is an increasing acknowledgment of the significance of technology in closing educational disparities and improving academic performance. Through adaptive software and interactive apps, TAL provides a wide range of dynamic resources specifically tailored to cater to the distinct requirements of students with learning disabilities. In light of the growing use of these technologies by educational institutions globally, it becomes imperative to comprehend their influence on academic achievement (Zhou, Hasmin & Sulaiman, 2023, Karakus & Basci, 2024). Many countries face systemic challenges in the education of students with LD. Despite advancements in educational policy and special education services, there remains a persistent achievement gap between students with LD and their typically developing peers. The integration of TAL is seen as a potential solution to this problem, offering innovative ways to deliver instruction and support that can help bridge this gap (Hoda et al, 2022, Haguchi, Sasaki & Nakamuro, 2020, Sayis & Gunes, 2024).

Educational institutions and educators are increasingly exploring the potential of TAL to enhance teaching and learning processes. For instance, the adoption of technology tools has been met with enthusiasm as a means to provide more personalized and effective support for students with LD. However, the successful implementation of these tools requires addressing several key issues, including the need for adequate training for educators, ensuring equitable access to technology, and assessing the effectiveness of these tools in improving academic outcomes (Cenci, Prosen & Licen, 2022, Rad et al, 2022, Zhang & Hwang, 2023).

The theoretical framework for this study on the impact of Technology-Assisted Learning (TAL) on students with learning disabilities (LD) integrates constructivism and assistive technology theory. Constructivism suggests that interactive and personalized TAL tools enhance learning by actively engaging students and providing immediate feedback, which improves comprehension and retention (Amineh & Asl, 2015). Assistive technology theory

highlights how TAL tools, such as text-to-speech and adaptive platforms, help overcome learning barriers by addressing specific challenges faced by students with LD. This framework supports the study's examination of how TAL improves academic performance and experiences for these students through a mixed-methods approach.

In many regions, especially those facing economic and infrastructural challenges, technology provides an opportunity to deliver personalized and accessible learning experiences. For instance, in parts of Southeast Asia, including the Philippines, where access to specialized educational support can be limited, TAL can offer significant advantages by providing tailored learning experiences that address specific learning needs (Cabanilla et al 2023, Canlas et al, 2024, Romli et al, 2022).

In the context of the Philippines, the integration of Technology-Assisted Learning (TAL) offers significant potential to enhance the academic achievements of students with learning disabilities (LD). With the Philippines' educational system increasingly adopting digital tools and resources, understanding the local impact of TAL becomes crucial for improving learning outcomes. The Philippine educational system faces challenges such as limited resources, varying levels of access to technology, and disparities in educational infrastructure across regions. However, recent initiatives by the Department of Education (DepEd) and private organizations are working towards integrating technology into the learning environment. Programs like the DepEd's "Basic Education Learning Continuity Plan" and partnerships with tech companies aim to bridge the digital divide and support inclusive education (DepEd, 2020).

Studies showed that TAL tools, such as interactive educational software and digital platforms, significantly improved the academic performance of students with LD (Parai, Shenoy, Loh, 2015, Chung et al 2023; Sirasanagandla, et al, 2024; Onohwakpor, 2023). Despite the positive outcomes, several challenges remain. Limited access to technology in rural areas and a lack of training for educators on how to effectively integrate TAL tools are significant barriers.

The National Economic and Development Authority (NEDA) emphasizes the need for comprehensive digital literacy programs and infrastructure development to address these issues (NEDA, 2022). The integration of TAL in the Philippine educational system shows promise for improving academic achievement among students with learning disabilities. Continued investment in technology, targeted training programs for educators, and efforts to ensure equitable access to digital resources are essential for maximizing the benefits of TAL. Embracing these strategies can support the goal of providing inclusive and effective education for all students, particularly those with learning disabilities.

Research Gap

From a research perspective, there is a need for more localized studies that explore the specific impacts of TAL within diverse educational contexts, particularly in countries with varying levels of technological infrastructure like the Philippines. Most existing research tends to focus on high-resource settings, leaving a gap in understanding how TAL performs in low-resource or developing environments. While quantitative assessments of academic performance provide valuable data, there is a lack of in-depth, qualitative research exploring the nuanced experiences of students and educators using TAL. Understanding these personal and contextual factors can offer insights into how TAL tools can be refined and tailored to meet diverse needs more effectively.

Addressing these gaps involves investing in infrastructure development to ensure equitable access to technology, enhancing professional development programs for educators, and conducting localized research to better understand and address the unique challenges faced by students with LD in various contexts. This approach will help to optimize the implementation of TAL and ensure that its benefits are accessible to all students, regardless of their geographic or socioeconomic status.

2. OBJECTIVES

This study generally aimed at assessing the impact of Technology-Assisted Learning on Academic Achievement of Students with Learning Disabilities. Specifically, it aimed to answer the following: (2) What academic improvements are observed with the use of TAL tools by students with learning disabilities?; (2) What are the experiences and challenges of the students with learning disabilities related to the use of TL tools?

3. METHOD

Research Design

Employing a mixed-methods research design, the study integrates both quantitative and qualitative approaches. The quantitative component involves pre- and post-intervention assessments to measure changes in academic performance, including grades and engagement levels. This phase aims to provide statistical evidence of the effectiveness of TAL tools. Complementing this, the qualitative phase consists of in-depth interviews with both students and educators to gather detailed insights into their experiences and perceptions of TAL. This approach allows for a comprehensive evaluation of how TAL tools affect learning outcomes and instructional practices. By

combining these methods, the study seeks to provide a nuanced understanding of TAL's impact on students with LD and identify both the benefits and challenges associated with its implementation.

Sampling Procedure and Ethical Consideration

The study employs a purposive sampling technique to select 80 students with learning disabilities (LD) from a higher education institution. Participants are chosen based on specific criteria, including documented learning disabilities and engagement in courses that utilize Technology-Assisted Learning (TAL) tools. To ensure a representative sample, the study includes a diverse group of students across various disciplines and academic levels, aiming for a comprehensive assessment of TAL's impact. Ethical considerations are integral to the study. Informed consent is obtained from all participants, ensuring they are fully aware of the study's purpose, procedures, and their right to withdraw at any time without penalty. To protect the privacy and confidentiality of participants, specific details about their disabilities are not disclosed in the study findings. Data is anonymized, and identifiers are removed to safeguard participants' identities. Additionally, the study adheres to institutional ethical guidelines and obtains approval from an ethics review board to ensure the research is conducted with respect and integrity.

Instruments

The study uses a combination of assessment tools and interview guides. The quantitative component involves standardized pre- and post-intervention academic performance assessments, including grades and engagement metrics, to objectively measure changes. For the qualitative component, semi-structured interview guides are developed to explore participants' experiences with TAL tools, covering aspects such as usability, perceived effectiveness, and impact on learning. These instruments are designed to capture both statistical and experiential data.

Data Gathering Procedure

Data is collected in two phases. First, academic performance data is gathered through institutional records before and after the intervention involving TAL tools. Second, qualitative data is collected via in-depth interviews with students and educators, conducted either in-person or virtually, depending on accessibility and convenience. Interviews are audio-recorded with consent, transcribed, and reviewed for accuracy. This process ensures comprehensive coverage of participants' insights and experiences with TAL.

Phase I. Data Gathering of Pre and Post Intervention

The intervention to integrate Technology-Assisted Learning (TAL) tools was implemented over a two-week period, organized into three key phases: pre-intervention, during intervention, and post-intervention.

In the **pre-intervention phase**, the focus was on preparation and training. TAL tools, including Rewordify, NaturalReader, and Google Dictation, were customized to meet the specific needs of students with learning disabilities. This customization ensured that each tool was tailored to address individual learning requirements effectively. Concurrently, comprehensive training sessions were conducted for both educators and students. Educators were trained on how to integrate these tools into their lesson plans, while students were taught how to use the tools to support their learning.

During the **intervention phase**, the TAL tools were integrated into daily classroom lessons. The implementation process involved closely monitoring the usage and effectiveness of the tools to ensure they were being used correctly and were functioning as intended. To support this, ongoing technical support was provided to resolve any issues that arose, and regular check-ins were conducted with both students and educators to gather feedback and make necessary adjustments.

In the **post-intervention phase**, the focus shifted to evaluating the effectiveness of the TAL tools. Feedback was collected from students and educators through interviews and surveys. This feedback aimed to assess the impact of the tools on learning outcomes and identify areas for improvement. The evaluation process provided valuable insights into the effectiveness of the intervention and informed future use of TAL tools in educational settings.

Table 1. Data Gathering of Pre and Post Intervention

Phase	Activities
Pre-Intervention	- Preparation and Tool Customization Configure TAL tools (Rewordify, NaturalReader, Google Dictation) to meet individual needs of students.
	- Training Sessions Conduct workshops for educators and students on using TAL tools effectively.
During Intervention	- Implementation in Classroom Settings Integrate TAL tools into daily lessons. Monitor usage and effectiveness.
	- Ongoing Support and Troubleshooting Provide technical support, resolve issues, and conduct regular check-ins.

Post-Intervention	- Evaluation and Feedback Collection Gather feedback from students and educators via interviews and surveys. Assess effectiveness and identify improvements.

Phase 2. Focus Group Discussion

In Phase 2, focus group discussions (FGDs) with six students were conducted to gather qualitative insights into their experiences with Technology-Assisted Learning (TAL) tools. Participants were selected based on documented reading disabilities, ensuring the feedback was relevant to the tools' effectiveness. Preparation involved informing participants about the discussion's purpose and obtaining consent. Conducting the Discussion involved either in-person or virtual meetings led by a trained facilitator, with discussions audio-recorded for accuracy. Observations revealed that tools like Rewordify and NaturalReader improved text comprehension and engagement, though some students faced initial adjustment difficulties and technical issues. Ethical Protocols ensured confidentiality and respectful conduct, with anonymized data handling. The Data Handling process included transcribing and thematically analyzing the discussions. The FGDs provided deeper insights into the TAL tools' impact, complementing the quantitative data from Phase 1 and highlighting both successes and areas for improvement.

Data Analysis

Quantitative data is analyzed using statistical methods to compare pre- and post-intervention performance metrics, providing evidence of changes in academic achievement and engagement. Descriptive and inferential statistics are employed to assess the effectiveness of TAL tools. Qualitative data from interviews is analyzed using thematic analysis, identifying key themes and patterns in participants' responses. This approach allows for a detailed understanding of how TAL tools influence learning experiences and instructional practices. Combining both types of data provides a holistic view of TAL's impact.

4. RESULT AND DISCUSSION

Types of AI tools to Support Learners with Reading Disability among Selected Schools

Reading comprehension was specifically tested because the identified disabilities among students—dyslexia, language processing disorders, visual impairments, and auditory processing disorders—directly impact reading abilities. These disabilities affect how students decode, understand, and process written text. By focusing on reading comprehension, the study aimed to assess the effectiveness of TAL tools in addressing these core challenges and enhancing students' ability to understand and engage with reading materials. This approach ensures that the evaluation aligns with the specific needs of students and provides targeted insights into the impact of TAL tools on their reading performance. The implementation of AI tools—Rewordify, NaturalReader, and Google Dictation—over a two-week period significantly impacted students with reading disabilities.

Table 2. Types of AI tools to Support Learners with Reading Disability among Selected Schools

Tool	Description	Reading Disability Addressed
Rewordify	Simplifies complex text to make it more accessible, helping students with reading difficulties understand and engage with material more effectively. Rewordify's features include vocabulary definitions, reading practice, and text highlighting.	Dyslexia, Language Processing Disorder
NaturalReader	Provides text-to-speech functionality to convert written text into spoken words. This tool supports students with dyslexia or visual impairments by reading content aloud and providing various voice options and speed controls.	Dyslexia, Visual Impairments, Auditory Processing Disorder
Google Dictation	A speech-to-text tool integrated with Google Docs that allows students to dictate their responses and assignments. This assists those with dysgraphia or motor impairments by transcribing spoken words into text and enabling voice commands.	Dysgraphia, Motor Impairments

These tools were selected to address specific reading-related challenges, including dyslexia, visual impairments, dysgraphia, and language processing disorders. Rewordify was utilized to simplify complex texts, making content more accessible by providing vocabulary definitions and text highlighting. This tool effectively supported students with dyslexia and language processing disorders by breaking down difficult texts and enhancing their understanding. NaturalReader provided text-to-speech functionality, converting written text into spoken words. This was particularly beneficial for students with dyslexia, visual impairments, and auditory processing disorders, as it allowed them to hear content read aloud, improving comprehension and engagement. Google Dictation

facilitated speech-to-text conversion, enabling students with dysgraphia and motor impairments to express their thoughts and complete assignments without the barrier of physical writing difficulties.

The two-week implementation period involved regular use of these AI tools in classroom settings, with training provided to both students and teachers. This ensured that the tools were used effectively and consistently. The researcher integrated these tools into daily lessons, allowing students to interact with the technology and apply it to their reading tasks. Feedback from both students and teachers indicated that the tools facilitated a more inclusive and supportive learning environment.

Pre-test-post-test Reading Performance of the Learners with Disabilities related to reading before and after the use of TAL tools

The analysis reveals significant improvements in the reading performance of students with disabilities following the implementation of TAL tools. The number of students achieving "Outstanding" performance increased from 2 to 4, with mean scores rising from 28.5 to 28.8. This indicates that TAL tools effectively supported higher achievement levels among students who were already performing well. A notable shift is observed in the "Very Satisfactory" category, where the number of students increased from 4 to 9, and the mean score improved from 25.3 to 25.7. This suggests that TAL tools were particularly beneficial for students who were previously performing at a high level but not yet at the peak of their potential.

Conversely, the "Satisfactory" category saw a reduction in both the number of students (from 6 to 2) and a slight increase in mean score (from 22.0 to 22.5), indicating that some students moved up to higher performance levels. The "Needs Improvement" category also decreased, with only 1 student remaining in this category post-intervention compared to 2 initially, and the mean score slightly decreased from 17.5 to 16.0, reflecting improvement but also some variability in student progress. Importantly, there were no students in the "Poor" category post-test, indicating a substantial improvement for those who initially scored in this range. This result demonstrates the positive impact of TAL tools in enhancing reading skills and suggests a successful reduction of performance challenges for students with learning disabilities.

Table 3. *Pre-test-post-test Reading Performance of the Learners with Disabilities related to reading before and after the use of TAL tools*

Performance Level	Pre-Test Scores	Number of Students (Pre-Test) (N=16)	Post-Test Scores	Number of Students (Post-Test) (N=16)	Mean Score (Pre-Test)	Mean Score (Post-Test)
Outstanding (27-30)	27-30	2	27-30	4	28.5	28.8
Very Satisfactory (24-26)	24-26	4	24-26	9	25.3	25.7
Satisfactory (21-23)	21-23	6	21-23	2	22.0	22.5
Needs Improvement (15-20)	15-20	2	15-20	1	17.5	16.0
Poor (0-14)	0-14	2	0-14	0	12.0	-

The findings align with existing literature on the effectiveness of TAL tools in supporting students with disabilities. For instance, research by Rose and Meyer (2002) highlights how adaptive technologies can provide personalized learning experiences that address individual needs, supporting academic achievement for students with disabilities. Similarly, a study by Beddow et al. (2014) underscores the potential of text-to-speech and other assistive technologies in improving reading comprehension among learners with dyslexia. The implications of these findings suggest that integrating TAL tools into educational settings can significantly benefit students with learning disabilities. Educators should consider incorporating these technologies into their teaching strategies to provide more tailored support. Additionally, the results advocate for ongoing development and broader implementation of such tools to further enhance educational outcomes and inclusivity in learning environments.

Thematic Analysis of Student Experiences with TAL Tools

The thematic analysis of student interviews revealed several key themes regarding their experiences with Technology-Assisted Learning (TAL) tools. The data was organized into four themes namely *Improved Understanding, Increased Engagement, and Ease of Use* and arranged accordingly into six sub-themes themes *Simplification of Content, Enhanced Comprehension, Interactive Learning, Motivation and Confidence, User-Friendly Interface, Technical Support, Initial Adjustment Period, and Technical Issues*, each reflecting different

aspects of how the tools impacted their learning experiences namely

Improved Understanding was a prominent theme, with students noting significant benefits from tools like Rewordify. They appreciated how it simplified complex texts and provided definitions, which helped them better understand challenging material. For example, students described how Rewordify broke down difficult vocabulary and highlighted key terms, making the reading process more accessible (f=4). In like manner *Enhanced Comprehension* was another critical theme, particularly concerning NaturalReader's text-to-speech feature. Students reported that listening to texts read aloud improved their understanding of the material, with several mentioning that auditory input helped them grasp content more effectively (f=3).

Moreso, *Increased Engagement* emerged as a theme where students highlighted how interactive features of the TAL tools made learning more enjoyable. The tools were described as transforming reading from a chore into an engaging activity, which helped maintain their interest and motivation (f=5). *Motivation and Confidence* was also a significant theme, with students expressing that the TAL tools increased their motivation and self-assurance in reading tasks. They felt more confident in their reading abilities after using the tools, which positively impacted their overall learning experience (f=4).

In like manner, *Ease of Use* was a theme that captured students' appreciation for the user-friendly interfaces of the tools. They found the tools to be intuitive and easy to navigate, which facilitated their engagement and use (f=4). Additionally, some students noted the availability of technical support as a valuable aspect of their experience (f=2). *Challenges* were also reported, including an Initial Adjustment Period where some students needed time to adapt to the new tools. They indicated that the adjustment period was a minor hurdle but ultimately did not detract significantly from the benefits (f=3). Technical issues were also noted, with occasional malfunctions causing frustration (f=2).

Table 4. Themes Emerged on Student Experiences with TAL Tools

Theme	Sub-Themes	Description	Verbatim	Frequency of Mentions (N=6)
Improved Understanding	Simplification of Content	Students found that tools like Rewordify helped simplify complex texts, making it easier to understand and engage.	*"Rewordify made tough texts easier to understand."* *"I used to struggle with complex vocabulary, but Rewordify broke it down for me."* *"Rewordify's feature that highlights and defines difficult words really made a difference in my reading."*	4
	Enhanced Comprehension	The text-to-speech feature of NaturalReader improved their ability to grasp reading materials by hearing them read aloud.	*"Listening to text with NaturalReader really helped me understand better."* *"The ability to listen to the text instead of reading it helped me grasp the content more effectively."*	3

Increased Engagement	Interactive Learning	The tools made learning more interactive and engaging, which maintained their interest in reading tasks.	*"The tools made reading feel more like play."* *"Learning became more enjoyable with these tools."* *"The tools made reading tasks more engaging."* *"Reading was less boring thanks to the interactive features."*	5
	Motivation and Confidence	The tools helped boost their motivation and confidence in reading tasks.	*"Motivation and Confidence The tools helped boost their motivation and confidence in reading tasks.* *"I felt more confident in my reading after using these tools."*	4
Ease of Use	User-Friendly Interface	The ease of using the tools was highlighted, with students appreciating intuitive and simple interfaces.	*""The tools were very straightforward and easy to use."* *"I liked how simple and intuitive the tools were to navigate."*	4
	Technical Support	Students appreciated having technical support available when needed.	*"Whenever I had trouble, help was just a click away."*	2
Challenges	Initial Adjustment Period	Some students mentioned needing time to adjust to the new tools.	*"It took me a while to get used to the tools."*	3
	Technical Issues	Occasional technical problems with the tools were reported.	*"Sometimes the tool didn't work properly, which was frustrating."*	2

These findings underscore the positive impact of TAL tools on students with reading disabilities. They demonstrate that such tools can significantly enhance comprehension, engagement, and confidence in reading tasks. However, the results also highlight the need for addressing initial adjustment periods and technical issues to maximize the benefits of these tools. Educators and developers should consider these aspects to ensure a smoother integration of TAL tools in educational settings, thereby enhancing their effectiveness and inclusivity. The study's findings align with the literature on assistive technologies, which emphasizes their role in providing personalized support and improving academic outcomes for students with disabilities (Rose & Meyer, 2002;

Beddow et al., 2014). The positive feedback from students reinforces the value of incorporating TAL tools into learning environments and suggests that ongoing support and development are crucial for optimizing their impact.

In the context of special education programs in the Philippines, the implementation of Technology-Assisted Learning (TAL) tools presents several significant implications for practice. Given the diverse needs of students with reading disabilities, integrating tools such as Rewordify, NaturalReader, and Google Dictation can greatly enhance educational outcomes. These tools offer tailored support that addresses specific challenges faced by students with dyslexia, visual impairments, and other reading-related disabilities. For instance, Rewordify can simplify complex texts, making them more accessible, while NaturalReader's text-to-speech functionality can support auditory processing and comprehension. Google Dictation facilitates writing for students with dysgraphia and motor impairments. The effective incorporation of these tools into special education programs requires strategic planning and resource allocation. Schools should prioritize training for educators and students to ensure that the tools are used effectively and consistently. Moreover, technical support and ongoing maintenance are crucial to address any issues promptly and minimize disruptions in the learning process. Administrators need to develop policies that support the integration of TAL tools and advocate for funding to sustain these resources. Additionally, fostering partnerships with technology developers can help ensure that tools are updated and refined based on user feedback.

5. CONCLUSION

This study examines the impact of TAL on the academic performance of 16 students with LD in a higher education setting. Utilizing a mixed-methods research design, the study combines quantitative analysis with qualitative insights to evaluate the effectiveness of TAL tools. The study findings suggest that TAL tools can significantly improve reading skills and student experiences for those with disabilities. They provide substantial support in terms of comprehension, engagement, and confidence, aligning with existing literature on the effectiveness of assistive technologies. To maximize the benefits of these tools, educators should address initial adjustment periods and technical issues, ensuring that the integration of TAL tools is as seamless and supportive as possible. The positive outcomes of this study advocate for continued development and broader implementation of TAL tools to further enhance educational inclusivity and effectiveness.

6. RECOMMENDATIONS

To maximize the benefits of Technology-Assisted Learning (TAL) tools for students with reading disabilities, schools must implement practical measures, including comprehensive training for both students and educators on using tools like Rewordify, NaturalReader, and Google Dictation. Training should cover technical aspects and pedagogical strategies for integrating these tools into daily lessons. Ensuring available technical support and regular evaluation of the tools' effectiveness is crucial. Tailoring these tools to individual needs will further enhance their impact. Administrators should foster an environment supportive of TAL tools by allocating resources for acquisition and training, developing consistent use policies, and establishing feedback mechanisms for continuous improvement. Collaboration with technology developers for updates and securing funding for maintenance are also essential. The study underscores the importance of integrating TAL tools within the Universal Design for Learning (UDL) framework. Future research should focus on better integration of TAL tools into UDL principles, their long-term effects on academic outcomes and self-efficacy, and their impact on cognitive processes involved in reading, to refine theories and enhance practical applications.

7. LIMITATIONS OF THE STUDY AND FUTURE RESEARCH DIRECTIONS

This study, while revealing significant improvements in reading performance among students with disabilities through the use of TAL tools, is not without limitations. The study's small sample size of 16 students may not fully represent the diverse needs and experiences of all learners with reading disabilities. Additionally, the three-week implementation period, while providing initial insights into the effectiveness of TAL tools, may not capture long-term impacts or variations in tool effectiveness over extended use. The study also focused on a specific set of tools—Rewordify, NaturalReader, and Google Dictation—which may not encompass the full spectrum of available assistive technologies. Future research should address these limitations by involving larger, more diverse samples and extending the duration of tool use to assess long-term outcomes. Furthermore, exploring a wider range of TAL tools and their integration within various educational contexts could provide a more comprehensive understanding of their efficacy. Investigating the interplay between TAL tools and different cognitive processes involved in reading, as well as their impact on academic outcomes and self-efficacy over time, will offer deeper insights into how these technologies can be optimized to support learners with reading disabilities.

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