



A comprehensive case study on the effective interventions for reversing reading disorder

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Abstract

Reverse Reading Disorder (RRD) is a rare and complex learning condition wherein learners can only process text written in reverse order, resulting in significant educational barriers. Despite its profound impact, empirical research on effective intervention strategies for RRD remains scarce. This study addresses this critical gap by evaluating the effectiveness of a personalized, multi-sensory intervention approach tailored for a student diagnosed with RRD. The research involved comprehensive diagnostic procedures, including standardized reading assessments, cognitive evaluations, and reviews of social, familial, and medical histories. Medical professionals confirmed the absence of neurological impairments. An individualized intervention plan was implemented over four years, incorporating visual, auditory, kinaesthetic, and tactile modalities. Instructional methods included reverse reading exercises, phoneme-grapheme training, and adaptive strategies designed to accommodate the student's unique learning profile. The findings demonstrate a significant reduction in reading errors, improved fluency, and enhanced comprehension. Assessment data reflected measurable progress in standardized reading tests and positive behavioural feedback from educators and support staff. This study underscores the importance of intensive diagnostics and adaptive, student-centred instructional design in addressing rare learning disorders such as RRD, and calls for broader recognition and research into individualized educational interventions.

Keywords: Diagnostic assessment; educational improvement; multi-sensory approach; personalized intervention; reverse reading disorder.

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1. INTRODUCTION

Learning debilities and disabilities included a wide range of cognitive complexities that greatly affect academic success and social assimilation (Visser et al., 2020; Swanson & De La Paz, 1998). Disorder conditions like Dyslexia, attention deficit hyperactivity disorder, and Visual Processing Disorders are widely reported while unfamiliar conditions create unique difficulties (Pickren et al., 2024). Reverse Reading Disorder (RRD) is regarded as one of such rare disability conditions that a learner is only able to read a text in reverse order. This scarce mental situation, though not well documented in educational studies, presents considerable impediments in normal educational settings, and requires particular planned interference policies (Hulme & Margaret, 2016). The current study aims to investigate the case of a student from Erbil, Iraq, identified with Reverse Reading Disorder, who was only able to read letters, words, and sentences in reverse order and struggled with conventional left-to-right written documents. Due to this condition, the learner was rejected from attending in several schools that were not equipped with the necessary tools, and qualified staff to address the challenges. This expulsion and marginalization by educational foundations is well-known for learners exhibiting complex learning disabilities, usually resulting from the unattainability of required materials or knowledgeable staff in schools.

According to many published studies, in cases like this, many countries, among them Iraq have limited capacity, and they need efficient educational infrastructure to aid neurodiversity learners. However, a private foundation like Barz School which is well-known for its comprehensive plans and practices, established a personalized multi-sensory intervention approach to treat the case of the student. Under the supervision of Paywand Jalal Hassan, the school designed a tailored learning program that integrated reverse-text reading exercises, phoneme-grapheme drills, and other personalized procedures and techniques to the learner's special cognitive needs. The research study intends to investigate the influence of these tailored interventions on the learner's academic performance, especially in addressing the limitations imposed by RRD. The results of the study contribute to the wider discourse on educational comprehension and the aid of neurodiversity learners. Through this case, studies emphasizes the essential role of educators in promoting inclusive learning environments, particularly for learners facing complex and abnormal educational difficulties (Salehi et al., 2024; Chen et al., 2024; Hulme & Margaret, 2016).

1.1. Literature review

This section is devoted to evaluate the literature available on reading disabilities, letter reversals and the consequences following reading disabilities. Theoretical frameworks and empirical results are essential for contextualising the study and focusing on methodological challenges in the field. In a study, Mitchell et al., (2010) evaluated advancements in personalised educational strategies, highlighting for identifying students with disabilities rather than being described by their incapacities. Their inclusive study identified obstacles to effective collaboration, advocating the need of personalised curricula to meet the learners' required needs. In another study, Sarudin et al., (2019) showed the impact of multi-sensory program in addressing word recognition competences. Their results demonstrated that incorporating visual, auditory, and tactile aids to a great extent supports reading skills. On the other hand, Castles et al., (1999) identified genetic and environmental causes to phonological and surface dyslexia, by using twin data to show considerable heritability. Their findings contribute to the cognitive processes underlying different profiles of dyslexia. Swanson and Jerman, (2007), and Morgan et al., (2024) investigated coexisting conditions among speech disabilities, language impairments, reading disorders, manifesting that early impairments of language and speech may raise risks of reading disabilities. The study highlights the requirement for comprehending of comorbidity for accurate diagnosis and intervention.

In order to emphasize the role of individualized learning plans in fostering self-reflection and goal setting, Li and Burke (2010) discussed the plans which supports lifelong learning among medical professionals. In a further study, Kim (2021) and Obaid (2013) offered evidences for the positive impact of multi-sensory methods of teaching in elevating skills of English language and mathematics disabled learners in Jordan, showing the effect of sensory-based plans. In a subsequent study, MacLeod et al., (2017) highlighted the significance of

parental engagement in IEPs development, focusing on cooperative rapport between educators and parents to confirm joint respect and identification of parents' expertise concerning their children's requirements. In a separate study, Lachmann (2002) examined theoretical frameworks relevant to reading disabilities and clarified that letter reversals in dyslexia stem from unsettled management between and phonological processing, rather than merely graphical impairments. In the same vein, MacLeod et al., (2017) explored certain brain areas responsible for dyslexia, enhancing the relationship between phonological disorders and reading disabilities.

1.1. Purpose of study

This study is different in the sense that it seeks to treat a unique condition of text reverse reading. Through a personalised intervention, the study contributes to the neurodiversity discourse, focusing on adaptive methods of interventions which encompass and accommodate diverse cognitive conditions.

2. MATERIALS AND METHODS

2.1. Participants

A single student who was diagnosed with Reverse Reading Disorder was the participant of the present study. Together with the student, a group of teachers, parents, and healthcare experts participated in the process of education and development. The study used diverse methods prepared for the student's educational needs, including: Mirror-style references, and sources are prepared for accommodating reverse reading condition, attached in the Supplementary Materials in this research. In order to assess and evaluate the learner's reading and writing competences, quizzes and questionnaires are designed throughout the tailored intervention process. The study also includes behavioural reports from teachers and social workers to record the progress and any experimental changes in performance during the interference.

2.2. Procedure

The involvement covered twelve weeks, during which the subsequent procedural steps were taken: **Pre-Assessment:** Initial reading and writing assessments of Woodcock Reading Mastery Tests were carried out to diagnose basic performance levels. **Intervention Phase:** In this phase, the learner was involved and immersed in a multi-sensory plan of learning, using materials tailored for progressively transition back to conventional reading and writing styles. This stage engaged personalised reading sessions, directed practice, and incorporation of feedback from teachers and parents. **Mid-Assessment:** Progress assessments were carried out in the middle of the process by the involvement to measure developments and accommodate approaches as necessary. **Post Assessment:** In the final stage, the assessment evaluated the efficiency of the interference and recorded the learner's overall development.

2.3. Data analysis methods

Quantitative Analysis: The study analyzed reading and writing scores using descriptive statistics to assess changes that occurred during the different assessment phases. Effect size calculations (Cohen's d) were employed to measure the magnitude of changes in performance scores. Additionally, ANOVA (Analysis of Variance) was used to determine whether significant changes in scores occurred across the various assessment stages. A progress monitoring chart was also created to visually represent trends in the learner's performance improvement.

Qualitative Analysis: Thematic analysis was performed on qualitative feedback from both teachers and parents to identify recurring themes and insights related to the learner's engagement and sensitive reactions during the intervention. This approach helped uncover key patterns and provided a deeper understanding of how the learner responded to the interference.

3. RESULTS

3.1. Quantitative analysis

The findings demonstrated great performance improvements in reading and writing points. The study confirms the intervention's effectiveness with statistical analyses indicating p-values less than 0.05. The effect

sizes (Cohen's d) indicate significant and large successful scores in both reading and writing achievement (table 1). Below shows the results and findings of the study, which summarizes the outlines of the reading and writing success rates of the learner at various measurement stages.

Table 1

Reading and Writing Performance Scores of the Student Pre-, Mid-, and Post-Intervention

Assessment Phase	Reading Score	Writing Score	Engagement Rating (1-5)	Change in Reading Score	Change in Writing Score	p value	Cohen's d
Pre-Intervention	45	40	2	-	-	-	-
Mid Intervention	65	60	4	+20	+20	<0.05	1.1
Post Intervention	85	82	5	+40	+22	<0.01	2.0

3.2. Qualitative insights

Both the feedback from teachers and parents indicated notable improvements in the learner's confidence and engagement during the reading sessions. Teachers observed an increasing level of participation, where the learner became more comfortable and self-assured in their abilities. Similarly, parents noted that their child exhibited a greater sense of initiative and willingness to engage with the material outside of structured sessions.

The recurring themes of resilience, motivation, and emotional progress were particularly emphasized across both sets of feedback. Teachers highlighted the learner's growing ability to tackle challenges without becoming discouraged, showing perseverance even when faced with difficult tasks. Motivation was also a consistent theme, with both teachers and parents noting an enhanced eagerness to learn and actively participate in reading activities. Furthermore, emotional progress was clearly evident, as the learner appeared to handle frustrations more constructively, demonstrating emotional growth throughout the sessions.

This positive feedback underscores the constructive impact of the intervention, as it not only supported academic development but also contributed to the learner's overall emotional and psychological growth. The influence of the intervention was seen as a key factor in fostering a more holistic and well-rounded educational experience, enhancing the learner's confidence, resilience, and motivation to succeed.

4. DISCUSSION

The results and findings of the study highlight the potential of focused interventions in developing reading skills among learners with reading related disabilities. The case study demonstrated how a multi-sensory approach facilitated the learner's gradual transition from reverse reading to fluent normal reading, emphasizing the need for personalized educational strategies. This approach underscores the necessity of addressing individual learning profiles and meeting the specific challenges faced by each learner.

The learner's progress underscores the importance of tailoring learning strategies to fit individual cognitive profiles. Such plans should address unique learning challenges, ensuring that educational approaches are specifically designed to meet the needs of each student. The success of the intervention was largely dependent on the collaborative efforts of educators, specialists, and parents. This highlights the importance of shared goals, effective communication, and productive cooperation to support the learner's development and maximize the impact of the intervention. The favourable outcomes observed in this study suggest that integrating multi-sensory learning methods such as visual, auditory, and kinesthetic approaches can significantly enhance reading skills, particularly for neurodiverse learners. These techniques cater to various learning styles and can help overcome barriers to reading proficiency.

Additionally, the study points to potential future research directions, including long term studies to assess the sustained impact of these interventions over time. Future investigations could also explore the

applicability of similar approaches for learners with other rare disorders, broadening the scope of effective educational strategies for diverse learning needs.

5. CONCLUSION

The study provides compelling evidence for the effectiveness of tailored and multi sensory learning plans in improving the abilities of learners affected by Reverse Reading Disorder. By using comprehensive educational diagnostic tools and implementing personalized educational strategies, the learner demonstrated significant improvements in both reading and writing skills. These enhancements suggest that when educational approaches are customized to meet the specific needs of learners, particularly those with reading related difficulties, substantial progress can be achieved.

The findings of this study make a valuable contribution to the ongoing discussion about inclusive education and the importance of adapting teaching methods to cater to the diverse needs of students. It reinforces the idea that traditional, one size fits all teaching methods may not be sufficient for learners with deep cognitive disorders, and that more flexible, adaptive approaches are necessary to ensure these students have an equal opportunity to succeed. By focusing on individualized strategies that incorporate multi-sensory techniques, the study highlights how accommodations in teaching can play a critical role in helping students overcome specific challenges they face in their educational journey.

In this context, the results underscore the growing recognition of the necessity for educational systems to adopt methods that are not only inclusive but also actively responsive to the unique cognitive profiles of students. For learners with conditions such as Reverse Reading Disorder, a more personalized approach that considers various sensory modalities such as visual, auditory, and kinesthetic learning proves to be beneficial in enhancing their overall academic performance. This study also calls for a broader application of such strategies across different learning environments, as it offers valuable insights into how to support students with complex learning needs.

Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: The study adheres to the ethical guidelines for conducting research.

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Appendix

An example of the research's tool

A local Sporting Hero

At the age of nine, Omar Abdulrahman started playing football. He started playing football at home as he grew up in a family of footballers. First, he played for Al-Hilal, a Saudi team, in 2000 and then he played for Al-Ain football club in 2007. He was 15 years old. Lots of football clubs wanted Omar to play for them, but he wanted to live close to his family in the UAE. He plays for the Emirati international team.

He hurt his leg in 2009 and couldn't play football for six months. Then, in 2011, he hurt his leg again. He is a very good football player and has won many awards, including Emirati player of the year in 2013. He played football in the 2012 Olympics. When Omar moved to Saudi Arabia, all of his family went with him too. His father has always helped him and Omar thinks he is a good football player because his family love and say prayers for him.



1 Omar is from the UAE.	A. True	B. False
2 He was 15 when he started playing football.	A. True	B. False
3 He has never hurt his leg.	A. True	B. False
4 He is a very good footballer.	A. True	B. False
5 He doesn't see his family often.	A. True	B. False