Exploring the use of text-to-speech technology to support reading comprehension in Welsh: a case study

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ABSTRACT

Following the disruption to education as a result of the coronavirus pandemic, there has been a detrimental impact on Welsh language reading comprehension skills among pupils in one school in South Wales. This is typical of reading comprehension skills across Wales (Estyn, 2022). The aim of the study was to compare the impact of reading intervention using text-to-speech (TTS) software with a traditional intervention (teacher-led reading) on 10 underachieving Year 6 pupils. A treatment group (TTS) and a control group (reading done by the researcher) were used, and reading achievement and enjoyment were measured through a series of reading comprehension books, 'Ditectif Geiriau' ('Word Detective') (Canolfan Peniarth, 2015) and online questionnaires. The results show that some pupils perform better with TTS, although levels of reading enjoyment vary. This research could benefit Welsh language educators, suggesting the potential of TTS as a supportive tool for pupils experiencing reading comprehension difficulties.

1. Introduction

There is a growing emphasis on developing and embedding technology skills in the classroom. Indeed, digital technology is an essential element of the Curriculum for Wales. Despite the benefits of technology within the classroom (e.g. Ciampa, 2017), it can negatively affect literacy, especially minority languages such as the Welsh language.

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In a Welsh-medium primary school, there was a decline in pupils' reading skills and their confidence in speaking Welsh, mainly due to the side effects of the COVID-19 pandemic (Welsh Government, 2023). Despite the challenges, the pandemic led to experimentation with technology, including the use of software to support pupils with Additional Learning Needs (ALN). This case study examines the potential of text-to-speech (TTS) software to support Welsh-language reading comprehension, following Estyn's (2022) findings about the impact of COVID-19 on literacy and the desire to improve children's reading skills through the use of technology.

2. Literature

Assistive technology (AT) offers a pathway to support the independence and productivity of individuals with disabilities and learning difficulties (BATA, 2022). Academics recognise the benefits in supporting ALN learners to reach their potential (e.g., MacLachlan et al., 2018; Alsolami, 2022; Arslan-Ari and Başer, 2023), with evidence from Estyn (2020) highlighting the positive impact of AT on standards and provision.

Analysis of Welsh Government (WG) documentation (2015, 2021) shows a lack of systematic consideration of the use of AT to support ALN pupils. While the ALN Code (WG, 2021) highlights key principles, MacLachlan et al. (2018) emphasise the need for cross-sector collaboration to ensure follow-up support. Multi-agency working is challenging (Frederickson and Cline, 2015), with current pressures on the education and health sectors limiting the ability to provide individual support (BBC News, 2022, 2023). The lack of teacher confidence in Wales regarding the new digital curriculum is highlighted, emphasising the need for continuous professional development and parent-teacher collaboration (Carroll et al., 2023).

The implementation of the ALN Code through the medium of Welsh presents additional challenges in terms of the availability of technologies (Marshall, 2021; Prys et al., 2022; WG, 2015). Marshall (2021) highlights the disadvantage of the Welsh language in terms of speech recognition technology, leading to bilingual speakers turning to English. This adds to the burden on Welsh-medium schools working in a bilingual system with fewer appropriate technological resources.

Text-to-speech (TTS) is software that reads text aloud (Jones et al., 2019). The paucity of literature on the use of TTS in Welsh echoes the general scarcity of

technological resources in the language (Marshall, 2021). Although developments have enabled the use of TTS in Welsh (e.g., WordTalk, Claroread, TextHelp), there is limited research assessing its impact. International research shows that TTS reduces the need for decoding, leading to improvements in reading comprehension (Bonifacci et al., 2021; Elkind et al., 1993; Lopresti et al., 2004; MacArthur et al., 2001; Wood et al., 2018).

The Response-to-Intervention (RTI) framework offers a tiered approach to supporting learners (Lembke et al., 2010; Riley-Tillman et al., 2020) with evidence to support efficacy in improving attainment (Austin et al., 2017; Bengeny et al., 2017; Coyne et al., 2019). While research shows the benefits of early interventions (Bengeny et al., 2017; Al-Onizat, 2021), there is a lack of research on the use of RTI in Wales.

There is a positive correlation between reading enjoyment and attainment (Clark, 2014; McGeown et al., 2015). McGeown et al's research (2015) suggests that confidence and attitudes towards reading can decline with age. Studies on the use of the Welsh language online (Honeycutt and Cunliffe, 2010; Price and Tamburelli, 2016) suggest that the Welsh language is often associated with formal situations, raising questions about reading for pleasure in Welsh. Differences between boys' and girls' attitudes towards reading are also identified (Boerma et al., 2016). While research on enjoyment in digital learning environments exists (Spring-Keller, 2010; McLaren et al., 2017; Hou et al., 2021), there is no research available in the context of Welsh-medium education.

3. Methods

This section outlines the methodological framework of this case study. The ethical considerations, sampling procedure, and methods of data collection and analysis used to examine reading enjoyment of Year 6 pupils are detailed. The study was based in a Welsh-medium primary school in South Wales.

Ethics

Ethical approval (CSESPPGT-179) was obtained prior to the commencement of the study (BERA, 2024). Permission was obtained from the headteacher of the school to carry out the research and information leaflets and consent forms were sent to the parents/guardians of the pupils concerned. Information leaflets were distributed

among the pupils, and the aims and purpose of the study were explained to them orally. Participants were informed of their right to withdraw. Confidentiality and anonymity were ensured by giving the pupils false names and the study data was kept on the university's secure 'One Drive'. The researcher was also the class teacher.

Sampling Procedure and Description

The study used purposeful sampling of 10 Year 6 pupils (6 males, 4 females) identified as underachieving by their scores on the *All Wales Reading Test* (AWRT, 2020). They all came from monolingual English or bilingual backgrounds, with half (n=5) having one Welsh-speaking parent. Consideration was given to pupils' wellbeing, with supportive interventions and appropriate materials provided. The activities took place during singing sessions on Monday afternoons. Participants were encouraged to give an 'honest' opinion, and that there was no need to consider pleasing the teacher (Banegas and Villacañas de Castro, 2015). An overview of the participants can be seen in Table 1. The control group are the pupils who read with the teacher first while the treatment group are the pupils who received TTS first.

Participants agreed to take part in the intervention as a way of supporting their Welsh-language reading comprehension through a group intervention, with the

Table 1: Overview of the participants

Name	Group	Gender	Chronological Age (Before the intervention)	Reading Age (Raw Score)	Non-Verbal Score	Welsh-speaking parents
Anwen	Control	Girl	10.05	8.11 (22)	89	Neither
Lowri	Control	Girl	10.09	<7.11 (5)	86	Mother
Gethin	Control	Boy	10.10	<7.11 (6)	100	Father
Dafydd	Control	Boy	11.00	< 7.11 (2)	88	Neither
Elan	Control	Girl	11.04	9.05 (29)	82	Father
Bleddyn	Treatment	Boy	10.10	9.02 (25)	90	Neither
Llŷr	Treatment	Boy	10.08	8.11 (22)	92	Mother
Efa-Mai	Treatment	Girl	10.07	<7.11 (11)	92	Neither
Iwerydd	Treatment	Girl	10.08	8.05 (17)	110	Father
Jac	Treatment	Boy	10.11	8.08 (21)	97	Neither

teacher reading the text or by using the TTS (Read&Write) software on a computer. A simple model of reading (SVR) was considered with the researcher grouping the participants according to the model as modified by (Catts et al., 2006). Table 2 shows the researcher's view as a teacher of how he could group the participants according to the SVR model.

Table 2: Adaptation of 'Simple View of Reading' (SVR) (Gough and Tunmer, 1986)

Language Comprehension	Word Recognition: Poor	Word Recognition: Good
Good	Gethin (Control) B Elan (Control) B Dafydd (Control) E Efa-Mai (Treatment)	
Poor	Lowri (Control) Llŷr (Treatment) A	Anwen (Control) Jac (Treatment) Bleddyn (Treatment) Iwerydd (Treatment)

Table 2 confirms the need for a reading intervention in the Welsh language to support reading comprehension for the identified participants. However, this was solely the opinion of the teacher on the basis of internal assessments. All children in the study had already received an RTI intervention to support reading comprehension. Furthermore, four children had received a further assessment for dyslexia (GL Assessment) on a device which categorised them as follows:

Table 3: Descriptions of dyslexia (GL Assessment, 2022)

Letter Code	Description
A	No signs of dyslexia
B	Few signs of dyslexia
C	Mild dyslexia
D	Moderate dyslexia
E	Severe dyslexia

Data Collection and Analysis

Data was collected through mixed methods (Creswell and Clark, 2017). A quasi-experimental design was used with a treatment group (TTS, n=5) and a control group (teacher-led reading, n=5). Both interventions were administered to both groups over six consecutive weeks, with reading levels measured before and after the intervention. The treatment group completed tasks on Chromebooks with Read&Write (TTS) software for the six weeks. During the same period, the researcher read to the control group. The sessions were held in a quiet room. The class teacher worked with both groups. Reading levels were assessed using the reading comprehension series, 'Ditectif Geiriau' (Canolfan Peniarth, 2015) (paper and online formats). Total scores and answers data were collected during the sessions.

Online questionnaires were used to measure pupils' enjoyment and well-being when reading. A 5-point Likert scale and an illustrative analogue scale were used after each session (number of sessions=6) (see Appendix 1).

Qualitative data was analysed using the Braun and Clarke (2022) thematic analysis and quantitative data was analysed using descriptive statistics (mean, standard deviation) and percentage stacked bar charts (South et al., 2022). The groups were compared using independent and paired sample t-tests. The data was triangulated to ensure authenticity.

4. Findings and discussion

Analysing the qualitative data using the Braun and Clarke (2022) approach highlighted the following; attainment, enjoyment, and the correlation between them. Data is presented for each question, along with a critical evaluation referencing existing literature.

Attainment

The first question examined whether TTS was more effective in improving reading comprehension attainment in Welsh than traditional intervention. Quantitative data was compared before and after the test over a six-month period. Progress was

seen in the reading levels of all pupils in the group with some pupils in both groups showing an increase of six months or more in reading age (see table 4).

Table 4: Pre-test and post-test results of Welsh reading tests

Name	Group	Gender	Chronological Age (Before intervention)	Reading Age October 2022 (Raw score)	Chronological Age (post-intervention)	Summer 2023 Reading Age (Raw score)	Reading Age Difference (Autumn 2022 – Summer 2023)
Anwen	Control	Girl	10.05	8.11 (22)	10.11	9.02 (25)	+0.03
Lowri	Control	Girl	10.09	<7.11 (5)	11.03	8.08 (18)	+0.09
Gethin	Control	Boy	10.10	<7.11 (6)	11.04	8.08 (19)	+0.09
Dafydd	Control	Boy	11.00	<7.11 (2)	11.06	8.02 (15)	+0.03
Elan	Control	Girl	11.04	9.05 (29)	11.11	12.05 (44)	+3.00
Bleddyn	Treatment	Boy	10.10	9.02 (25)	11.04	10.05 (35)	+1.02
Llŷr	Treatment	Boy	10.08	8.11 (22)	11.01	8.08 (19)	-0.03
Efa-Mai	Treatment	Girl	10.07	<7.11 (11)	11.00	8.11 (22)	+1.00
Iwerydd	Treatment	Girl	10.05	8.05 (17)	10.11	8.08 (19)	+0.03
Jac	Treatment	Boy	10.11	8.08(21)	11.05	9.02 (24)	+0.06

Table 5 below sets out pupils' weekly attainment with the data suggesting a better response from pupils to the TTS intervention. Interrupted time series (ITS) data was used to mitigate threats to authenticity. Table 5 shows the percentage of pupils' correct answers to 'Ditectif Geiriau' questions over six weeks. There was no clear tendency to show that one intervention had more impact than the other on reading fluency.

The number of questions differed between the groups i.e. there were fewer questions for the children using the TTS software. Figure 1 showed similar results between the groups over time, with the treatment group performing better at weeks 2 and 6. This may be due to be due to the nature of the digital questions.

Data was collected over 12 weeks to allow both groups to test both interventions. Figure 2 shows the control group's improved performance when reading with the teacher in the first six weeks. Improved performance of the computer-based treatment group was seen early in the intervention and improvement in reading with the teacher later. The researcher identified an increase in the confidence of some pupils across both groups.

Table 5: Participants' attainment during the first six weeks of the intervention

Name	Group	Gender	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Anwen	Control	Girl	66.67%		66.67%	50.00%	70.00%	57.14%
Lowri	Control	Girl	91.67%	30.00%	83.33%	100.00%	50.00%	85.71%
Gethin	Control	Boy	83.33%	30.00%	66.67%	64.29%	60.00%	42.86%
Dafydd	Control	Boy	91.67%	30.00%	41.67%	42.86%	60.00%	71.43%
Elan	Control	Girl	91.67%	80.00%	91.67%	85.71%	100.00%	
Mean			**0.85**	**0.43**	**0.70**	**0.69**	**0.68**	**0.64**
Bleddyn	Treatment	Boy	87.50%	100.00%	100.00%	100.00%	66.67%	100.00%
Llŷr	Treatment	Boy	75.00%	66.67%		33.33%	100.00%	100.00%
Efa-Mai	Treatment	Girl	75.00%	66.67%	33.33%	66.67%	33.33%	33.33%
Iwerydd	Treatment	Girl	100.00%	100.00%	100.00%		66.67%	100.00%
Jac	Treatment	Boy			66.67%	66.67%	66.67%	
Mean			**0.84**	**0.83**	**0.75**	**0.67**	**0.67**	**0.83**

Figure 1: Attainment of both groups in the first six weeks

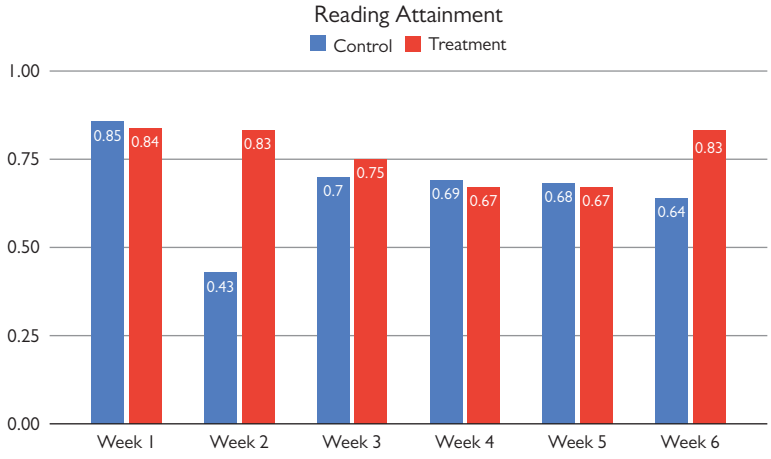


Figure 2: Attainment of the control group and treatment group with and without TTS (that is, solely reading with the teacher)

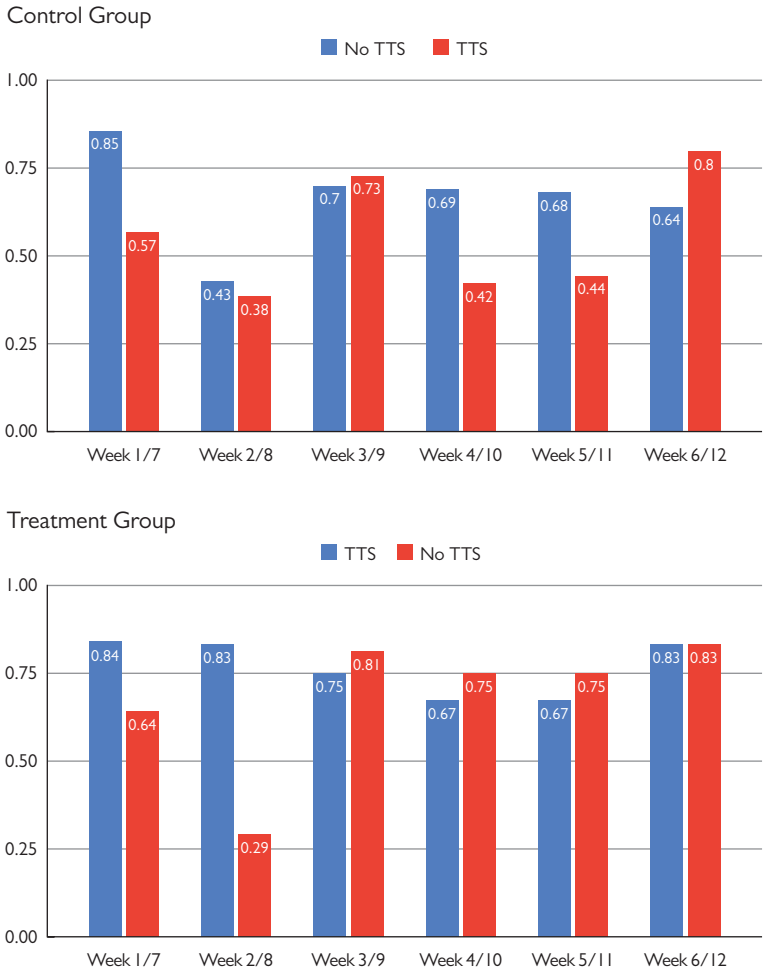


Figure 3: The difference in the mean scores of the two groups over the time of the interventions

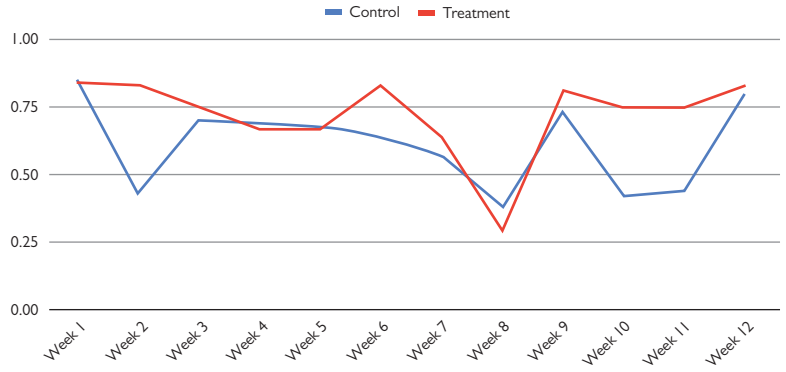


Figure 3 shows differences between the mean scores of the two groups over time, but a similar trend in some weeks. This may be explained by the Easter holidays where pupils did not practise their Welsh reading.

The two interventions were compared using related t-tests (table 6). The P-value for the control group was insignificant, but significant for the treatment group, suggesting a positive effect of TTS on the achievement of the treatment group, although the sample size was small.

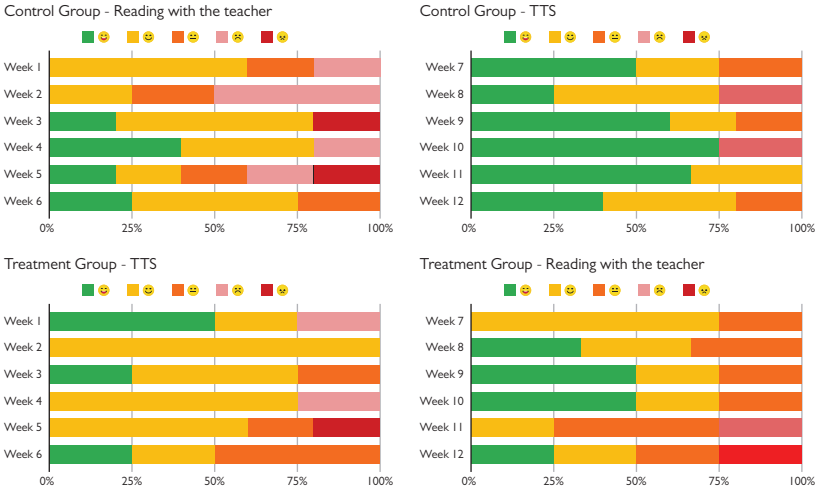
Table 6: Related t-test results

Group	Control		Treatment	
Type of intervention	TTS	No TTS	TTS	No TTS
Mean	0.5567	0.6650	0.7650	0.5567
GS	0.1749	0.1358	0.0804	0.1749
GSC	0.0714	0.0554	0.0328	0.0714
N	6	6	6	6

Enjoyment

Secondly, it was examined whether TTS supported the enjoyment of reading. Pupils answered a Likert-scale questionnaire after each session (figure 4). The data showed increased enjoyment over time in both groups, even when the type of intervention changed. Factors such as increased confidence and a better relationship with the researcher could have contributed to this. An interest in animal-themed texts affected the enjoyment of some pupils. The data did not provide clear evidence that TTS supported reading enjoyment, but suggested a change in enjoyment over time.

Figure 4: Participants' responses to the statement 'I enjoyed the task'



Reading habits were assessed at the beginning and end of the study. Pupils enjoyed reading in English more than in Welsh, with little change over time for the Welsh language. Attitudes to reading in English declined. Girls' and boys' enjoyment was compared, showing a higher level of enjoyment among boys, contrary to previous research (Boerma et al., 2016). Reading habits questionnaires showed differences between the two sexes. The finding that pupils prefer reading in English rather than in Welsh concurs with the findings of Estyn (2022).

Attainment and Enjoyment

The correlation between attainment and enjoyment was explored (figure 5). The data did not show a clear link between the two factors. Figure 6 shows that there was little difference in ease of following the tasks between the two interventions. The data suggests that TTS is not necessarily easier to follow than reading with the teacher. Further data is needed to understand the possible correlation.

Figure 5: A heat map showing enjoyment and attainment as a percentage

		Reading with the teacher						TTS						
	Group	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Key
Anwen	Control	66.67%		66.67%	50.00%	70.00%	57.14%	33.33%		66.67%	33.33%	66.67%	100.00%	
Lowri	Control	91.67%	30.00%	83.33%	100.00%	50.00%	85.71%	66.67%	50.00%	66.67%	33.33%	66.67%	100.00%	
Gethin	Control	83.33%	30.00%	66.67%	64.29%	60.00%	42.86%	66.67%	50.00%	66.67%	33.33%	0.00%	66.67%	
Dafydd	Control	91.67%	30.00%	41.67%	42.86%	60.00%	71.43%		37.50%	66.67%			33.33%	
Elan	Control	91.67%	80.00%	91.67%	85.71%	100.00%		100.00%	50.00%	100.00%	66.67%		100.00%	
		TTS						Reading with the teacher						
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	
Bleddyn	Treatment	87.50%	100.00%	100.00%	100.00%	66.67%	100.00%	92.86%		91.67%	80.00%	83.33%	100.00%	
Llŷr	Treatment	75.00%	66.67%		33.33%	100.00%	100.00%	78.57%	50.00%	83.33%	60.00%	50.00%		
Efa-Mai	Treatment	75.00%	66.67%	33.33%	66.67%	33.33%	33.33%		25.00%	58.33%	80.00%		83.33%	
Iwerydd	Treatment	100.00%	100.00%	100.00%		66.67%	100.00%	85.71%	12.50%	91.67%	80.00%	83.33%	83.33%	
Jac	Treatment			66.67%	66.67%	66.67%		64.29%				83.33%	66.67%	

Figure 6: A heat map showing enjoyment and perceived level of challenge

		Reading with the teacher						TTS						
	Group	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Key
Anwen	Control	3		5	3	4	4	4		4	5	5	5	
Lowri	Control	4	3	5	5	4	5	5	4	5	5	5	5	
Gethin	Control	5	3	5	3	3	4	5	5	5	5	5	5	
Dafydd	Control	5	4	4	2	2	4		3	3			4	
Elan	Control	4	3	3	5	4		4	4	3	2		3	
	Mean	4	3	4	4	3	4	5	4	4	4	5	4	
		TTS						Reading with the teacher						
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	
Bleddyn	Treatment	5	5	5	5	4	4	5		5	5	3	5	
Llŷr	Treatment	5	4		3	3	5	5	5	5	5	3		
Efa-Mai	Treatment	4	3	4	3	3	4		5	5	5		5	
Iwerydd	Treatment	3	4	5		3	5	3	3	3	5	5	5	
Jac	Treatment			4	5	5		5			2	3	5	
	Mean	4	4	5	4	3	5	5	4	5	5	4	5	

Discussion

The results of the study indicate improved performance in the treatment group when using TTS, but that the control group's performance improved when reading with the teacher. This finding is partly consistent with the literature suggesting that TTS is beneficial for learners with reading difficulties (Wood *et al*., 2018; Silvestri et al., 2021), but contradicts the finding of Silvestri et al. (2021) regarding the efficacy of TTS for dyslexia. The four pupils with dyslexia traits performed better with the teacher. Reading with the teacher could have contributed to better concentration.

The results suggest the potential for TTS to support some pupils, although others perform better with the teacher. The study aligns with claims about the benefits of assistive technologies for ALN learners (MacLachlan et al., 2018; Alsolami, 2022; Arslan-Ari and Başer, 2023). Schools need to plan carefully for the use of technology (EEF, 2023). The actual impact of TTS was difficult to measure as both groups received both interventions. History and maturity affect the validity of pre- and post-test data (Cohen et al., 2018; Meltzoff & Cooper, 2018).

The findings show inconsistent enjoyment when using TTS and reading with the teacher. Increased confidence could affect the need for TTS. A slight difference in enjoyment was found between girls and boys, contrary to previous research. Reading enjoyment in English was higher than in Welsh, in line with Estyn's findings (2022). This distinction is important for the sustainability of the Welsh language (Marshall, 2021; Price and Tamburelli, 2016).

There was no clear correlation between attainment and enjoyment, contrary to the work of Goergiou et al. (2018), but in line with Karl et al. (2011). The data suggests that enjoyment is not a prerequisite for success. Further research is needed to explore the relationship between the two languages.

The main aim of the study was to explore how TTS can support reading in Welsh, as additional learning provision. Higher levels of independence were seen by the end of the intervention. Early intervention with younger pupils may be more effective (Bengey et al., 2017). However, the limitations of the study must be acknowledged due to the small sample size and the lack of a formal SVR assessment.

5. Conclusion

This study examined the use of TTS in supporting Welsh reading, revealing its potential for some learners although attainment outcomes vary between TTS and teacher-led reading. Negative attitudes towards reading Welsh were seen compared to English. There was no clear correlation between enjoyment and attainment. The findings contribute new information about the effectiveness of TTS in a Welsh language context, raise important questions about attitudes to minority language reading and suggest pathways for future research and educational provision.

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Appendix 1: Participant Enjoyment Questionnaire