

C-Pen Exam Reader: a Critical Review of a Text-to-Speech Scan Pen for Secondary Pupils with Literacy Difficulties.

Introduction

The [C-Pen Exam Reader](#) is an OCR scan pen which utilises text-to-speech technology to read aloud a single word or line, is lightweight and portable, and can be fitted with headphones – it is widely available to buy [online](#) and costs between £190 and £230. In line with the [Digital Learning and Teaching Strategy for Scotland](#), this kind of technology fits well into an inclusive classroom – whether we consider the [Universal Design for Learning](#) (UDL) approach (Rose et al, 2005), inclusive pedagogy (Florian & Spratt, 2013) or the more widely used term of differentiation.¹ While there are conflicting viewpoints about what ‘inclusive education’ truly means in policy and practice (Allan, 2008), it is not the scope of this study to discuss its merits or pitfalls. Rather, this study takes a face-value interpretation of inclusion as a school in which staff “remove the exclusionary barriers” (Allan, 2008) for learners with ASN – classrooms and exam provision where all pupils have the necessary resources to access the curriculum and display their knowledge in an equitable manner.

A limited number of previous studies have been conducted, though these were using the full capacity of the scan pen which contains a dictionary facility and this study is concerned only with the Exam Reader version. The findings of the American study (Schmitt et al, 2012) were mixed in terms of the Pen’s usefulness. The British C-Pen website features several [case studies](#), but with the exception of one (Mortimore 2018), the studies lack the authenticity and transparency of neutral research². One case study is available for the [Exam Pen](#) specifically, which found that there was a demonstrable benefit for some pupils in their comprehension. However, because this study can only be found on the manufacturer’s website, there is clearly a risk that only a favourable trial has been published – and the results have not been replicated. Additionally, there is a fundamental confusion in this paper between dyslexia and visual processing difficulties, claiming that the dyslexic students’ “problem is created by their inability to read the jumping, moving, incomprehensible formation of shapes that are commonly known as words.” (Garner, 2016)⁹ Visual difficulties are found in some dyslexic people, but not all, and not all people with visual processing issues are dyslexic (Gilchrist et al, 2018).

Additional voices (for example, the Scottish voices) can’t be added – but the C-Pen’s claim to be [“naturally speaking”](#) depends on the user’s accent as well as the sophistication of the

¹ According to Florian and Spratt (2013), “inclusive pedagogy demands that class teachers take responsibility for all learners, including those who are experiencing difficulties. Class teachers are encouraged to view difficulties in learning as dilemmas for themselves as teachers (rather than deficits in children) and to seek new approaches to support children.” This technology certainly counts as a new approach.

² There is no evaluation of the Pen’s accuracy and reliability; no measurable impact is evident – for example, through comparative test results; no University affiliation is cited; one study discloses that it was commissioned by Scanning Pens Ltd (Franklin, 2018); and the same researcher authors / co-authors almost every study (5 of 6).

technology, and there are clearly vast differences in dialect throughout the British isles which could impact on understanding for pupils less used to received pronunciation English. (Similarly, the American studies would have evaluated American text-to-speech synthesis so the studies may not be comparable to ones conducted here.)

A small case study was used in order to test whether the technology works in exam scenarios for pupils with literacy difficulties in my Scottish school, to establish whether it was accurate, would assist reading speed, and whether it would make any significant difference to their assessed Reading Quotient (RQ). As Head of Support for Learning, I wanted to evaluate potential technology for Assessment Arrangements (AAs) which would be practical (a limited number of laptops, human readers and separate accommodation causes logistical problems in each exam diet) and which is discreet enough to avoid potential stigma.

Method

Participants

The participants of this study were all boys: one from S1 and two from S2. The S1 pupil, Robert, and one S2 pupil, Duncan, are dyslexic. The other S2 pupil, Alan³, has Developmental Language Disorder (DLD) which affects his decoding and comprehension of written text.

Materials

The boys used the GL New Group Reading Test (NGRT) assessment 3A, which tests vocabulary (through a sentence completion exercise) and comprehension, by means of a standardised, normed assessment. GL Assessments could not confirm the exact font and size of the text, but I judge this to be Verdana size 14. The line spacing looks to be set at 1.5 and the text is well-spaced on each page. (Appendix 3)

Design

I used a SETT template to establish pupils who would be suitable participants for this study (appendix 1). A comparison of raw and standardised scores provided quantitative data. I observed the pupils using the Exam Reader, interviewed them about their experience afterwards, and used an online [questionnaire](#) to collate qualitative data.

Procedure

All three boys had, within the previous month, sat the NGRT assessment 3B as part of the school's annual literacy screening programme. I used paper 3A – an alternative one at the same level – for the Exam Reader test in order to compare time taken to complete it, and end results. A new paper was used because even though the boys had not received any feedback or corrections on the first paper, it eliminated the chance that their first reading of

³ All pupil names have been changed to protect identities.

the paper would give them any advantage, affecting the independent variable. They were shown how to use the C-Pen, and had a trial run before this assessment.

Discussion

The pupils were all keen to use the C-Pen, and thought it was a very impressive innovation to begin with. They all learned how to use it very quickly – it was straightforward and simple to use.

Alan used the pen for almost every question to begin with, but became less keen as time went on, due to inaccurate readings (for instance, “calf” became “caif”; “me” became “m”). In the first section of the paper, he scanned one question three times, and each time it was wrong. By the second half of the paper, he abandoned it altogether. The results are shown below:

Alan	NGRT 3B (No C-Pen)	NGRT 3A (With C-Pen)
Time taken	50 minutes	50 minutes
Sentence completion score	11	16
Passage comprehension score	17	17
Raw score	28	33
RQ Standardised score	87	92

Alan used the pen most in the sentence completion task – the one where an improvement in score is evident. By the second of the four reading passages, he had stopped using it, so it is not possible to conclude if the C-Pen would have aided any increase in comprehension for this task. Given that he stopped using it, the time measurement is also not a reliable gauge of the pen’s efficacy; indeed, it appeared to slow him down in the first half when he had to repeatedly scan sentences. Alan felt it helped him to work more quickly, but there was no discernible time difference in the two tests.

Please rate how much you liked or disliked the features of the C-Pen.

Size - comfortable to hold and use? Excellent

Volume - was the range good enough? Good

Reliability - did it work every time? OK

Accuracy - did it read the text perfectly? Poor

How much text could be read in one scan - enough? Too little? OK

Discretion - could you use this subtly, without feeling "different" or self-conscious? Good

Figure 1: Alan’s feedback

Duncan did not like the pen at all, rating only two of its features positively – volume and discretion. (Figure 2.) He was clear that he would not use this in a real exam, due to its inaccuracy and unreliability.

Please rate how much you liked or disliked the features of the C-Pen.

Size - comfortable to hold and use?	Poor
Volume - was the range good enough?	Excellent
Reliability - did it work every time?	Poor
Accuracy - did it read the text perfectly?	Very poor
How much text could be read in one scan - enough? Too little?	Poor
Discretion - could you use this subtly, without feeling "different" or self-conscious?	OK

Figure 2: Duncan's feedback

Duncan's results are as below:

Duncan	NGRT 3B (No C-Pen)	NGRT 3A (With C-Pen)
Time taken	30 minutes	30 minutes
Sentence completion score	16	16
Passage comprehension score	19	25
Raw score	35	41
RQ Standardised score	97	105

There is an observable improvement in Duncan's comprehension score, which can possibly be attributed to the use of the C-Pen – but it is not possible to conclude this definitively, since it is also possible that, while the test paper is of the same normed level as the first one, he found these passages easier to understand. It is also unlikely that someone who disliked the pen so much would use it in the future to aid comprehension, even if the improvement was proven to be causation rather than correlation: he would need to find that its reliability improved with familiarity and/or new technological advances.

We have recently begun using a reader with Robert in class tests due to his severe dyslexia – this has been shown to have a demonstrable impact on his understanding. For example, he re-took paper 3B with a reader, and the difference is noted here:

Robert	NGRT 3B (No C-Pen or Reader)	NGRT 3B (With Reader)
Time taken	60 minutes	50 minutes
Sentence completion score	10	14
Passage comprehension score	11	26
Raw score	21	40
RQ Standardised score	82	109

While it is important to note that the above comparison is using the paper 3B in both instances, whereas the C-Pen trial is with 3A, the very significant difference from a below average RQ to a high average one is unlikely to be due simply to a previous familiarity with the test. It appears to be clear that Robert benefits hugely from having text read aloud to him.

It is therefore interesting to examine the results of the C-Pen test alongside both previous assessments:

Robert	NGRT 3B (No C-Pen)	NGRT 3B (With Reader)	NGRT 3A (With C-Pen)
Time taken	60 minutes	50 minutes	80 minutes
Sentence completion score	10	14	14
Passage comprehension score	11	26	13
Raw score	21	40	27
RQ Standardised score	82	109	88

His score was an improvement with the Pen in both sentence completion and comprehension, but it was not as significant as the jump achieved when using a human reader. Robert found the Pen “bulky” and explained that “it’s tiring to keep switching pens all the time.” Initially, he said that he was “moving along quicker than if [he] was on [his] own”, but several inaccurate readings (“Ben” became “den”; “arms” became “lnrlc”); “to” became “X”; “example” became “exampie”; “plot” became “piu”) made him re-scan and eventually hesitate because he didn’t trust the Pen to read aloud accurately. This slowed him down so significantly that he did not finish the test in one lesson, as expected, but had to complete it in another period. He much preferred having a person read, because “a reader would be much more fluent. In an exam you’re against time.” 15

Robert’s experience highlights a crucial catch-22 many pupils would experience with this technology. He needs text-to-speech (or a reader) to assist with decoding, and therefore comprehension, but also needs to have enough confidence in his own vocabulary to know if it sounds right or not. The mistakes cited above were obvious enough that he could spot them, but as the text became more complex, Robert began to encounter unfamiliar words. He checked with me whether those words had been pronounced correctly (they had in 4 out of 5 instances), but this defeats the point of text-to-speech technology. Given that “previous text-to-speech literature suggests that those with the greatest reading disability may benefit the most from text-to-speech assistive technology” (Schmitt et al, 2012), the unreliability of the Exam Reader Pen’s performance means that the very pupils who depend on this technology to be accurate may lose faith, as Robert did, that anything it says is actually correct.¹⁷ “I’m not sure if it’s saying it wrong because I don’t know it and it was wrong before.” 16

All three boys found the pronunciation awkward / unclear at times (for example, “juror” was pronounced with emphasis on the second syllable). The letter “i” frequently mis-scanned as an “i”, turning words such as “carefully” into “carefuily” – with a correspondingly inaccurate pronunciation. It didn’t always pause for enough time at a full stop, which is an error many dyslexic pupils make: it is unhelpful to have the reading support make a similar infraction as this can also impede understanding. Clearly, the Pen works best for a single word or line, but when looking for a comprehension aid, pupils tend to need more text read in one go – otherwise the fractured reading style offers insufficient support. Similarly, Schmitt et al (2012) found that the Pen decreased comprehension and extended the time taken.

Please rate how much you liked or disliked the features of the C-Pen.

Size - comfortable to hold and use?	OK
Volume - was the range good enough?	OK
Reliability - did it work every time?	Very poor
Accuracy - did it read the text perfectly?	Very poor
How much text could be read in one scan - enough? Too little?	Very poor
Discretion - could you use this subtly, without feeling "different" or self-conscious?	OK
Space to explain any answer further::	was not very claeer and not acuerit at all

Figure 3: Robert’s feedback

The inconsistent accuracy, reliability and pronunciation echo findings from Bath Spa University (Mortimore 2018) where pupils seemed underwhelmed at first, although more of them warmed to the technology later; although this study evaluated the full Reader Pen with a dictionary function, the problems noted were similar to the ones encountered in this study. It is possible that with time and practice, the young people in this study may also grow to like the Pen more; the limited time they had to use it may have influenced its reliability.

This study was limited to a small sample size, one gender and a narrow age range (12 – 13). A larger sample size with a more diverse group of learners would be preferable for future studies. Further research should focus on experimenting with accuracy when reading various font types and sizes, colour of paper, and effectiveness within different subject areas (previous practice with a pupil outwith this study highlighted serious flaws when reading Maths and Chemistry papers). Technology continues to develop at a rapid pace; as synthesised voices and scanner technology improve, it is reasonable to hypothesise that later results may be more favourable than, and not comparable with, the findings from the current resources utilised in this study.

Conclusion

The concept of this scan pen is excellent, because decoding words is a known barrier to comprehension, and while text-to-speech technology can be a helpful intervention for readers who struggle with decoding and fluency (Wood et al, 2018; Parr, 2013), accessing a computer in class or exams is not always possible or desirable. The Pen fits with a UDL / inclusive school since pupils could use this relatively discreetly in the classroom, and be in the main exam hall with the full cohort, rather than in separate accommodation.

However, as with most grand claims, the devil is in the detail – the Pen helps readers to decode words as long as (1) the technology is sophisticated enough to scan with sufficient accuracy, (2) it pronounces the word correctly / in an accent which is familiar and comprehensible, and (3) the reader has enough trust in the device to accept what he/she hears. Added to this, of course, the user must have sufficient awareness of the word's meaning, or be able to work it out from context, in order for the pen to assist with comprehension. This variable cannot be accounted for by the makers of this technology but they should be wary of the nuance of such claims.

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Time considerations are also important – if the pen does not work accurately enough, it will not speed up the user's reading rate, due to having to re-scan and the additional doubt that the user faces in trusting whether it is correct on this occasion: the last worry that a pupil with literacy difficulties needs is to have an added layer of confusion. For schools to provide this technology, or recommend that parents spend a significant amount of money on it, it must be a more reliable version than what is currently available with the C-Pen Exam Reader. If we are truly going to get it right for every child, we must be confident in getting the technology right too.

Appendix 1: SETT Plan

Student	Environment	Tasks
<p>Alan</p> <ul style="list-style-type: none"> • S2 • Developmental Language Disorder • Decoding and comprehension difficulties • Receptive speech / processing difficulties • Reading Quotient 87 • Likes IT 	<p>Currently uses reader for some tests – experimenting with best AA supports. Usually needs extra time. Likes the independence of IT but also enjoys having a reader for the decoding support.</p> <p>RQ determined without any IT or human support.</p>	<p>Independent reading: decoding & comprehension across the curriculum / in tests.</p>
<p>Duncan</p> <ul style="list-style-type: none"> • S2 • Dyslexic • Decoding and comprehension difficulties • Likes IT • Reading Quotient 97 	<p>Manages independently in classes at present – no IT or reader support.</p> <p>RQ determined without any IT or human support.</p>	<p>Independent reading: decoding & comprehension across the curriculum / in tests.</p>
<p>Robert</p> <ul style="list-style-type: none"> • S1 • Severely dyslexic • Phonological, decoding and comprehension difficulties • Likes IT • Reading Quotient 82 (without reader), 109 (with reader) 	<p>Currently uses reader for most tests – experimenting with best AA supports. Usually needs extra time and responds well to IT. Enjoys having a reader so he can trust what he reads and for the decoding help.</p>	<p>Independent reading: decoding & comprehension across the curriculum / in tests.</p>

Appendix 2: Pupil Questionnaire Results – Summary

	Very	a little	not at all
How enjoyable was the C-Pen to use?	1	1	1

Please rate how much you liked or disliked the features of the C-Pen.	Excellent	good	OK	poor	very poor
Size – comfortable to hold and use?	1		1	1	
Volume – was the range good enough?	1	1	1		
Reliability – did it work every time?			1	1	1
Accuracy – did it read the text perfectly?				1	2
How much text could be read in one scan – enough? Too little?			1	1	1
Discretion – could you use this subtly, without feeling "different" or self-conscious?		1	2		

	Yes	No	Not Sure
Did the pen help you to understand the text?	1	1	1
Do you think you would use the C-Pen in a real exam?	1	2	
Do you feel that using the C-Pen made you work more quickly than when you read by yourself?	1	1	1

Appendix 3: Sample NGRT Page

Each of the passages in this test has a set of questions. For some of these questions you will need to find the best word to fill the gap; for each gap you have a choice of five words. Shade in the box beside the word you think best fits each gap. **Do not** write in the gap.

The rest of the questions relate to details/information in the passage. For each of these questions there is a choice of five answers; you need to shade in the box beside the answer you have chosen.

The passage and questions on these pages have been done as an example. Turn over and start the test when you understand what to do.

Charlotte and Emma were sisters. One day they went to see **A** aunt Susan. The girls were very interested in their aunt's sun-room. It had two chairs made out of bamboo.

The chairs were covered with brightly coloured **B**. By the west window there was a little cart filled with violets in pots. In front of the south window were a little yellow elephant and a monkey made out of wood. A wooden tray rested on the **C** of the elephant. On this tray was a wide variety of spiky cactus plants. Beside the other window to the east was a rubber tree.

The heat of the sun would have been overpowering on cloudless days so slatted blinds had been fitted to provide some shade.

In the centre of the sun-room was arranged a pleasantly cool-sounding fountain in a miniature pool which had its own small pebbles looking like large rocks.

- A**
- his
 - her
 - their
 - them
 - both

- B**
- plants
 - pots
 - carpets
 - cushions
 - wheels

- C**
- back
 - floor
 - legs
 - feet
 - hide

References

Allan, J. *Inclusion For All?* In: Bryce T.G.K., Humes, W.M. (ed.). *Scottish Education : Beyond Devolution*. Edinburgh: Edinburgh University Press, pp. 701-710.
(<http://www.euppublishing.com/book/9780748625932>)

Anthony, T., Franklin, C., Latham, A., & Mills, G. (2018). *Year 2: Continuation Of The Study Of A 9-Year-Old Child With Dyslexic Tendencies – The C-Pen Readerpen For Every Day Classroom-Based Work: Assistive Technology And Dyslexic Primary Aged Children*.
(<http://www.readerpen.com/#academic-research-section>)

Rose, D. H., Hasselbring, R. S., Stahl, S., & Zabala, J. (2005). Assistive Technology and Universal Design for Learning: Two Sides of the Same Coin. In D. L. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of Special Education Technology Research and Practice* (pp. 507–518). Knowledge By Design, Inc.
(www.researchgate.net/publication/265116505_Assistive_Technology_and_Universal_Design_for_Learning_Two_Sides_of_the_Same_Coin_Two_Roles_for_Technology_Assistive_Technology_and_Universal_Design_for_Learning)

Education Scotland. (2018). *Route Map through Career Long Professional Learning (CLPL) for Dyslexia and Inclusive Practice*
(<https://education.gov.scot/improvement/documents/inc36routemap.pdf>)

Enable (2017). #IncludED in the Main?! 22 steps on the journey to inclusion for every pupil who has a learning disability. Enable Scotland. <https://www.enable.org.uk/wp-content/uploads/2017/08/IncludED-in-the-Main-22-Steps-on-the-Journey-to-Inclusion.pdf>

Florian, L. & Spratt, J. (2013) *Enacting Inclusion: A Framework For Interrogating Inclusive Practice*. *European Journal of Special Needs Education*, 28:2, pp119-135.
(<https://doi.org/10.1080/08856257.2013.778111>)

Florian, L and Black-Hawkins, K. (2011) *Exploring Inclusive Pedagogy*. *British Educational Research Journal* Vol.37, No.5, pp813 – 828.

Florian, L. (2008). *Special Or Inclusive Education: Future Trends*. *British Journal of Special Education*, Volume 35, pp202 – 208

Research Assignment for Inclusive Digital Technology course EDUA11399
Moray House School of Education, University of Edinburgh.

Franklin, C. (2017). *Study Of Mature Students With Identified Disabilities And The Use Of Supportive Technology*. (<http://www.readerpen.com/#academic-research-section>)

Franklin, C. (2019). *Functional Skills Within Prisons – C-Pen Examreader And Readerpen Supporting Functional Skills In English, Levels 1-3*. (<http://www.readerpen.com/#academic-research-section>)

Franklin, C. (2018). *Study – Prison C Transcript Of In-Mate Interviews – Use Of The Readerpen At Pre-Functional Level – English*. (<http://www.readerpen.com/#academic-research-section>)

Franklin, C; Latham, A; Mills, G. (2017). *Study Of An 8-Year-Old Child With Dyslexic Tendencies And The C-Pen Reader For Every Day Classroom Based Work Assistive Technology And Dyslexic Primary Aged Children*. (<http://www.readerpen.com/#academic-research-section>)

Garner Education Services. (2016). *The C Pen Exam Reader – A quantitative and qualitative Study*.
(<https://static1.squarespace.com/static/564210b6e4b047c0f3f9b0c0/t/5719fd78ab48de0f879e97a5/1461321083975/SP+English+GCSE+Report%5B5%5D.pdf>)

Gilchrist, J., Holden, C. and Warren, J. (2018) *Specific Learning Difficulties (SpLDs) and Visual Difficulties: A Guide for Assessors and SpLD Practitioners*. SASC Working Group.
(http://www.sasc.org.uk/SASCDocuments/Visual_Difficulties_guidance_for_SpLD_practitioners_Final_June2018.pdf)

Mortimore, T. (2018) *The Impact Of Using A Readerpen On Year 10 Learners In A Multicultural Urban School*. Bath Spa University. (<http://www.readerpen.com/#academic-research-section>)

Parr, M. (2013) *Text-to-Speech Technology as Inclusive Reading Practice: Changing Perspectives, Overcoming Barriers*. LEARNing Landscapes Vol. 6, No. 2, pp303 – 322.

Scottish Government. (2016). *Enhancing Learning And Teaching Through The Use Of Digital Technology* (<https://www.gov.scot/publications/enhancing-learning-teaching-through-use-digital-technology/pages/2/>)

Research Assignment for Inclusive Digital Technology course EDUA11399
Moray House School of Education, University of Edinburgh.

Schmitt, A, McCallum E, Hennessey J, Lovelace T, & Hawkins R. (2012). *Use of Reading Pen Assistive Technology to Accommodate Post-Secondary Students with Reading Disabilities*. *Assistive Technology* 24:4, pp229-239. (<https://doi.org/10.1080/10400435.2012.659956>)

Wood, S; Moxley, J; Tighe, E; Wagner, R. (2018) *Does Use of Text-to-Speech and Related Read-Aloud Tools Improve Reading Comprehension for Students With Reading Disabilities? A Meta-Analysis*. *Journal of Learning Disabilities*, Vol. 51(1) pp73 – 84.

Zabala, J. (2005) *Using the SETT Framework to Level the Learning Field for Students with Disabilities* (https://www.learn.ed.ac.uk/bbcswebdav/pid-2954013-dt-content-rid-6125094_1/courses/zp_Inclusive_Digital_Technology_playground/zabala_sett_leveling_the_learning_field.pdf)