Closing the gap: supporting literacy through a computer-assisted-reading-intervention

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Schools in England are expected to 'close the gap' for a range of vulnerable pupils who are achieving below the levels seen amongst their same-aged peers. They are also highly accountable for additional funding that is provided to support this goal. The project reported here involved collating and analysing a range of data in order to evaluate the impact of a widely used computer-assisted-reading-intervention (CARI). Sixteen primary school pupils, all of whom were identified by their school as underachieving in literacy, used the CARI daily over a five-week period. The post-intervention data showed some clear gains in reading and spelling skills for all bar one of the children. The findings are discussed in relation to the wider literatures on CARIs. The research concludes that the CARI under investigation offers a useful and cost-effective adjunct to whole-class and group reading instruction and may be particularly beneficial for supporting the learning of pupils who are struggling to consolidate the knowledge and skills covered in their regular classroom reading instruction.

***Key words*: computer-assisted-reading-intervention (CARI), curriculum access, literacy support, Nessy Reading and Spelling.**

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Introduction

Schools in England are now required to close the achievement gap by promoting better learning outcomes for vulnerable children and young people. Since 2011, funding in the form of the Pupil Premium Grant (PPG) has been available to support this endeavour (DfE, 2018). This has provided schools with an opportunity to implement a range of interventions for supporting vulnerable pupils, both within and in addition to mainstream provision. Schools are accountable for these funds and are required to publish on their websites how the grant is being spent and to provide 'evidence of impact' (Foster and Long, 2018). This implies the need for some form of evaluative research. The project arose from a university initiative to establish collaborative research partnerships with schools and to support their self-evaluation processes. Phase 1 of the project aimed to establish the immediate impact of using the CARI on children's literacy skills. Phase 2 focused on process and aimed to enable the school to reflect on and develop best practice. This article presents the findings of phase 1. In doing so, it helps address the lack of evaluative information on a specific CARI in peer-reviewed literature and illustrates how one school approached documenting evidence of impact.

CARIs and learning

Educational software programmes claim to support the learning process. Indeed, there is a thriving commercial industry keen to offer a growing range of applications and equipment to educational institutions. Commentators have noted the increased use of educational technology in schools over the last decade but caution that not enough is known about their effectiveness (Archer *et al*., 2014; Grant *et al*., 2012; Royle and Colfer 2010).

Computer-assisted-reading-interventions feature prominently in the broader field of educational technology yet the evidence-base for their effectiveness appears to be mixed. In two of the most extensive reviews of the impact of educational technology on reading outcomes for struggling readers, the authors argue that the methodological weaknesses of some studies and the small-scale nature of others make definitive conclusions about the merits and efficacy of CARIs difficult (Slavin *et al*., 2011; Cheung and Slavin, 2013). Their overall findings were that technological applications produce small but positive effects.

More recent research however provides more encouraging and robust evidence for the value of CARIs for supporting learning. These studies address some of

the methodological weaknesses of earlier studies and would therefore have met the criteria for inclusion in reviews such as those conducted earlier by Slavin *et al*. (2011) and Cheung and Slavin (2013). The CARI used by Messer and Nash (2018) in their London research provided opportunities for 78 children with reading delays to develop their phonological awareness and decoding skills. Their randomised controlled trial found the CARI to be effective in these areas and children also showed improvements in spelling. Similarly, in the US, Schneider *et al*. (2016) found their web-based intervention to be successful in supporting the reading fluency and spelling skills of the 170 Grade 2 pupils (7 year olds) in their controlled quasi-experimental study.

CARIs appear to be versatile and have been found to benefit a range of learners. These include: pupils with hearing impairments (Von Mentzer *et al*., 2014); pupils with moderate learning difficulties (Tyler *et al*., 2015); and pupils with special educational needs (Van de Ven *et al*., 2017). They have also been found to be effective across different languages. Kyle *et al*. (2013) aimed to establish whether two Finnish CARIs would be equally effective when translated and used with English-speaking children. They found that both CARIs produced significant gains in single-word reading and spelling in comparison with the control group. This is particularly promising, given that the opaque nature of English poses additional challenges to struggling readers in comparison to transparent languages such as Finnish, where the relationship between the phoneme and grapheme (sound and symbol) are consistent.

Different CARIs have different purposes, characteristics and foci, or are designed for different pupil populations. This makes it difficult for schools to assess the relative merits of a specific programme prior to purchase. There are currently no peer-reviewed evaluations of Nessy Reading and Spelling (henceforth referred to as Nessy) and it has not featured in reviews such as those conducted by Cheung and Slavin (2013) and Slavin *et al*. (2011). The Nessy website (Bristol Dyslexia Centre, 2018) claims efficacy for its programmes and points to supporting research. However, with few details about that research publically available, it is difficult to evaluate the basis of their claims. In their conference presentation, Tan and Chua (2012) reported using Nessy alongside Wordshark (a similar CARI) to support the learning of four 9-11 year-old pupils in Singapore who had dyslexia and ADHD. Their data showed no improvement in reading and only a slight improvement in spelling. However, there was a noticeable improvement in pupils' attentiveness and engagement, which the presenters viewed as a positive outcome and attributed to the motivational aspects of CARIs. These somewhat

discouraging results might be partially accounted for by the specific learning difficulties experienced by their participants, the small sample size, and by the fact that Nessy was delivered only once or twice a week. Research suggests that reading interventions tend to be more effective when delivered 'little and often' (Brooks, 2013), and indeed, the Nessy website (*ibid*) recommends 20 minutes daily for children whose poor literacy skills require 'intensive instruction'.

The CARIs used by Kyle *et al*. (2013) share many of the same characteristics as Nessy and were delivered in a similar manner to the intervention reported in this article, and with children of a similar age who had also been identified as under-achieving in literacy. Their positive results are encouraging for users of Nessy.

The current study aimed to investigate the extent to which Nessy supported the reading and spelling skills of a group of children who had been identified as underachieving in literacy. The main purpose was to ascertain evidence of impact of an intervention that was funded by the Pupil Premium Grant. In doing so, it helps to redress the lack of independent evaluative research on this specific CARI. The research also aimed to incorporate children's perspectives, which are largely absent in the research on CARIs. The findings are discussed in relation to the wider literatures on CARIs.

The research

The intervention

Nessy Reading and Spelling (Bristol Dyslexia Centre, 2018) is one of a number of commercially available CARIs that are used in schools not only in the UK but also in other English-speaking countries around the world. It offers a structured multi-sensory phonics-based programme comprised of interactive games, activities and worksheets that aim to promote the development of a range of reading and spelling skills. The programme targets elements of reading and spelling such as phonological awareness, letter-sound knowledge, letter and word recognition, vowel and consonant blending, word segmentation, and the ability to manipulate prefixes and suffixes. It is typically aimed at struggling readers and writers and has been designed primarily for pupils aged six to ten but can be used flexibly with a range of ages. The programme is comprised of ten progressively harder levels (referred to as 'Islands'). Although not designed specifically to support

progression through the National Curriculum levels in England, the teaching and learning sequences align closely with these.

The school's decision to purchase Nessy had been made the previous school year and was based on a recommendation by a staff member who had used it in a previous school. The decision was also influenced by the option of purchasing just a small number of licences, thus enabling the school to test out the programme without having to make a larger investment. There was no contact with, or sponsorship from, the publishers of Nessy.

Setting and participants

The research represents a small-scale evaluative study (Kemmis and McTaggart, 2005). It took place in a primary school in the outskirts of a medium-sized town in the English Midlands. There were approximately 250 pupils on the roll. The surrounding area was mixed in terms of the economic resources available to families and included pockets of high social deprivation. Eight percent of pupils were on the SEND (special educational needs and disability) register, eight percent received free school meals, and ten percent were eligible for the PPG.

The research was planned as part of the school's on-going self-evaluation process. The involvement of a university staff member meant that it was also conducted in accordance with the British Educational Research Association ethical guidelines (BERA, 2018) and was cleared by the ethics committee of the associated university. Written informed consent was gained for those involved in the research including parental consent for the children involved and for their anonymised data to be reported. Two copies of a letter explaining the nature, duration and purpose of the intervention and evaluation were either sent home with children or passed on directly to a parent or carer by a staff member. Parents/carers were asked to sign and return one copy to indicate consent for their children's involvement. Once parent/carer consent had been gained, the research was explained to the children and their verbal assent sought. Care was taken to emphasise the voluntary nature of their involvement and also that they could stop any time if they changed their mind.

Phase 1 of the research, and the focus on this article, involved analysing pre and post-intervention data for all 16 pupils who engaged with Nessy over the autumn and winter terms of 2014/15. Nine pupils were on the SEND register and four

Table 1. Year group of pupils who took part in the evaluation

Year Group	*Number of Pupils*
Year 2	3
Year 3	4
Year 4	4
Year 5	3
Year 6	2
Total number of pupils	16

were entitled to free school meals. The pupils were drawn from Year 2 to Year 6 classes (ages 6 to 10). The distribution across year groups is shown in Table 1.

The research process

The children engaged with Nessy in a one-to-one withdrawal situation supervised by a teaching assistant (TA). Sessions lasted between 20 and 25 minutes and took place five times a week over five consecutive weeks. This relatively short period was chosen as a way of delivering the intervention to a larger number of pupils within the resources available – namely, the number of Nessy licences that the school had purchased and the availability of TAs. Using the programme daily was a way of providing a more concentrated experience within the chosen time-frame and accords with the Nessy website recommendations for 'intensive instruction'. The intervention was delivered 'in addition to' and not 'instead of' the class literacy sessions. Children accessed the intervention through referrals from their class teacher. Standard Achievement Test (SATs) results, as well as teacher observations and work samples were used to identify pupils who were underachieving in literacy. The aim of the intervention was to close the gap between a pupil's current achievement levels in literacy and those expected of pupils that age. The research questions were:

- To what extent does Nessy support the reading and spelling skills of pupils identified as underachieving in literacy?
- What are pupil perceptions of Nessy

In order to determine improvements in reading and spelling over the course of the intervention, three pre and post-intervention measures were taken for each pupil. These were:

- Schonell reading test scores
- Schonell spelling test scores (administered only to Year 3, 4, 5 & 6 pupils)
- Assessment built into Nessy (Nessy levels – 'Islands')

The Schonell tests are standardised assessment instruments that provide a reading age and a spelling age in years and months. Although somewhat dated now, they have been widely used across the English-speaking world and are still considered useful for providing an estimate of a child's reading and spelling level (Turner, 1997). They exist in parallel forms (two different versions of the same test) thus making them particularly useful for a test-re-test situation.

The introductory assessment built into Nessy measures a pupil's attainment across a range of phonic-based skills; and the results determine their starting level ('Island'). The programme is comprised of ten progressively harder 'Islands'. A child must achieve at least 80 percent mastery of a level before graduating to the next. Movement from easier to harder levels indicates progress over time.

Pupils' views of Nessy

In-line with recognition of the value of listening to children (Clark and Moss, 2011) school staff thought that pupil views of Nessy would add an important dimension to the research. In particular, they were interested to learn about the extent to which pupils enjoyed 'going out for Nessy', the extent to which they thought it helped them with their learning, and the extent to which it helped them do better work in class. To gather this information, two Year 6 pupils, a boy and a girl, were trained to interview Nessy users on their views about the intervention. This accorded with the view that children are not only reliable informants on their own experiences, but are also competent to be actively involved in the research process (Kellett, 2005). This aligned well with other school practices whereby pupils are provided with opportunities to take on roles and responsibilities outside their immediate classroom context. It also helped reduce the possibility that pupils would give the answers they thought adults wanted to hear. Interviews took place in the same private space used for Nessy sessions. Three key questions focusing on enjoyment, learning and improved work in class were asked, with some follow-up prompts where appropriate. A visual support, exemplified in Figure 1, was used to help with these. Interviews lasted between five and eight minutes in duration and were video-recorded by one of the Year 6 pupils while the other asked the questions. Roles alternated with each interview. Recordings

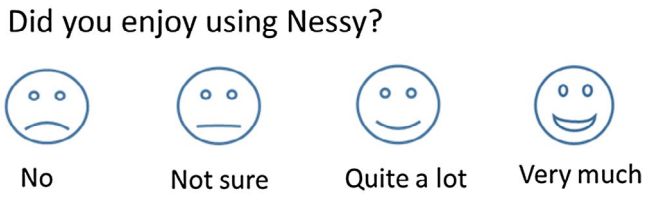

Figure 1. Visual support [Colour figure can be viewed at wileyonlinelibrary.com]

were subsequently reviewed by the manager of the intervention and a short summary produced for each child.

Results

Figure 2 shows the difference, in months, between the pupils' pre and post-intervention Schonell results. As can be seen, with the exception of pupil 11, whose spelling score dropped, pupils' post-intervention reading and spelling ages were higher than their pre-intervention ages. For some pupils this was considerable, while for others the increase in reading and spelling ages matched the duration of the intervention. Bearing in mind that pupils were selected for the intervention because of literacy difficulties and were already attaining below their chronological age, this represents an encouraging rate of progression. Older pupils tended to show more improvement than younger pupils. Across the 16 pupils, the average increase in both reading and spelling ages after completing the programme was more than six months.

For Nessy levels, all 16 pupils started at level 1 or 2, and over the course of the intervention progressed at least two levels with two pupils progressing as many as five levels and one pupil, six levels. Again, the older pupils progressed more than the younger ones with the average gain for Year 2 and 3 pupils being 2.4 levels and that for Year 4 and 5 pupils being almost 4. Across the group, the average number of levels progressed through was just over three (see Table 2).

Pupils views of Nessy

The extracts below, chosen to represent three different year groups, illustrate one key finding – namely, that pupils thought Nessy helped them with reading and spelling.

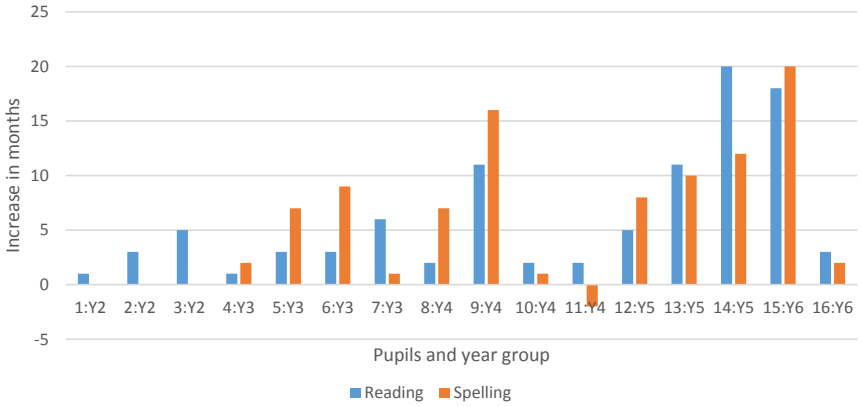

Figure 2. Post-intervention Schonell results [Colour figure can be viewed at wileyonlinelibrary.com]

Table 2. Year group and the average number of levels ('Islands') progressed through during the intervention

Year 2 and 3 (7 pupils)	2.4
Year 4 to 6 (9 pupils)	3.9
All pupils	3.25

> *It helps me be a good reader (Year 3 pupil)*
>
> *It helps [with reading and spelling] cause it turns words into something fun. (Year 4 pupil)*
>
> *Some words, before, I couldn't spell … like 'because' and now I can.* (Year 6 pupil)

All pupils indicated that they enjoyed using the programme. Fifteen indicated that they enjoyed using Nessy 'very much' and the remaining one, 'quite a lot'. All said that they would recommend it to other pupils. Features that they particularly enjoyed included the animated rules and the games. They also indicated that they found it easy to learn how to use. As illustrated by the Year 6 pupil above, all but one thought that it had helped them to improve their classwork. Pupils thought they were better at reading and spelling through doing Nessy but they could not

articulate how they knew that or how they thought it helped them, although the 'fun' element was clearly important to many pupils.

Discussion

The research found that the intervention was successful in supporting the development of a range of phonic-related skills for pupils who were underachieving in literacy. With the exception of one pupil, all three pre and post-intervention measures demonstrated an improvement in reading and spelling skills across the group. For some pupils this was considerable, particularly given the short duration of the intervention. It is unclear why pupil 11's spelling score dropped but it was unexpected that a pupil scored lower in the post-intervention assessment than in the pre-intervention assessment. Interestingly, closer investigation of pupil 16, whose progress was less marked than that of the other Year 5 and 6 pupils, revealed that it was their reading comprehension skills rather than their decoding and encoding skills that led to them being identified as underachieving in literacy. Unlike the other pupils, Pupil 16's Schonell reading and spelling ages was in-line with their chronological age. A single-word reading test such as Schonell does not assess reading comprehension and these skills do not feature strongly within Nessy. It is therefore not surprising that a pupil whose decoding skills were already well-developed did not substantially increase the number of words read accurately in Schonell over the time-frame involved. This finding is an important reminder that a full profile of a pupil's literacy strengths and weaknesses need to be known in advance, so that an intervention is appropriately targeted.

For the remaining pupils, the published research on CARIs offer some likely explanations for the noted gains in reading and spelling age. Some relate to the cognitive aspects of learning to read and spell while others relate to motivational aspects, or a combination of both.

First, Nessy offers repeated but varied opportunities for 'overlearning' of a range of phonic-based knowledge and skills in a carefully ordered sequence. This accords with current understandings about reading development. While debates about the best ways to teach reading continue (see Ellis and Moss, 2014; Stuart *et al*., 2008) there is a general consensus that many learners benefit from approaches that incorporate the teaching of phonics in small, structured, sequential steps (Brooks, 2013; Rose, 2006; Stuart and Stainthorp, 2016). This is what Nessy offers. Importantly, the range and variety of opportunities to learn specific

knowledge or skills, built into Nessy and other similar CARIs, provide multiple opportunities for repetition while keeping learning fresh and preventing it from becoming boring. Seine *et al*. (2011) highlight this as a particularly salient feature of the CARI in their research and make the point that over-crowded literacy settings '*are likely to challenge at-risk students, who acquire reading skills by degrees and require abundant repetition for decodin*g' (p1014). The structure and phonics-focus of Nessy, alongside multiple opportunities to practise specific skills, are therefore features likely to have contributed to the noted gains in children's post-intervention results.

Learning is likely to have been further supported by the multisensory and interactive nature of the programme. The former supports learning through engaging multiple neural pathways while the latter helps maintain high levels of engagement. Tan and Chua (2012) suggest that the attractive graphics and simple navigation were particularly salient features of Nessy in sustaining the focus and attention of the children with ADHD in their research. They also draw attention to the immediacy of feedback that is built into the programme. They suggest that this feature, alongside the opportunity to earn rewards ('Nessy nuggets') helps to maintain engagement and motivation. Other researchers have drawn attention to the 'novelty' effect when discussing the motivational attributes of CARIs (Hutchison and Reinking, 2011; Saine *et al*., 2011). The children in this study did not specify the particular features of Nessy that they enjoyed or thought helped with their learning but their accounts suggest that the 'fun' element was important and anecdotal accounts from teaching assistants indicated high levels of pupil engagement, both of which are likely to support learning.

Additionally, Nessy has been designed so that progress through the levels requires mastery of knowledge and skills at the lower level. This results in a personalised programme, tailored to the needs of a specific child, and allows a child to progress at his or her own pace while providing an appropriate sense of challenge. This substantially reduces two potential frustrations of class reading instruction – those of either moving through a programme too quickly to allow consolidation of knowledge and skills, or moving too slowly, resulting in boredom. Both of these situations, particularly the former, are likely to have a negative impact on a pupil's motivation and confidence.

In their research in 60 Dutch primary schools, Van de Ven *et al*. (2017) explain the positive results for the children using their 12-level CARI in terms of motivation issues. They make the point that struggling readers experience more pressure

to improve their reading skills than do other readers, and that this is likely to have a negative impact on both motivation and confidence. They conclude that reading interventions should therefore not only aim to improve literacy skills but also increase intrinsic motivation to read as well as build confidence. The aforementioned features of Nessy are likely to help with both of these issues. The individually tailored learning offered by the programme ensures that learners experience an appropriate balance between challenge and success while the interactive nature of the programme helps sustain motivation. These features may also explain why all children in this study reported enjoying using Nessy.

Conclusions

The research presented in this article illustrates how one school went about documenting evidence of impact of a short-term literacy intervention. It represents the first step in an on-going self-evaluation process. The impact on individual learners was variable but the data overall indicate that Nessy was effective in supporting the reading and spelling skills of a group of children who were underachieving in literacy. The research concludes that Nessy, and other similar CARIs, offer an effective medium for supporting the development of a range of phonic-based literacy skills and that it may be particularly beneficial for supporting the learning of those pupils who are struggling to consolidate the knowledge and skills covered in their regular classroom reading instruction. Pupils enjoyed using it and were therefore motivated to engage fully in sessions. Important characteristics likely to have contributed to the positive findings include the sequential, individualised nature of the programme, the immediacy of feedback that is provided, and the high level of interactivity that is required. Pupil perceptions of the programme indicated that it made learning fun. This therefore also has the potential to help build confidence and motivation to read.

CARIs such as Nessy are not intended as a replacement for teachers but the results presented here indicate that when appropriately targeted, they offer a beneficial adjunct to classroom teaching. In this study the TAs were present, thus increasing the resources required to deliver the intervention. However, once familiar with the programme, pupils could easily engage independently or with minimal supervision. A CARI such as Nessy therefore also offers a cost-effective way of supporting learning. This is important given the current financial constraints experienced by many schools in England.

Reflections

The research process served as a useful starting point for gathering evidence of impact. However, the small-scale and short-term nature of the intervention mean that any conclusions drawn must be read with caution. Additionally, the lack of a control group means that the gains attributable to the intervention cannot be separated from those that the children may have made anyway as they continued with their normal classroom reading instruction. Nevertheless, for children whose achievements in literacy had already fallen behind those of their classmates, the gains made by most of them over the course of the intervention were noteworthy.

Going forward, the school needs to build on this by continuing to collect pre and post intervention data for all children who use Nessy and to introduce a second post-test some months later to determine the durability of any gains made. Broadening the range of measures taken would also be useful. Pre and post-intervention running records (Clay, 2005), for example, would provide a more detailed picture of the extent to which a child's specific decoding strengths and weaknesses are addressed through a CARI. This would help ensure that the intervention is appropriately targeted. Importantly, there needs to be an assessment of the extent to which skills learned during an intervention are also applied back in the classroom context. This represents on-going work for the school.

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