Rapid recovery in sub-optimal readers in Wales by a self-paced computer-based reading programme

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Abstract

Basic literacy skills underlie much future adult functioning, and are targeted in children through a variety of means. Children with identified special needs in reading were exposed to a self-paced computer programme that focused on improving phonetic ability. Exposure was limited to 3, 40-min sessions a week, for ten weeks. The children were assessed in terms of their reading, spelling, and mathematics abilities before the programme commenced, and immediately after the programme terminated. The computer-programme improved reading and spelling by about eight months, but had no impact on mathematics. The results suggest that brief exposure to a self-paced phonetic computer-teaching programme had some benefits for the sample.

Keywords: computer-based reading programme; reading problems; externalising behaviours; internalising behaviours; phonetics
Improving reading-skills of pupils would impact a wide range of critical personal- and social-issues, and research regarding the most effective and cost-efficient methods for enhancing literacy-skills are a clear need and priority. At present, of pupils entering secondary schools in Wales, 40% are unable to read at their appropriate age-level: 20% have a reading age less than 9:6 years, and a further 20% read 6-12 months behind their age, and less than 30% attain highest literacy standards (Estyn, 2011).

Improvement in these literacy levels is seen by the Welsh Assembly Government as a key target-area for pupils in schools (WAG, 2010), and it is estimated that poor literacy costs the UK £81b/year, including £23b in social-care costs (World Literacy Foundation, 2012). Those with reading difficulties are slower to attain a similar level of academic achievement than their peers (O'Connor & Padeliadu, 2000), and may find it impossible to access curricula (Estyn, 2011). Consequently, poor literacy is linked with worse employment prospects (Dugdale & Clark, 2008), and predicts decreased engagement in adult-education and retraining programmes, further reducing employment opportunities (WAG, 2005).

However, poor literacy not only increases spending on special education provisions, and produces consequent loss of earnings and increased levels of welfare benefits for those individuals who do not read well, but also it has wide-ranging deleterious consequences for social-care costs. It increases costs associated with the health services and criminal justice systems. Individuals with poor reading-skills display heightened stress (Daly, Bonfiglio, Mattson, Persampieri, & Foreman-Yates, 2005), and have generally worse health prognoses (Bostock & Steptoe, 2012), with poor reading especially predicting poor health in later life (WAG, 2010). Moreover, poor literacy-skills are strongly associated with increases in anti-social behaviours:
poor readers have a greater tendency to exhibit problem behaviours at school (Morgan, Farkas, Tufis, & Sperling, 2000), with 70% of permanent school exclusions associated with these problems, and 60% of prisoners having poor reading-skills (Dugdale & Clark, 2008).

Reading difficulties are linked to deficits in a variety of cognitive skills O'Connor & Padeliadu, 2000; Harford, Johnston, Nepote, Hampton, Moore, Neal, Mueller, McGeorge, Huff, Awed, Taro, Huffman, 1994; Mann, 1993), and phonics-programmes have been suggested to help overcome these problems (DfES, 2006; WAG, 2010). The benefits of phonics on reading-ability have been demonstrated (Johnston, & Watson, 2003; MacDonald, 2010), as have concomitant reductions in behaviour problems (Hughes, Phillips, & Reed, 2012; Morgan, Farkas, Tufis, & Sperling, 2000), and such approaches are now considered a priority (DfES, 2006; Sharpies, Slaving, Chambers, & Sharp, 2011; WAG, 2010). Unfortunately, these one-to-one interventions are time-intense, and involve significant teacher-workload.

Recently, ICT has been employed to deliver phonics-teaching, partly with the aim of reducing direct teacher-intervention, and making the programmes accessible to greater numbers of children. However, success with such ICT-based interventions has been mixed (cf. Brooks, Miles, Torgerson, & Torgerson, 2006; Given, Wasserman, Chari, Beattie, & Eden, 2008; Hughes et al., 2012; Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2010). Thus, although ICT has large potential in this area, and there is some evidence to support its use, there are issues to resolve in terms of further exploring its effectiveness.

The current research examined the impact of a particular phonics-based reading programme (see Hughes et al., 2012) on the ability of a group of readers (sub-optimal readers) who have been targeted by WAG (WAG, 2010). This group do not
have a special educational need, but represent the 20% of pupils who read 6-12 months behind their chronological age. In a previous study of this programme, its effectiveness with very poor readers (reading 3-4 years below their chronological age) was established in a randomised control study. The current observational study explored its impact on this group of sub-optimal readers over approximately one-term’s exposure.

**Method**

**Ethics Statement**

Ethical approval for this research was obtained from the Department of Psychology Ethics Committee, Swansea University. The participants and their next of kin/caretakers/guardians on their behalf provided their written consent to participate in this study. This procedure was approved by the Ethics Committee.

**Participants**

Twenty pupils (15 boys and 5 girls) attending a secondary school were recruited for this study. The school was a mixed-comprehensive, state, secondary school (11-18 years), with about 1600 pupils. The school was in WAG Band 2 (1 being the best, 5 being worst, on a range of performance indices). Four participants (2 boys and 2 girls) did not take part in the programme. The pupils were all from Year 8, and were all aged either 12 or 13 years (mean = 12.4). The pupils had all been identified as having slight reading problems by the school (although none had been given a statement of special educational needs concerning dyslexia), and all were engaged in special reading classes at the school.
The mean IQ score (Wechsler Abbreviated Scale of Intelligence) for the sample was 88.2 (+ 13.2). The mean British Ability Scale (BAS) word reading ability age equivalent for the sample was 11:8 (+ 1:7) years, the mean spelling ability age equivalent was 8:3 (+ 1:4) years, and the mean maths ability age equivalent was 8:9 (+ 1:3) years. The mean reading ability as measured by the Woodcock Reading Mastery Test was 9:7 (+ 1.25).

Measures

Wechsler Abbreviated Scale of Intelligence (WASI; Sattler, 1998) measures intellectual ability, and is suitable for ages 6 to 89 years. It comprises four subtests, two assessing language (vocabulary and similarities), and two performance measures (block design and matrix reasoning). Thus, the WASI generates two scores of abilities, verbal and performance scores, and a full score of intellectual functioning. Test reliability has been stated at .87 to .92.

British Abilities Scale (BAS II; Elliot, Smith, & McCulloch, 1996) includes three achievement scales (reading, spelling, and maths), which index educational achievement. It is suitable for use with children and adolescents from two years, six months old (2:6) to seventeen years, eleven months old (17:11).

Woodcock Reading Mastery Test (Woodcock, 1987) is a norm-based test for individuals of 5 years and upwards that measures basic reading and comprehension skills.

Intervention

The ‘self-learn read and spell’ computer programme© was developed for individuals, between 8 and 20 years, with reading problems, and attempts to improve
phonetic discrimination. The programme has 23 levels of phonics teaching (see Table 1), starting with simple review of the alphabet (Level 1), moving through phonetic three-letter word teaching (Level 2), and then dealing with specific phoneme-grapheme correspondences (e.g., Level 7 deals with double vowels where only one vowel is sounded). A screen shot of one of the teaching levels is shown in the top panel of Figure 1, and all of the levels and stages are shown in Table 1.

Pupils must score 80% on a level to move on to the next level, and incorrect words are placed in a ‘revision folder’ to learn on the next level. The folder has a red, amber, and green ‘traffic light’ system, whereby unrecognised words are represented as red, indicating that they need to be learned, but once this has been achieved the words moves to amber, and, if after a further test proves positive, they turn green. However, should the user again fail the test, the words will remain amber until such time as they are correct.

Successful completion of each level allows access to one of four computer games. The pupil can go into the games zone for a specified period depending on their performance in the test in that level (80% = 5 min; 90% = 10 min; 95% = 15 min). All games have phonics features to help practice with the skills learned in the programme. A screen shot of one of the games is seen in the top panel of Figure 1.

Procedure

The pupils were tested, in the school, by an appropriately trained psychologist (who was also a qualified teacher), and who administered the WASI, and the BAS
achievement scales. The sample then completed ten weeks of exposure to the above computer programme. The children were scheduled for three, 40 min sessions a week of their intervention, for a period of six weeks. The children worked singly at a computer at their own pace through the programme, and could ask for assistance if they needed help. During this time the, the median level reached on the computer programme was Level 9. After the ten weeks, the pupils were reassessed by the same psychologist in terms of their BAS scores, and the same teacher again completed the SDQ and CDI.

**Results**

The mean length of time actually spent on the programme by the sample was 11.7 hours ($\pm 2.4$; range = $6.2 – 15.1$), and the mean level of the programme reached by the pupils was level 9.03 ($\pm 2.66$; range = $3 – 15$). The mean time taken to complete a level of the programme was 1.36 hours ($\pm .36$; range = $.85 – 2.10$). These two variables were statistically significantly correlated with one another, $r(14) = .550$, $p < .05$, but neither correlated significantly with IQ (WASI), both $ps > .70$.

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Figure 2 about here

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Figure 2 shows the change in the ability scores (follow-up minus baseline) for the three BAS achievement scales (expressed in months). Inspection of these data reveals that the children improved by around 6 months in terms of reading and spelling according to the BAS measure, and by around 10 months in terms of the WRT reading test. There was little improvement in the BAS maths scores. These impressions were corroborated by comparing the actual change scores in months, with
those that would be expected in the period of the study by means of related t-tests. These tests revealed statistically reliable changes in BAS reading ability, \( t(15) = 2.20, p < .05 \), WRT reading ability, \( t(15) = 3.42 p < .01 \), BAS spelling, \( t(15) = 3.07 p < .01 \), but not in BAS maths ability, \( t < 1 \).

Discussion

The current report assessed the effectiveness of a self-paced computer-based phonics reading programme on the reading ability of sub-optimal readers (i.e. those pupils who read below their chronological age but do not have a statement of special educational needs). In general, the programme was found to improve the reading ability of this group (as measured by both the BAS and the WMRT scales), and also to impact positively on the pupils’ spelling ability. However, the programme, not surprisingly, had little impact on the pupils’ ability in mathematics.

The striking aspect of the findings was that, although exposure to the programme was relatively brief (around 11 hours), reading performance increased by around half to three quarters of a month for every one hour spent on the programme. Extrapolating from these data, this would mean that over the course of a typical school term, assuming 10 weeks, with around 2 hours exposure per week, the 20% of
pupils in Wales who are 6-12 months behind their chronological age in reading (see Estyn, 2011) could catch up this deficit through exposure to this programme.

In these positive results, the current programme replicates some of the positive findings for ICT delivered phonics teaching (e.g., Brooks et al., 2006; Hughes et al., 2012), and points to a potentially time-efficient way in deliver such teaching.

Notwithstanding these gains, there are a number of points that should be made with respect to the present results. Clearly, this was an observation study that did not include a comparison group who did not receive the programme. This means that there is no way to know with certainty what the improvement of these pupils would have been without the programme. However, it can be said that the reading of the pupils improved well in advance of that which would have been expected by maturation alone, and did so in a group of pupils who had not previously shown great advances in reading. Thus, it is not clear that increases in reading ability would follow naturally from maturation in this population. Moreover, in a small-scale randomised control study, the same reading programme was found to improve reading beyond that seen in a teaching-as-usual group (Hughes et al., 2012).

A further point to note in tempering the conclusions that can be drawn from this study is the existence of some reports that have not shown ICT-based teaching to be particularly effective in this area (Given et al., 2008; Saine et al., 2010). It is unclear what precise factors are responsible for these differences, but the nature of the reinforcers that are employed may be crucial (see Eisenberger & Cameron, 1996), and the current programme has undergone extensive testing for the acceptability of such rewards in the context of teaching reading.

There are some practical issues that should also be considered in terms of the implementation of such a programme. The pupils in this study were timetabled to
have 10 weeks exposure to the programme, with 3 40min sessions a week (that is, they should have received 20 hours exposure). The mean level of exposure was actually only around 11 hours, so there is an issue as to why the pupils only spent about half of the timetabled period engaged on the programme. This suggests some close monitoring of progress may be needed in order to deliver the full impact of the programme. Another issue concerns the correct point at which to start pupils on the programme. All pupils started at Level 1, and worked through. This may not be an optimal use of time, and some means of determining the best level on which to start the pupils to maximise their time on the programme would be an advance.

In summary, the current observational study demonstrated that sub-optimal readers can benefit from an ICT-delivered phonics-reading programme, and that these gains can be made quite quickly in this group. Projects from these data suggest that this group could be caught up with their peers in terms of reading in one term of exposure.
References


Harford, D.P., Johnston, M., Nepote, P., Hampton, S., Moore, S., Neal, J., Mueller,


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Figure captions

Figure 1. Screen shots of part of the teaching programme (top panel), and computer game used as a reinforcer (bottom panel).

Figure 2. Mean in change (follow-up minus baseline) in BAS and WMRT age-equivalent scores.

Figure 3. Mean in change (follow-up minus baseline) in BAS and WMRT scores per hour spent on the programme, and per level mastered on the programme.
Figure 1
Figure 2

[Diagram showing months change (follow-up minus baseline) for BAS Reading, BAS Spelling, BAS Maths, and WRMT Reading.]
Figure 3

![Bar chart showing change in months per hour and per level for BAS Read, BAS Spell, BAS Maths, and WRMT Reading.](chart.png)
<table>
<thead>
<tr>
<th>Level</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Letters and sounds A – Z</td>
</tr>
<tr>
<td>Level 2</td>
<td>Three letter phonics words</td>
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<tr>
<td>Level 3</td>
<td>Four letter phonics words</td>
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<tr>
<td>Level 4</td>
<td>Four and five letter phonics words – endings</td>
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<tr>
<td>Level 5</td>
<td>Long vowels and short vowels, Task 1</td>
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<tr>
<td>Level 6</td>
<td>Magic ‘e’ words</td>
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<td>Level 7</td>
<td>Two vowels together</td>
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<tr>
<td>Level 8</td>
<td>The trouble with ‘o’</td>
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<tr>
<td>Level 9</td>
<td>Sounds like ‘oo’ and ‘o’</td>
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<tr>
<td>Level 10</td>
<td>The ‘u’ and ‘ough’ sounds</td>
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<tr>
<td>Level 11</td>
<td>Sounds like ‘or’ and ‘er’ and</td>
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<tr>
<td>Level 12</td>
<td>Sounds like ‘i’ and ‘u’ and ‘oi’ and ‘r’</td>
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<tr>
<td>Level 13</td>
<td>Sounds you don’t expect!</td>
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<tr>
<td>Level 14</td>
<td>Adding to words at the end; ‘er’, ‘ed’, ‘est’ and ‘ing’</td>
</tr>
<tr>
<td>Level 15</td>
<td>Adding to words at the end; ‘ive’, ‘ous’ and words ending ‘y’</td>
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<tr>
<td>Level 16</td>
<td>Adding to words at the end; ‘ial’ and ‘ion’</td>
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<tr>
<td>Level 17</td>
<td>Adding to words at the end; ‘ic’, ‘able’, ‘ible’, ‘ly’, ‘ment’, ‘less’</td>
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<tr>
<td>Level 18</td>
<td>Adding to words at the beginning</td>
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<td>Level 19</td>
<td>Words with a silent letter</td>
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<td>Level 20</td>
<td>‘i’ before ‘e’ except after ‘c’</td>
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<td>Level 21</td>
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