

ARROW: A New Tool in the Teaching of Literacy: Report of Early Evaluation

This article summarises part of a four year action research study in Waterford. It compares a technological evidence based literacy tool (ARROW) with four other evidence based interventions in five post-primary and ten primary schools. Gains in word reading, spelling, and comprehension across the five interventions are presented, together with qualitative results on ARROW. While ARROW compared favourably, it distinguished itself in terms of efficiency. Its gains were significantly greater relative to teaching time and learning time spent on the various interventions.

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INTRODUCTION

The National Educational Psychological Service (NEPS) team embarked upon a three year project to raise reading standards in primary and post-primary schools in Waterford, delivering evidence-based interventions for children with literacy difficulties. In the course of evaluating the literature on these interventions, it became clear that one of the most impressive interventions currently available is ARROW (Aural- Read- Respond- Oral- Write) (Brooks, 2007). Accordingly, NEPS psychologists liaised with ARROW trainers to bring this programme to Ireland, trialling and establishing it in a number of schools. This initiative was supported by the National Council for Technology in Education who assisted four schools (two primary and two post-primary schools) with the financial costs associated with the specialist software needed.

ARROW, a programme developed by Dr. Colin Lane, works on the principle that hearing one's own voice is a psychological key to language comprehension. People are particularly attuned to the sound of their own voice and it is suggested that listening to oneself enhances cognitive processing. Training in this area helps children to attend to the 'internal sounds' of words and therefore enhances phonemic and phonological awareness, which in turn has a beneficial affect on reading. Using computers, headphones and a structured system of examples and exercises the program displays a piece of text at an appropriate level (anything

from a single letter to a short paragraph). The child hears it spoken, repeats it aloud, records it, and then plays it back. Finally, the child writes down the piece of text. The programme lasts approximately thirty minutes per day and for a total of ten hours. One adult may supervise a number of students, as long as each has access to a computer.

Training for teachers requires a financial outlay including the bringing of a specialist trainer from the United Kingdom. Teachers undertake to complete an initial two days training, and to implement the programme with a minimum of five students. They evaluate their work and following completion of a mini portfolio of work they become fully accredited with their status as an ARROW tutor reviewed annually.

Does it Work?

Brooks (2007) evaluated a large range of literacy interventions and, in relation to ARROW he noted, "The ratio gains show that this amount of progress...was remarkable, if not spectacular" (p. 133). He cites a study of ninety-one children who made average gains of seven months in reading and six months in spelling after just one and a half week's of intervention. However, it should be noted that the study cited was unpublished, and the data was provided by Dr. Lane, who devised the system.

Dr. Lane has also supplied further data to this author, involving 445 children in twenty schools. Typically, after two to three hours of ARROW training, children made average gains of nine and a half months in reading age. Those who undertook longer programmes (eight to ten hours of ARROW tuition) made gains of fourteen months in reading age. Prior to this project, there was no evidence of the efficacy of this intervention published in a peer reviewed journal. However, since the completion of the project, a comparison of five interventions, including ARROW (Nugent, 2011) has been published. While the 2011 publication encompasses elements of the present study, it is the first detailed account of ARROW. Findings based on forty-nine students, (mean pre-intervention word reading standard score of eighty-one) showed that after three months of intervention (totalling seven hours of tuition), the average participant made over twelve months progress in reading.

The Current Project

Prior to 2009 ARROW was unavailable in Ireland. Dr. Colin Lane travelled to Ireland and over two days, teachers were trained in the use of the programme. Typically, ARROW was installed on five computers in a school. Teachers then began to implement the programme and the NEPS psychologist co-ordinating the

project undertook to carry out an evaluation, including quantitative and qualitative information. ARROW was just one element of a series of Waterford Reading Projects (Murphy, Nugent and O'Neill, 2008; Nugent, 2011) and was introduced in Phase Three of the Projects. Other programmes trialled in the targeted fifteen primary and post-primary schools included:

- Accelerate/Accelerate (Clifford and Miles, 1994)
- Paired Reading
- SNIP (a precision teaching package) (Smart and Smart, undated)
- Toe by Toe (Cowling and Cowling, 1993).

There is further commentary on these programmes later in this article.

METHODOLOGY

Three separate sets of data were considered when evaluating the programme. Firstly, some of the children following the ARROW programme were included in the third phase of the Waterford Reading Projects. These projects involved teachers delivering an evidence-based intervention over a specified time frame (three months) and collecting pre- and post-intervention data about reading ability, using a standardised test, The Wide Range Achievement Test, fourth edition (WRAT 4) (Wilkinson and Robertson, 2006). The second data set consisted of pre- and post-reading and spelling scores (Schonell, 1976).

Finally, additional qualitative data was collected, through a structured questionnaire involving eight of the eleven teachers engaged in the ARROW programme. Open-ended questions asked teachers to consider the benefits, difficulties and limitations of the programme while considering the extent of their satisfaction with it. A further two teachers participated in an interview review. This data was supplemented by the researcher's direct contact with some of the schools involved and included observations of students at work.

Participants

The ARROW programme was delivered in four schools and a total of eighty-five students participated. They included students from a girls' post-primary school in the city with international students and students from the travelling community forming part of the sample. Students from a mixed community school in a rural area also participated. Of the primary schools, one was a large primary school for girls and the second was co-educational. Therefore, while more girls than boys participated the schools were representative of Irish schools.

The average chronological age of student participants was eleven years, four months, with a reading age range of six years, three months to sixteen years, six months. Students with specific learning difficulties (dyslexia) and students with mild general learning disabilities were included, although specific data on each group was not collected. Participants were selected on the basis of their attendance in learning support/resource. It was believed participants were representative of the cohort of students receiving learning support/resource teaching in mainstream primary and post-primary schools.

Eleven teachers were trained and delivered the programme with between one and four trained in each school. Some developed considerable expertise, and had experience of delivering the programme to over thirty students, while others were just becoming familiar with it, delivering the programme to just five students.

FINDINGS

Structure of Teaching, Teaching Time and Learning Time

The data collected included the number of hours and minutes tuition received by each student and the number of students in each teaching group allowing the researcher to evaluate how much teacher time each student received. Teachers delivered the programme to groups of students, during the learning support/resource teaching time. No additional support from special needs assistants was needed. The average participant attended seven hours of tuition. Some were seen individually, while others were seen in groups of up to six depending on the organisation of the school. The average teacher time spent delivering the programme was two hours per student. Schools tended to deliver the programme over about fifteen sessions with each session approximately thirty minutes long. Most students completed the programme within six weeks (averaging three sessions per week).

Pre-Intervention Scores

At pre-intervention, students generally were performing below the tenth percentile (Table 1). It should be noted that WRAT 4 scores are represented as standard scores. The perfect average standard score is 100, with an average range of ninety to 109. A score of eighty is at the ninth percentile, while a score of seventy is at the second percentile. The average participant had a standard score of eighty (ninth percentile) in all WRAT 4 tests at pre-intervention.

Schonell scores are given as age equivalents and therefore it is worth remembering that the average chronological age of participants at the outset of the

intervention was eleven years, four months. The average word reading age was just under nine, while the average spelling age was nine (Table 1). This indicates that participants were, on average, almost two and a half years below their chronological age in reading and spelling at the outset of the intervention.

Table 1: Pre-intervention test results for all participants

Test Used	N	Minimum	Maximum	Mean
WRAT- word reading	43	56	98	80
WRAT- spelling	24	55	105	80
WRAT- sentence comprehension	40	55	104	80
Schonell- word reading	71	5.3	12.8	8.9
Schonell- spelling	72	5.4	13.5	9.0

Progress in Reading and Spelling

Overall, participants made standard score gains in all areas tested, with average standard score gains of five in word reading and three in reading comprehension (Table 2). These standard scores can be changed into age equivalents using the mean age and translating pre-test means and post-test means into age equivalents. Schonell data shows similar findings: Gains in Schonell word reading were in the order of 0.8 of a year (nine months) while gains in spelling were 0.52 of a year (six months).

Table 2: WRAT results, pre- and post-intervention, calculated as age equivalents, with total gains made over intervention period

Test	Pre-intervention	Post-intervention	Gains
Word reading	7.8	8.7	0.9 (11 months)
Spelling	7.9	8.2	0.3 (4 months)
Comprehension	7.8	8.6	0.8 (10 months)

How do ARROW Results Compare with Other Evidence-Based Outcomes?

The results for the ARROW project were compared with the gains made by participants in the interventions referred to earlier as part of the Waterford Reading Projects, Phase Three (Table 3). Based on these results the ARROW

programme delivered outcomes in word reading that are almost average compared to other evidence-based interventions. Gains in spelling and reading comprehension are stronger than average. However, the Toe by Toe (Cowling and Cowling, 1993) intervention significantly out-performed ARROW (and all other interventions) on both measures of reading. A limitation of this finding is that only six participants followed the Toe by Toe programme.

Table 3: WRAT 4 Standard score gains in word reading, spelling and sentence comprehension, by intervention, with number of participants

Programme	Number*	Gains word reading	Gains spelling	Gains comprehension
ARROW	42	5.0	1.7	3.12
Acceleread	7	0.43	2.57	0
Paired reading	17	8.18	-.81	0.94
SNIP	13	6.85	0.89	2.33
Toe by Toe	6	10.17	No data	8.0
Totals	85	5.94	1.1	2.65

** This is the total number of participants for whom data was collected. However, not all participants had full, valid data. In particular, it should be noted that data about spelling scores was limited. Spelling was not a target of the Waterford Reading Projects and not all teachers collected data about spelling progress. Therefore, spelling results should be treated with caution, as they are based on relatively small numbers, with only 42 of the 85 participants represented.*

Teaching and Learning Time

An important consideration in calculating the efficacy of any intervention programme is the amount of time given by students to learning and the amount of teacher time required to deliver the programme. One of the very particular advantages of the ARROW programme is that it can be effectively delivered to groups; typically five students at a time. Other interventions were delivered to individuals or pairs.

Students in most interventions spent comparable amounts of time learning, although those participating in paired reading spent significantly longer. For ARROW, the average time spent learning per student was seven hours and nine minutes.

Therefore, the results reported above, with between nine and eleven months progress with reading and four to six months progress in spelling, are very good.

The author was also impressed with the value that ARROW gives in terms of teacher time. The average amount of teacher time used per student to deliver these results was two hours.

The ARROW programme requires significantly less teacher input per student (two hours) than any of the other interventions in this study (between four and six and a half hours) (Figure 1).

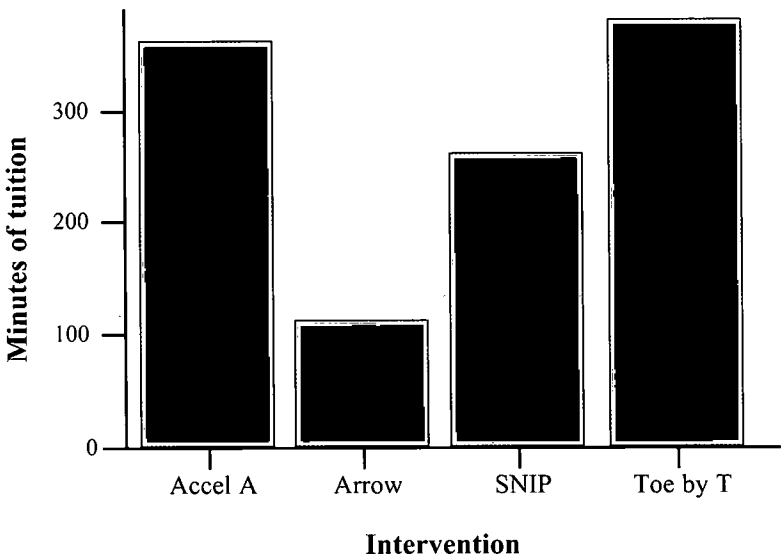


Figure 1: Teacher time spent delivering each programme in minutes

It was not possible to estimate teacher time involved in paired reading, as the time involved is not just contact time, but time spent on organising. It was however, possible to calculate student progress for all other interventions comparing the average gains of students, per hour of teaching time. This adjusted calculation shows that, in this regard, ARROW is the most effective intervention (Table 4).

Table 4: Adjusted gains in scores, based on equal teaching time (one hour)

Intervention	Gains in word reading	Gains in comprehension
ARROW	2.5	1.55
Acceleread	.07	0
SNIP	1.55	.52
Toe by Toe	1.59	1.25

How do ARROW Results Compare to Other Research?

Obviously, it is helpful to compare the outcomes of ARROW with other interventions trialled within the same community. However, the broader context of national and international research should also be considered. It is important to be aware, that the outcomes reported for the Phase 3 of the Waterford Reading Projects are excellent, so the bar for comparison has been set high.

Interestingly, Brooks (2007) states that, “Good impact – sufficient to at least double the standard rate of progress – can be achieved and it is reasonable to expect it” (p. 32). This would imply that we should be aiming for our struggling readers to make two years progress in one year.

The most comprehensive review of learning support in Ireland was carried out by Shiel, Morgan and Larney in 1998. They tracked 124 students who had literacy support over two years, from second class to fourth class. The average pre-intervention literacy standard score of participants was eighty-three (making the cohort slightly more able than the group who did ARROW). The average gain after two years of intervention was 3.41 standard scores. The forty-two participants in this study for whom standard score gains are available made similar gains in comprehension in just three months (3.12 standard score gains) and more impressive gains in word reading (5.0 standard score gains).

Additionally, Nugent (2006) evaluated outcomes for 100 primary aged children with severe dyslexia, availing of specialist services (special schools, reading units and resource teaching). Average pre-intervention scores were seventy-seven in word reading. Gains in word reading after two years of intervention were 5.95, while students engaged in the ARROW programme gained 5.0 points in just three months.

Finally, Murphy, Nugent and O’Neill (2008) reporting on the first phase of the Waterford Reading Projects noted that average gains for participants after three

months was 1.68 in word reading and 5.70 in comprehension. In this regard the ARROW cohort did considerably better in word reading (5.0, rather than 1.68 in the same time frame), but less well in the area of reading comprehension (3.2 for students participating in ARROW, compared to 5.7 for those in the comparison group).

This evaluation of ARROW indicates that the programme certainly meets the standards set by Brooks (2007) in that participants made twice the normal rate of progress over the 3 months of intervention. Depending on what scores were used, participants in ARROW made between nine and eleven months progress in reading after three months and four to six months progress in spelling.

Both Brooks (2007) and Lane (2008) reported slightly more impressive results for ARROW when used in the UK. However, it is not clear that the UK cohort is comparable in terms of the extent of their reading difficulties. In fact, some of the participants in Lane’s study were already average or above average in their reading skills, and ARROW was being used to further enhance their skills. Those in the Brooks study had ‘low attainment’, but the extent of this was difficult to quantify.

Benefits of ARROW

In terms of benefits teachers overwhelmingly commented on the progress that students made in reading and spelling. Student enjoyment or pride in ones work was also commented upon (Table 5).

Table 5: Teachers’ perceptions regarding programme benefits

Theme	N	Illustrative Comment
Progress in reading and spelling	7	‘Definite impressive improvement of reading and spelling for the majority of students’
Student enjoyment of programme (and pride in achievement)	11	‘Students enjoy using ARROW’ ‘Students can recognise their own progress’ ‘The self-voice enhanced learning and students liked it’
Individualised, with student control over pace	4	‘An independent child-centred approach to learning’
Other	4	‘Benefits EAL students and students with speech difficulties’

Limitations and Difficulties with ARROW

Responses to the question about difficulties and limitations of the programme yielded more varied results and some of the responses were specific to the age groups involved. Timetabling was an issue at post-primary level. Technical support was more problematic in primary schools. Older students were reportedly bored towards the end of the programme, while younger students needed more help to get started. Other comments included the English accent, problems for those with handwriting difficulties (as this is an integral part of the programme) and the difficulty of not being able to save work done.

Comments about the ARROW Programme

All participating post-primary level teachers noted that it would be best to consider ARROW as a short, intensive input, for example, offering four weeks of intervention rather than six weeks. In one school, teachers felt that a group of five students was too large, while another school invested in more computers to use the programme with up to seven students at once. Two teachers commented that implementing the programme required more teacher supervision than had been indicated during training.

In terms of satisfaction with the programme responses were generally positive, with only one teacher neutral about the programme and uncertain about recommending it. The other seven were *happy* or *very happy* with it. One teacher wrote, "I must admit that I was somewhat sceptical when I first heard about ARROW, but now, after having used this approach for more than six months with approximately thirty-six post-primary students and having conducted pre- and post-student assessment tests, I am pleased to report that the makers of ARROW have earned the respect and appreciation of another educator".

DISCUSSION

The data has shown ARROW to be an effective intervention for those with literacy difficulties and that teachers are generally positive about it. However, some issues have arisen which require further consideration. In considering the qualitative data, it was clear that the more experienced teachers were in using ARROW, the more positive they were about it. Scrutiny of the outcomes (gains in reading) showed that the same teachers, on average, got better results than colleagues with less experience delivering the programme. This is not surprising, but does suggest that we should be a little cautious about the results of this project, in that there is some evidence to suggest that results (both in terms of student achievement and in terms of teacher satisfaction) may increase as teachers develop their expertise in using the programme.

A related issue is the importance of teacher training. International research strongly supports the idea of improved outcomes for children's reading, when teachers are well-trained and well-supported (National Reading Panel, 2000; Slavin, Cheung, Groff and Lake, 2008).

Focus on Particular Groups

A further issue for consideration is how ARROW works with particular groups of students. ARROW was trialled with eighty-five students. While anecdotal, there was some evidence to suggest that it is was particularly effective for students for whom English was an additional language and for those with speech and language difficulties. Teachers commented on how these students responded very positively to the programme and made gains, not just in literacy, but in the confidence to talk and read in the classroom. A post-primary student with a marked speech difficulty and poor articulation had not found speech and language therapy to be helpful. However, after using ARROW her teachers reported that her speech was clearer and more intelligible and that she had greater confidence in using her voice. In a primary school ARROW was used with a student with very significant learning difficulties, who had virtually no intelligible speech and a student with a significant visual impairment and limited speech. In both cases, use of the free field programme, which allows students to record their own speech and listen to it, improved speech quality and language use.

CONCLUSION

The NEPS Waterford Reading Projects have shown that there are a number of effective evidence-based interventions including ARROW. ARROW delivers results that are comparable with best international practice and this project suggests that even more impressive results may be possible as teachers become more experienced in using the programme.

Disadvantages include the cost of start-up, including the purchase of computers and specialist soft-ware and the cost of specialist training. Maintenance of the programme, including maintaining teacher competence and maintaining the equipment is also a factor to be considered.

Advantages of ARROW include the gains achieved in reading and spelling and student enjoyment of the programme. Perhaps what gives ARROW an advantage over some other programmes is that it requires only a short burst of intervention (averaging seven hours of tuition) and it can be delivered effectively to groups of children, making it a very effective use of teacher time. This programme can

therefore be offered to relatively large numbers of children and may be a useful way of raising reading standards in our schools.

Further detail on the ARROW programme is available from Arrow Tuition Ltd.

REFERENCES

- Brooks, G. (2007) *What Works for Children with Literacy Difficulties? The Effectiveness of Intervention Schemes*, London: Department for Children, Schools and Families.
- Clifford, V. and Miles, M. (1994) *Accelerated/ Accelwrite: Guide to Using Talking Computers to Help Children Read and Write*, Cambridge: IAnsyst Ltd.
- Cowling, K. and Cowling, H. (1993) *Toe by Toe: A Highly Structured Multi-Sensory Reading Manual for Teachers and Parents*, Basildon: Author.
- Lane, C. (2008) *Data from June 2007- April 2008* (unpublished paper), Somerset.
- Murphy, S., Nugent, M. and O'Neill, F. (2008) An Investigation of the Effectiveness of Reading Interventions for a Local Population of Primary School Children, *REACH, Journal of Special Needs Education in Ireland*, Vol. 21 (2), pp. 97-109.
- National Reading Panel (2000) *Teaching Children to Read: An Evidence-Based Assessment of the Scientific Research Literature on Reading and Its Implications for Reading Instruction* (NIH Publication No. 00-4754), Washington: National Institute of Child Health and Human Development.
- Nugent, M. (2006) Special Educational Services for Children with Specific Learning Disability (Dyslexia): An Evaluation, *REACH Journal of Special Needs Education in Ireland*, Vol. 19 (2), pp. 102-111.
- Nugent, M. (2011) Comparing Five Interventions for Struggling Readers in Ireland: Findings from Four Years of Action Research, *LEARN Journal of the Irish Learning Support Association*, Vol. 33, pp. 127-143.
- Schonell (1976) *Schonell Graded Word Reading Test*, Aston Index: LDA.

- Shiel, G., Morgan, M. and Larney, R. (1998) *Study of Remedial Education in Irish Primary Schools, Summary Report*, Dublin: Educational Research Centre, St Patrick's College.
- Slavin, R., Cheug, A., Groff, C. and Lake, C. (2008) Effective Reading Programs for Middle and High Schools: A Best-Evidence Synthesis, *Reading Research Quarterly*, Vol. 43 (3), pp. 290-322.
- Smart, C. and Smart, P. (undated) *SNIP Precision Teaching Pack*. www.snip-newsletter.co.uk (accessed 5th February 2012).
- Wilkinson, G.S. and Robertson, G.J. (2006) *Wide Range Achievement Test, fourth edition WRAT 4*, Psychological Assessment Resources Inc.



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