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Literacy and Numeracy Innovative Projects Initiative

Final project reports for Round Two

Literacy Intervention: Extending the Evidence Base for Determining Effective Options

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Executive summary

The aim of the present project

The aim of the present project was to evaluate the effectiveness of three interventions options for students in Year 2 who have been identified as at risk of experiencing ongoing reading difficulties. The initiative was based on the assumption that students differ in the ways in which they acquire early literacy knowledge. It proposed that for those who have literacy learning disabilities, the learning assumptions made by the teaching provided needs to match the ways in which individual students learn.

The present methodology

Earlier research has shown that learning to be literate requires a knowledge of oral language and particular ways of thinking. Examples of these areas of psycholinguistic and cognitive knowledge include phonemic and phonological awareness, orthographic processing and learning alpha-numeric symbols, vocabulary, listening comprehension and syntactic knowledge, rapid automatized naming, short term memory processing and general nonverbal competence and visuospatial processing.

The project used these areas of knowledge to develop 'literacy learning readiness' profiling procedures. These were used to describe the psycholinguistic and cognitive knowledge of Year 2 students judged to be at risk of literacy learning disabilities. Three subtypes of early literacy learning disabilities were identified in the 'literacy at risk' group; (1) a phonological knowledge difficulty cohort of 23 students; (2) an orthographic knowledge difficulty cohort of 13 students; and (3) an oral language knowledge difficulty cohort of 17. All performed on literacy assessment tasks (prose and isolated word reading tasks) below the 25th percentile. Their literacy learning patterns were compared with that of a group of 55 'good progress' Year 2 readers whose literacy performance was above the 25th percentile on prose and isolated word reading tasks.

Each cohort was provided with a literacy intervention pathway that matched its literacy learning profile. The three alternative intervention pathways targeted were: (1) a phonological intervention pathway; (2) an orthographic intervention pathway and (3) an oral language comprehension intervention pathway. Each student, on the basis of her or his 'literacy learning readiness profile', was allocated to one of the intervention pathways. The three pathways had the same literacy outcomes but developed them differently. In addition to learning literacy knowledge, the students were taught to encode the knowledge gained in long term memory. As well, students' self efficacy as readers was monitored.

Each intervention pathway consisted of sessions of 30 minutes duration on each school day for 15 weeks (or its equivalent). Each intervention were administered either individually to students or to small groups of students. In each intervention, students were assigned randomly to either the one-to-one option or the small group option. The intervention was implemented in the students' schools.

Reading assessment measures were administered to all students prior to and after the teaching period. As well, students' reading ability was assessed in every fifth session and their self efficacy as readers was assessed on two occasions.

The texts used were in the interventions written based on matching texts designed for matching Grade 1 interventions. They were based on the words to be taught in each session. The same texts were used for the three interventions.

The findings of the project

All of the interventions improved students' reading accuracy and comprehension. The post-intervention reading score, measured in mean reading age, was higher than the pre-intervention score for all conditions. The three interventions did not differ in their effectiveness in enhancing accuracy but did differ in improving comprehension; the oral language comprehension extended comprehension more than the other interventions.

In terms of the comparative effectiveness of each pathway on the two reading outcomes, the orthographic and oral language comprehension pathways improved both accuracy and comprehension equally, while the phonological intervention enhanced comprehension improved more than accuracy. Although all interventions improved reading accuracy and comprehension, not all students experienced the same level of improvement. For each intervention group and the good progress readers, readers differed in the extent of their improvement.

The project describes in detail the literacy learning profiles of those who made the lowest gains for each pathway. In summary, the results show that these students would probably have benefited from an intervention that targeted a broader range of literacy knowledge and skills than the focus of the intervention to which they were exposed.

The project also compared the relative effectiveness of teaching students individually, in pairs or in groups of three (the 'teaching formats'). Similar levels of accuracy or comprehension gains were made in the three contexts, with the exception of the phonological intervention. In this case, students who learnt in groups of 3 achieved lower comprehension gain than those learning in pairs.

This outcome has implications both for individual students and for making most effective use of teacher time and expertise. If students in the early years who have reading disabilities learn equally effectively in small groups as individually, economy of time and resources may suggest the implementation of small group teaching regimes.

The influence of self efficacy on reading achievement was examined by assessing students' self-efficacy as readers on two occasions. For approximately two thirds of the students, self efficacy as a reader increased as the intervention proceeded. These students had a more positive belief about their success as readers on the later occasion.

The relationship between self efficacy and reading progress is complex. The project investigated how trend in self efficacy was linked with gain in reading score. The trends suggested that reading

ability increased independently of the change in self efficacy. The project notes various limitations of its findings in this area.

During the implementation of the interventions, the teachers recorded various anecdotal observation of influences on the early literacy learning of the underachieving students. These were usually unanticipated and may merit consideration in future research.

One outcome related to students' preference for predictable teaching routines, familiar types of activities and tasks. Some students suggested, in their own words, that the regular routines allowed them to manage and direct their learning better. With familiar activities they felt more comfortable predicting, monitoring how they are reading, changing their minds and reviewing what they had read. This observation was counter-intuitive for some of the teachers, who had believed that these students would lose motivation and become bored more easily and need access to a changing learning environment.

A second observation of teachers working in the oral language comprehension intervention pathway was that teaching students to apply the comprehending strategies such as paraphrasing or the RIDER strategy on a sentence by sentence basis was more successful than having students apply it either to sub-sentence units or to multiple sentence units. While in hindsight this seems an intuitively reasonable finding, it had not been noted in earlier research on teaching reading comprehension strategies.

An observation of teachers working in the phonological intervention pathway was that some 2-sound were more difficult than others. A similar observation was made for 3-sound rimes. For some of the rimes, many of the students had difficulty retaining the vowel, and substituted it, for example, they read "rim" as "ram". Their difficulty suggested they needed to learn to distinguish between and to pronounce vowels accurately in the rime units before teaching them to use the sounds in phonological activities. The phonological intervention was modified to include auditory discrimination and pronunciations necessary to scaffold the phonological learning.

A second observation of teachers working in this intervention was that students' sound familiarity influenced their success learning phonological knowledge. Teachers noted that students differed in the particular rimes they found easier to handle. While this was not, on the surface surprising, the teachers found that the relative ease was linked with students' personal earlier experiences with particular words. Students' relative familiarity with words and the importance of the words in their existing experiential knowledge influenced how well the students could use them during learning. Teaching activities need to take account of this effect.

Implications for teaching and learning

This analysis shows that at risk readers can make the same level of progress as average readers when exposed to interventions that match their existing literacy learning profiles. It also suggests that, to improve accuracy at the Year 2 level for these students, an intervention that matches their profile is likely to be effective. To improve comprehension, on the other hand, an intervention that includes oral language training may be more effective.

For each intervention, not all students will necessarily make the same level of improvement. The performance of the lowest achievers in each intervention suggest that these students need instruction that targets more than area of knowledge. Those students who made least gains in reading accuracy in the phonological teaching intervention would have benefited from teaching that targeted oral comprehension teaching as well, particularly knowledge to do with manipulating word meanings (verbal analogies) and short term memory for words. Corresponding students in the orthographic intervention context would have benefited from teaching that targeted expressive syntax and phonemic segmenting for shorter words. The lowest achievers in the oral comprehension intervention would have benefited from phonemic segmenting instruction.

For comprehension on the other hand, those making least gains in the phonological intervention would have been assisted by teaching in phonological short term memory and those who made least gains in the orthographic teaching would have been assisted by teaching in areas of nonverbal reasoning.

Some of the anecdotal observations mentioned above have relevance for teaching. Teaching sessions that have a level of routine and familiarity for students would seem to enhance their preparedness to predict, monitor how they are reading and review what they had read. The use of familiar tasks and procedures can provide these students with a level of stability. Novelty in these teaching situations can be introduced through texts that elicit students' curiosity and interest.

Teaching students to apply comprehending strategies such as paraphrasing or the RIDER strategy to meaningful units in the text, such as sentences, enhances comprehension. This equips readers with procedures they can use systematically to operate as effective 'knowledge builders'. The effectiveness of this teaching procedure can be trialed for a variety of reading comprehension strategies. Readers can learn to apply the strategy to each sentence systematically and to integrate or synthesise their impressions progressively. This would assist those students whose reading difficulties mean that they lack an effective repertoire of reading strategies.

Teaching students to generate accurately the sounds in words before they submit the words to phonological analysis is an important teaching procedure for those whose difficulty is in the phonemic area. Phonological imitative activities, auditory discrimination and pronunciation activities can easily be incorporated in early literacy programs for these students.

The findings also have implications for how teachers organise students who have literacy learning difficulties into learning groups. They suggest that individual student instruction may not yield greater improvement than teaching in small groups. They also alert teachers to the importance of social interactions in the learning support context.

The contribution of the project's outcomes to the overall objective of the Literacy and Numeracy Innovative Projects Initiative

The project's specific outcomes contribute to the overall objective of the Literacy and Numeracy Innovative Projects Initiative. The project identifies teaching procedures for improving the literacy skills of Australian children potentially at risk of literacy failure. The three interventions provide a framework for integrating in an explicit way specific learning processes such as psycholinguistic

and cognitive knowledge, memory and the self management of literacy learning in literacy intervention programs.

It provides a validated framework for the early assessment and identification of literacy learning difficulties, for mapping these into literacy learning readiness profiles and for matching these with the most appropriate intervention. This framework, with further research, could easily be extended to meet the needs of students in the middle years of schooling who are not meeting the national literacy benchmarks.

Early reading difficulties have been attributed to a range of causes: (1) phonemic and phonological awareness ability; (2) orthographic knowledge and the rapid naming of alphanumeric symbols; (3) visual encoding of alphanumeric symbols; (4) linguistic competence; (5) nonverbal competence (ie visual-spatial awareness); (6) memory and learning competence. Implementing teaching that targets this range of causes has been problematic. The alternative intervention pathways provide a framework for doing this, by attempting to link specific interventions with students' learning needs at particular times.

The outcomes of the project provide school communities with the knowledge necessary for understanding early literacy difficulties, for identifying those aspects of an at risk student's knowledge that are 'in place' and for targeting specifically the literacy learning needs of a particular student at any time. A challenge for teachers, schools and the community is how to 'unpack' the literacy learning needs of any at risk student. In its integration of a range of learning processes into a literacy learning readiness profile, the project provides the necessary knowledge for this.

Areas for further research

The project has indicated various areas in which further research would be most beneficial in the context of improving the literacy learning outcomes of educationally disadvantaged students. The value of matching the literacy learning readiness profiles of at risk readers with a particular intervention pathway has implications for effective educational provision at the individual student, school and systemic levels. The findings of present study are limited by the number of students that could be included. Future research may examine this for a larger number of students and for students in the middle years of education. It may also lead to improved (1) literacy learning readiness profiles in terms of the cognitive and psycholinguistic knowledge necessary for literacy and (2) more finely oriented and targeted alternative intervention pathways that could be compared.

Future studies may examine the stability of the levels of reading improvement achieved through each intervention over time. The interventions in this project included three teaching procedures that are expected to enhance retention of knowledge: (1) an explicit teaching procedure to assist efficient storage and retrieval from long term memory; (2) the gradual acquisition of self management and self direction strategies as readers; and (3) self efficacy as readers. Future research may examine the influence of each of these on the retention of literacy knowledge over time by 'at risk' readers.

To improve the effectiveness of each intervention on reading comprehension and accuracy, future research may investigate further the differences in psycholinguistic or cognitive ability more and

least likely to be associated with improvement for each outcome. The comparatively low numbers of students in this study do not permit the validation of the literacy learning profiles as diagnostic tools. However, they provide a basis for developing such procedures. The profiles could then be mapped into modified interventions and trialed. The learning characteristics of those students who did not progress for each intervention merit further research.

The present study points to further research to examine the optimal conditions for teaching comprehending strategies such as the sentence level application of visualisation and paraphrasing and for teaching rime units could lead to improved teaching in each of the interventions. This project is based on the belief that the implementation of teaching procedures that are supported empirically are more likely to lead to enhanced learning outcomes.

Identification of the teaching context most likely to facilitate literacy learning merits future consideration. While the findings of the present study suggest that teaching pairs of students may be as effective as individual one to one instruction, at least for some levels of reading disability, more numerous cohorts are necessary to examine this influence empirically. It would be useful to know, for example, which students were most likely to benefit from learning in a group of two and who would benefit more from individual teaching.

The influence of self efficacy on the reading performance of at risk readers merits further research. This may examine the extent to which the gain in self efficacy is a consequence of factors such as involvement in the intervention, the feedback provided, level of success in recent literacy activity, for example, recent high levels of reading accuracy.

Summary

The present study has shown how alternative literacy intervention pathways can lead to the same literacy learning outcomes for Year 2 cohorts who differ in their approach to literacy learning and who are matched to a teaching pathway.

Background of the project

Literacy acquisition remains one of the most important components of child development. Early reading difficulties have been attributed to a range of causes, many constructed in terms on psycholinguistic processes:

- Phonemic and phonological awareness ability (Bus & van Ijendoorn, 1999; Iversen & Tunmer, 1993; Byrne & Fielding-Barnsley, 1995; Velluntino et al, 1996);
- Orthographic knowledge (Berninger & Abbott, 1994) and the rapid naming of alphanumeric symbols (Lovett et al, 2000; Wolf et al, 1999);
- Visual encoding of alphanumeric symbols (Swanson & Alexander 1997; Watson & Willows, 1995);
- Linguistic competence (Catts et al, 2001; Morris et al, 1999);
- Nonverbal competence (ie. Visual-spatial awareness); and
- Memory and learning competence (Watson & Willows, 1995).

Implementing programs that match this range of causes has been problematic. While the success of teaching practices and programs within the early years of schooling (for example, Crevola & Hill, 2001; Wasik & Slavin, 1993) has been clearly demonstrated, some students continue to experience ongoing reading difficulties (Ainley, Fleming & McGregor, 2002). While Reading Recovery, for example, achieves its aim with many students, a number do not make satisfactory progress during the intervention (Reading Recovery Council of North America Report, 1998; Shanahan & Barr, 1995) while others do not sustain the gains achieved during the period of intervention (Ainley, Fleming & McGregor, 2002).

To meet the needs of this group of students, schools have implemented a range of programs such as THRASS, the Spalding Method, Corrective Reading and SWELL. Again, the evidence associated with the implementation of these programs would suggest that not all students benefit equally from the chosen program (Chan & Dally, 2000). The question raised by this finding is not which program works, but which intervention will be the most effective for which student.

A critical issue that needs to be considered in this arena is that specific factors may be more significant at particular times in the literacy learning process (Muter & Snowling, 1998); (Hiebert & Taylor, 2000). What is acknowledged is that schools have a limited time in which to ensure students have commenced literacy acquisition with studies showing that students who are well behind their peers by Year 3 remain so for the remainder of their schooling (Foorman, Fletcher, Francis, Schatschneider & Mehta, 1998). Crevola & Hill (1997) commented on the lack of success of programs focused on resolving reading difficulties for students beyond the second year of school.

The development of intervention programs for young at risk readers that target specific aspects of reading difficulty have attracted increased interest in recent years. A recent study by Lovett, Steinbach & Frijters (2000) compared the effectiveness of three teaching approaches with readers

who had either a phonological deficit, a rapid naming deficit or a double deficit. These were a metacognitive phonics program, an explicit phonological training program and a control program that taught organizational strategies, academic problem solving, study and self help techniques rather than specific literacy training. The three categories of reading difficulty improved, with the metacognitive phonics program improving word reading best while the phonological training program improved phonological knowledge. A second recent study by Wolf, Miller & Donnelly (2000) describes a teaching approach (called RAVE-O) that helps readers with rapid automatized naming (or 'RAN') difficulties to improve their automaticity in naming letter clusters, their understanding of word meanings and links between them and their word retrieval activities. Again, a phonological training program was used simultaneously with RAVE-O.

The approach to linking specific literacy learning readiness profile with a matched intervention, proposed to be used in this project, was used earlier by Munro & McCusker (2002). This exploratory investigation provided partial validation for the profile-intervention matching procedure for Year 1 at risk students. The study identified the cognitive and psycholinguistic factors that predicted reading performance of Year 1 readers, for a sample comprising 310 at risk readers and 160 good progress readers. These factors led to the identification of 'categories' or 'types' of reading difficulty in the at risk group, based on the cognitive and psycholinguistic factors. These were used to generate the literacy learning readiness profile.

The investigation involved an initial exploration of the efficacy in matching the profile of a reader with the most effective intervention pathway. Three intervention pathways, similar to those proposed for the present study, were implemented; the phonological awareness, orthographic processing and comprehension strategy pathways. At risk readers were allocated randomly to these. A comparatively restricted intervention duration of 20 sessions each of 30 minutes duration led to reading gains of up to twelve months for some of the students. Some of these students had earlier received intervention from the Reading Recovery program but continued to be at-risk following their involvement in Reading Recovery.

This review provides a brief review of the research and theory underpinning activities of the proposed project.

Project aims and objectives

The aim of this project was to evaluate the effectiveness of three intervention options for students in Year 2 who have been identified as at-risk of experiencing ongoing reading difficulties. The three alternative intervention pathways targeted were:

- phonological knowledge and skills relevant to text reading;
- orthographic knowledge and skills relevant to text reading; and
- oral language comprehension knowledge and skills relevant to text reading.

Each student, on the basis of her/his 'literacy learning readiness profile', was allocated to one of the intervention pathways.

Learning to be literate requires a knowledge of areas of oral language (or psycholinguistic knowledge) and ways of thinking (or cognitive knowledge). The profile described student knowledge in a number of psycholinguistic and cognitive areas necessary for learning to be literate. The profiling procedure was validated in an earlier investigation of the 'literacy learning readiness' of Year 1 at risk students (Munro & McCusker, 2002). The approach to linking specific literacy learning readiness profile with a matched intervention was also used in the earlier study.

Examples of these areas of psycholinguistic and cognitive knowledge necessary for learning to be literate include the following:

- phonemic and phonological awareness; repetition of nonsense words, rhyme detection, phonemic blending, segmenting, phonemic deletion, matching spoken and written forms of words;
- orthographic processing; learning alpha-numeric symbols, orthographic processing for words, learning an orthographic code, visual symbolic processing;
- oral language knowledge; vocabulary, listening comprehension and syntactic knowledge, receptive and expressive vocabulary, verbal analogies, expressive schema knowledge;
- rapid automatic naming; naming rapidly items by colour, size and shape;
- short term memory processing; short term memory for words, sentences, list learning, visual short term memory for letters and objects; and
- general nonverbal reasoning; nonverbal competence and visuospatial processing.

Participants involved and their selection

Identification of students

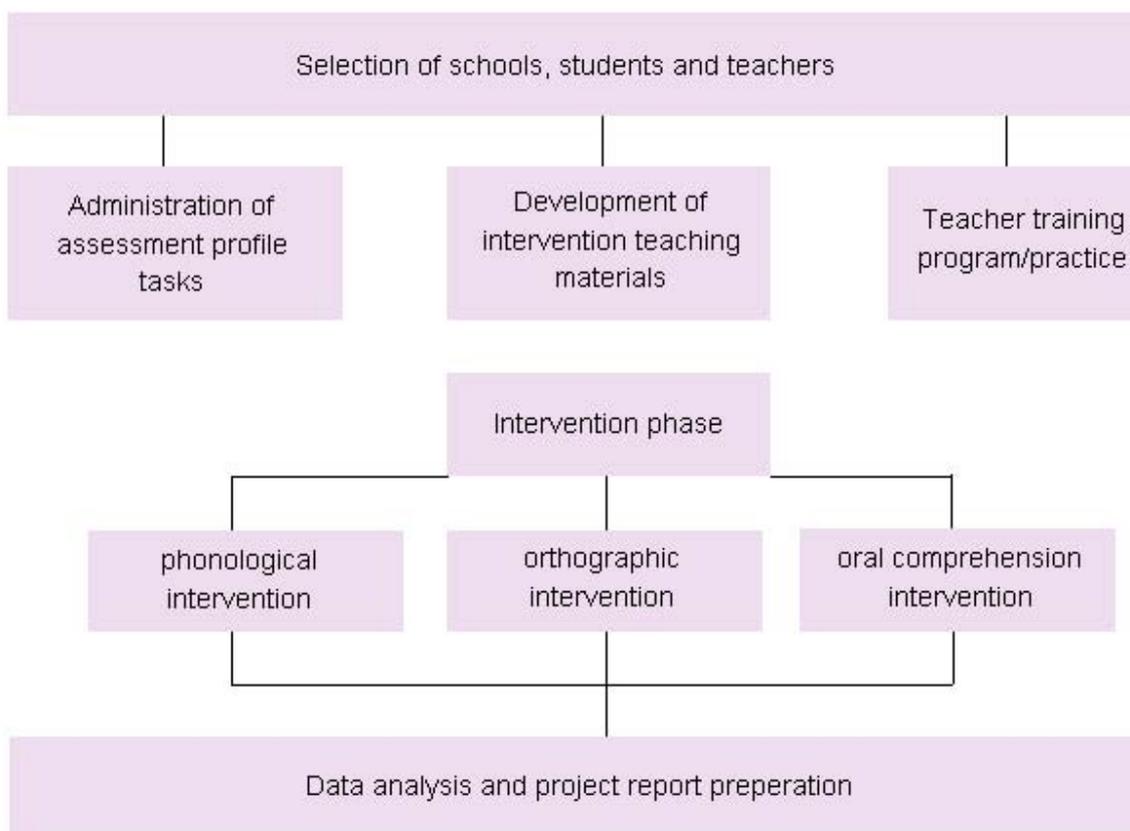
The 'literacy at risk' Year 2 students involved in the project attended 7 Catholic primary schools in the Archdiocese of Melbourne. They came from a group of students who had been identified as experiencing ongoing reading difficulties by their schools on the basis of their performance on literacy assessment tasks (prose and isolated word reading tasks).

In all, 48 students were selected for involvement in the study. All displayed prose and isolated word reading ability in the 'at risk' range, that is, in the lowest 25th percentile range. The reading assessment scales used for this identification are described in the following section. Of the group of 'at risk' students, 27% had attended Reading Recovery during Year 1.

The performance of the 'at risk' readers was compared with that of a group of 'good progress' readers. The good progress group comprised 55 Year 2 students whose reading ability in both accuracy and comprehension was judged by their schools as displaying average reading ability. Their performance on literacy assessment tasks (prose and isolated word reading tasks) exceeded the 25th percentile.

The key phases in project implementation

The key phases in the implementation of the project were as follows:



Assessment materials used

The following assessment materials were used:

- The Neale Analysis of Reading Ability (Third Edition; Neale, 1999) was used to assess students' prose reading accuracy, comprehension and fluency, the Burt Word Reading Test (Gilmore, Croft & Reid, 1981) was used to assess isolated word reading and Clay's Text Level identification procedure (Clay, 1993) was used to assess independent reading level attained by students.
- The set of tasks used to assess psycholinguistic and cognitive knowledge in areas necessary for learning to read collated by Munro & McCusker (2002). These tasks assess knowledge in the following areas:
 - phonological awareness; phonemic blending and segmenting;
 - orthographic processing; learning an orthographic code and orthographic processing of words;
 - synthesizing graphemic and phonological knowledge (letter cluster – sound linking and spoken – written word matching);
 - oral language knowledge; listening comprehension, story schema, imitative syntax. Expressive syntax receptive syntactic awareness, receptive vocabulary and verbal analogies;
 - rapid automatic naming; RAN for letters and for digits;
 - alpha-numeric symbolic encoding; visual symbolic processing;
 - short term memory processing; visual memory for objects and for letters, short term memory for words and phonological short term memory; and
 - general reasoning (both verbal and nonverbal).

A literacy learning readiness profile was compiled for each student using the profiling procedure validated for Year 1 literacy at risk students (Munro & McCusker, 2002). The profile refers both to students' accuracy and automaticity in manipulating psycholinguistic and cognitive information during literacy-related tasks.

Following this compilation, of the 48 students selected, 22 were judged as likely to benefit from a phonological-phonemic focus, 12 from an orthographic focus and 14 from an oral language comprehension focus. Each student was allocated to either the phonological, orthographic or oral language comprehension intervention based on the area of need indicated by the profile.

Program material used

The program materials and tasks used for each intervention pathway are as follows.

Phonological awareness pathway

Each teaching session targeted a particular onset and/or rime unit. For one syllable words this is that part that includes the vowel and following consonants. The rime unit in the word 'stamp' is 'amp'. The activities, task description and time allocated to each activity were as follows:

- Text Reading (Shared Reading Strategy): Students re-read text from previous session (5 mins). The text contained a high portion of words that had onset and or rime units already taught phonologically.
- Rhyming Activities: The student saw three pictures, two of which had the rime unit targeted in the session (and that rhyme) and identified the non-rhyming word (10 Trials, 3 mins).
- Blending Task: The student heard a target word that had the target rime said in separate sounds and blends these to say whole word (10 Trials, 3 mins).
- Segmentation Task: The student heard a target word that contains the target rime and identifies each sound in sequence by putting a counter in each box for a three or four box sequence (10 Trials, 3 mins).
- Reading Target Words: The student read words that had the target rime and was cued to identify rime unit and onsets (3 mins).
- Writing Target Words: The student wrote words that had the target rime (3 mins).
- Text Reading: The student read prose that had the targeted rime and onset units and retold the story (7 mins).
- Reflective: The student commented on what has been learnt in the session (3 mins).

Orthographic processing pathway

Each teaching session targeted a particular letter cluster unit. The activities, task description and time allocated to each activity were as follows:

- Text Reading: The student re-read text from previous session (5 mins). The text contained a high portion of words that have letter cluster units already taught orthographically.
- Reading Target Words: The student was cued to read written words that contain targeted rime and/or onset letter cluster units (3 mins). If this task is completed accurately, the student goes to the Reading Text task. Otherwise the student goes to the blending task.
- Blending Task: The student blended written onsets and rimes into words (10 trials, 3 mins).
- Segmentation Task: The student segmented a written word containing the onset and/or rime letter cluster into sounds. The student also segmented mixed-rime words (10 trials, 3 mins).
- Writing Target Words: The student wrote the target words (3 mins).
- Text Reading: The student read new text that had words with the targeted onset and/or rimes and retold the story (7 mins).
- Reflective: The student commented on what has been learnt in the session (3 mins).

Oral language comprehension pathway

Each teaching session targeted the use of a comprehension strategy developed initially in oral language contexts and then applied to reading. A useful comprehending strategy involves readers making a mental picture of the text while reading silently and modifying it as the reading continues.

After they have read the first sentence of a text, readers picture it and add to this as they continue reading. When they need to recall the ideas, they 'replay the videotape' to themselves and talk about what they see. Teaching visualization strategies improves reading comprehension for reading underachievers (Clark, 1984; Levin, 1973). The visualization assists readers to monitor the ideas read and to recognise clashes between the present and earlier ideas, to predict and to guess the meanings of unfamiliar words.

One version of this strategy is the RIDER strategy (Clark, 1984). Readers (1) read a portion of print; (2) imagine or 'make a picture in their minds'; (3) describe the image or draw pictures of what they have read; (4) evaluate the image for correctness; check the image against the text; and (5) repeat the process. The RIDER strategy was taught initially. The activities, task description and time allocated to each activity were as follows:

- Text Re-telling: The student re-told the text read in the previous session, said the mental pictures she/he had re the text. The student can use pictures from the text to re-construct its theme (3 min).

- Text Reading (Shared Reading Strategy): The student and teacher re-read the text from the previous session. The teacher demonstrated use of the RIDER strategy during the reading (5 mins).
- Picture Drawing: The student described the picture s/he had imagined (5 mins).
- Reading Target Words: The student matched key content words from the text to be read with reference pictures, by sorting word cards, placing each card on pictures in story it represented (3 mins).
- Writing Target Words: The student wrote key content words from the text to be read by copying each from its card (3 mins).
- Text Reading (Shared Reading Strategy): The student said the RIDER Strategy (or part of it) before beginning to read (8 mins).
- Reflective: The student commented on what has been learnt in the session (3 mins).

The progression of oral language comprehension strategies taught are:

- use of RIDER strategy (sessions 1-10); and
- use of text questioning strategy and incorporated with RIDER strategy (What is the name of the story? What do I already know about this? What do I think will happen in the story?) (Sessions 11 – 20).

The set of activities used to teach retelling and paraphrasing are as follows:

- Text Retelling: Students (1) re-told the text from the previous session, saying what they remembered about it (3 – 5 mins) and (2) were cued to retell in their own words sentences read to them from the story they read in the previous session (5 mins).
- Text Reading (Shared Reading Strategy): Students and teacher re-read the text from the previous session. The teacher cued the use of paraphrasing during the reading. The reader read each sentence and retold it, changing as many words as possible (5 - 8 mins).
- Synonyms (Text from Previous Session): Students matched key content words from the text to be read with synonyms, by sorting word cards and placing each card on a synonym in the story (3 - 6 mins).
- Reading Target Words (New text; 3 - 6 mins).
- Writing Target Words for a new text: Students wrote key content words from the new text to be read by copying each from its card (3 - 6 mins).
- Text Reading (shared reading strategy for new text): Students say the paraphrasing strategy before they begin to read: “After I have read each sentence I will try to say it my way. I will change as many words as I can” student reads passage. Teacher cues the student to paraphrase aloud after each sentence read in the text (8 - 12 mins).
- Reflective: Student comments on what has been learnt in the session (3 mins).

In each intervention pathway, every fifth session was a review session. This session included the re-administration of measures of prose and isolated word reading (prose reading comprehension and accuracy, word reading accuracy and orthographic knowledge for text similar to those used on intervention teaching) described earlier and students' reading self-efficacy.

Methodological procedures used

As noted earlier, the three interventions were based on areas of areas of knowledge that characterised areas of literacy underachievement:

- phonological knowledge and skills relevant to text reading;
- orthographic knowledge and skills relevant to text reading; and
- oral language comprehension knowledge and skills relevant to text reading.

Each of these interventions was administered either individually to students or to small groups of students. In each intervention, students were assigned randomly to either the one-to-one option or the small group option. The intervention sessions were implemented in the students' schools.

Each intervention pathway consisted of 30-minute sessions on each school day for 15 weeks (or its equivalent). Reading assessment measures were administered to all students prior to and after the teaching period. The texts used were written expressly for the three interventions and were based on the words to be taught in each session. They were ordered in terms of readability. The same texts were used for the three interventions.

Both the pre- and post- assessments and the interventions were administered by qualified teachers who were received specific training in the administration of the three pathways. Steps to control variation in teaching style included practice sessions and a moderation process to ensure that all teachers implemented a similar intervention. Feedback from the teachers during the early stages of the implementation permitted the researchers to modify aspects of the intervention routine.

Detailed report of the findings of the initiative

This investigation examined the efficacy of matching the literacy learning profiles of at risk Year 2 readers with the intervention pathway judged to be most effective. The readers achieved below the 26th percentile in reading comprehension and accuracy on standardized tasks. The three intervention pathways that were compared were the phonological, orthographic and oral comprehension interventions.

As noted earlier, each student was placed in one of the intervention groups based on their area of need indicated in their literacy learning profile. Those allocated to the phonological intervention had displayed, in the assessment of their psycholinguistic and cognitive knowledge in areas necessary for learning to read, specific difficulties in this area, orthographic or oral language comprehension intervention.

Literacy learning characteristics of sub-groups of 'at risk' readers

The learning characteristics of the subgroups of Year 2 at risk readers, described on the range of cognitive and psycholinguistic factors necessary for early learning to be literate, are shown in Table 1, in terms of mean performance on each characteristic.

Table 1: The cognitive and psycholinguistic characteristics of the students comprising the three interventions (means, standard deviations)

Area of Psycholinguistic and Cognitive Knowledge	Phonological (n = 23)		Oral Comprehension (n =17)		Orthographic (n =13)	
	mean	sd	mean	sd	mean	sd
Phonemic, phonological knowledge						
Phonemic blending total	3.43	1.08	3.82	.39	3.69	.63
Phonemic segmenting (simple)	2.87	1.10	3.88	.49	3.77	.44
Phonemic segmenting (complex)	.78	1.09	3.06	1.43	2.15	1.28
Oral language						
Listening Comprehension	5.35	2.77	5.71	2.28	5.31	2.29
Story Schema	3.00	1.28	3.12	1.45	3.08	1.12
Imitative syntax	7.18	2.68	8.71	3.24	8.38	3.52
Expressive syntax	8.65	3.42	8.82	3.15	9.69	3.33
Receptive syntactic awareness	8.52	2.94	9.71	2.62	8.69	3.79
Receptive vocabulary	86.52	8.31	89.12	7.98	87.62	8.62
Verbal analogies	8.13	1.42	8.18	.95	7.85	1.21
Visual symbolic, orthographic processing						
Visual memory for objects	2.74	1.14	2.82	1.13	3.69	1.03
Visual memory for letters	9.52	1.78	10.71	1.05	10.15	1.34
Learning an orthographic code						
Visual symbolic processing	12.61	2.81	12.41	2.18	12.08	2.87
Orthographic processing of words	9.74	2.00	10.00	1.37	9.54	2.70

Rapid Automatic Naming (RAN)						
Rapid automatised naming of letters (sec)	39.26	8.78	33.97	8.53	45.23	12.75
Rapid automatised naming of digits (sec)	42.08	8.03	38.58	8.57	46.80	14.91
Short term memory						
Short term memory for words total	18.09	5.57	21.12	5.49	20.23	5.86
Phonological short term memory	10.83	4.24	15.47	4.23	12.38	3.71
Reasoning scores						
Verbal reasoning standard score	77.39	18.51	76.18	17.37	73.62	23.12
Nonverbal reasoning standard score	88.65	10.31	88.88	9.98	89.46	15.03

Comparison by inspection of the mean performance of the intervention groups supports their existence. The following discussion examines these differences further.

Differences in psycholinguistic or cognitive ability between the three intervention groups

Differences between the three intervention groups were examined using One-way ANOVA and comparison of mean performance for each psycholinguistic or cognitive ability. In this comparison, the performance of the phonological, orthographic and oral comprehension intervention groups are compared.

The phonological intervention group had the lowest achievement levels on several of the abilities. They:

- retained fewer letters in visual memory for letters ($t(38) = -2.443, p < .019$) and fewer sound sequences in phonological short term memory ($t(38) = 3.42, p < .001$) than the oral comprehension group; and
- had lower phonemic segmentation ability than the other two groups; they were less able to segment both shorter words (for the oral comprehension group, $t(38) = 3.54, p < .001$; for the orthographic group, $t(34) = 2.81, p < .001$) and longer words (for the oral comprehension group, $t(38) = 5.718, p < .001$; for the orthographic group, $t(34) = 3.412, p < .01$).

The orthographic intervention group retained more objects in visual memory for letters than the oral comprehension group ($t(38) = 2.164, p < .05$), had lower phonological short term memory ($t(28) = 2.08, p < .05$) and took longer to name automatically letters ($t(28) = 2.89, p < .001$) and digits ($t(28) = 2.37, p < .05$).

Differences in learning letter cluster knowledge between the three intervention groups

The mechanisms involved directly in learning letter cluster knowledge, that is, learning letter cluster – sound links and learning to match spoken and written letter cluster information are shown in Table 2.

Table 2: Mean scores of each intervention group for the mechanisms involved in learning letter cluster knowledge

Area of Letter Cluster – Sound Processing	Phonological (n = 23)		Oral Comprehension (n = 17)		Orthographic (n = 13)	
	mean	sd	mean	sd	mean	sd
matching spoken and written letter cluster information	10.52	1.08	10.88	1.11	10.85	.80
matching spoken and written letter cluster information automatically	5.83	2.23	7.41	2.48	6.31	1.44
learning letter cluster – sound links	5.96	2.88	9.76	1.82	8.62	2.10
using letter cluster – sound links automatically	3.61	3.49	8.06	3.60	3.62	3.12

The oral comprehension group had the best developed mechanisms for learning letter cluster knowledge and the phonological group the least developed knowledge. The comprehension group was more able to use letter cluster – sound links automatically than the orthographic group ($t(34) = 3.54, p < .01$) and the phonological group ($t(38) = 3.98, p < .01$). This group was well more able than the phonological group to learn letter cluster – sound links ($t(38) = 4.77, p < .01$) and more able to match spoken and written letter cluster information automatically ($t(38) = 2.12, p < .01$). The orthographic group had higher letter cluster – sound links than the phonological group ($t(34) = 2.90, p < .01$) but not use letter cluster – sound links more automatically.

Differences between the three groups in the knowledge they have for learning to read was examined by identifying how their psycholinguistic or cognitive abilities correlated with learning to read words. Patterns in the correlations between particular psycholinguistic or cognitive abilities

and letter cluster knowledge by each group are shown in Table 3. The strength of the correlation used (Pearson's correlation coefficient) is shown in the relative size of the value in each case.

Table 3: The psycholinguistic or cognitive abilities associated with learning letter cluster knowledge by each intervention group (2-tailed Pearson correlation)

	Skill to use letter cluster – sound links automatically	Skill to match spoken and written letter clusters	Skill to match spoken and written letter clusters automatically
Imitative Syntax		Phonological r(21) = .44*	
Phonemic segmenting (simple)	Phonological r(21) = -.43*	Phonological r(21) = -.55**	
Phonemic segmenting (complex)		Phonological r(21) = -.52**	Phonological r(21) = -.43*
Time taken for rapid automatised naming of letters	Phonological r(21) = -.540** Oral comprehension r(16) = -.58*	Phonological r(21) = -.626**	
Time taken for rapid automatised naming of digits	Oral comprehension r(16) = -.51*	Phonological r(21) = -.560**	
Phonemic blending total		Orthographic r(13) = .56*	
Short term memory for words total			Orthographic r(13) = .57*
Receptive Syntactic Awareness		Oral comprehension r(16) = .57*	

* Correlation is significant at the 0.05 level (2-tailed); $p < .05$.

** Correlation is significant at the 0.01 level (2-tailed); $p < .01$.

This analysis suggests that a case is made for each of the three interventions. For the phonological intervention group, abilities in imitative syntax, phonemic segmenting and the time

taken for rapid automatised naming of letters influenced aspects of letter cluster learning. Lower ability in these areas was linked with lower letter cluster learning capacity.

For the orthographic intervention group, the ability to blend sounds and to retain a string of words in short-term memory influenced aspects of letter cluster learning. Those students less able to blend sounds or to retain information in short term memory had greater difficulty learning letter patterns.

For the oral comprehension intervention group, the ability to name letters and digits automatically and to use grammar influenced their letter cluster learning. Those students less able to retrieve the names of items relatively automatically or to use grammar had greater difficulty learning letter patterns.

This analysis has direct implications for the implementation of early literacy intervention programs. It indicates that multiple literacy learning profiles are likely to exist in a cohort of reading underachievers. In any group of literacy underachievers, some may have immature phonological and phonemic knowledge, some may have difficulty learning letter clusters and some may have immature oral language knowledge necessary for comprehending text.

The analysis identifies the areas that characterize some of the learning profiles of these students. If it can be shown that the different learning profiles benefit from different interventions that match their literacy learning characteristics, it indicates the need for both differential diagnostic tools and for teaching that accounts for these.

Conclusions

Reading gains for each intervention

The gain in reading score for both comprehension and accuracy, for each student was calculated as a gain in reading age in months. General linear modelling procedures were used to examine whether the type of intervention the students had and the context in which they were taught influenced gains in either reading comprehension or accuracy.

Gain in reading comprehension was influenced both by the type of intervention ($F(2, 40) = 4.18$) and by the teaching context ($F(2, 40) = 5.56$). In other words, one of the interventions led to greatest improvement for teaching groups of both sizes (that is, the interaction of type of intervention x teaching context did not achieve significance ($F(3, 40) = 1.01$)).

Gain in reading accuracy, on the other hand, was not influenced either by the type of intervention or the teaching context ($F(2, 40) = 1.63$). The improvement was much the same for all three interventions and size of the teaching group (that is, the interaction of type of intervention x teaching context did not achieve significance ($F(3, 40) = 1.69$)).

Multiple comparisons procedures allow you to compare the extent of improvement for the three interventions in each teaching group. The results confirmed the interpretation above. The three types of intervention differed in their influence on comprehension but not on accuracy. Mean accuracy gains were similar across the various conditions.

All of the interventions improved students' reading accuracy and comprehension. The mean pre- and post intervention scores, in terms of reading age and standard deviations and the mean chronological age for each group (in months) are shown for each intervention in Table 4. The 2-tailed paired samples t-test value for each change, also shown, indicates that the post-intervention reading score was higher than the pre-intervention score for all conditions. The change in reading age for the good progress readers over the same period is also shown.

Table 4: The mean pre- and post accuracy and comprehension reading scores (mean reading age in months, standard deviation) for each intervention

	Intervention condition							
	Phonological (n = 22)		Orthographic (n = 11)		Oral Comprehension (n = 13)		Good Progress (n = 55)	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Accuracy reading outcome								
pre	79.5	6.7	76.7	6.0	87.0	8.8	107.0	11.2
post	87.1	6.7	83.4	6.9	91.4	6.6	115.3	17.8
t-test	t(21) = -6.00**		t(10) = -2.32*		t(12) = -2.31*		t(54) = -4.80**	
age	94.7	5.74	94.6	3.8	95.2	7.3	94.9	4.0
Comprehension reading outcome								
	n = 22		n = 12		n = 14			n = 55
pre	75.9	5.3	76.1	5.2	76.5	4.2	103.5	13.4
post	87.8	8.4	83.7	9.8	90.7	6.2	113.5	19.1
t-test	t(21) = 6.39**		t(11) = -2.51*		t(13) = -9.73**		t(54) = -5.22**	
age	94.7	5.74	94.1	3.6	95.8	7.1	94.9	4.0

* $p < .05$, ** $p < .01$

The three interventions did not differ in their effectiveness on enhancing accuracy but did differ in improving comprehension. Analysis of variance procedures with the post intervention score as the dependent variable and the pre intervention score as the covariate indicated that the three interventions were equally effective in improving accuracy ($F(2, 37) = 2.46$). For comprehension, on the other hand, the oral language comprehension extended comprehension more than the other interventions ($F(2, 37) = 3.893$, $p < .05$).

The issue of whether one reading outcome was improved more than the second was examined by comparing the mean gains in comprehension and accuracy for each intervention. Comprehension improved more than accuracy during phonological intervention (paired samples t-test, $t(21) = 2.145$, $p < .05$, 1-tailed), but not during either orthographic training ($t(11) = .84$) or during oral language comprehension training ($t(13) = .21$).

As well, the gains in the three intervention contexts did not differ from the gains in accuracy and comprehension made by the good progress readers over the same period. Comparison of the mean gains (Oneway ANOVA, independent samples t-test for comparison of means) indicated that the gains did not differ ($p > .05$). The at risk readers with the interventions made gains of the same size as good progress readers exposed to regular instruction.

Distribution in gains in reading accuracy

Although all interventions improved reading accuracy, not all students experienced the same level of improvement. For each intervention group and the good progress readers, some readers showed greater improvement than others. The percentage of students showing each gain in reading accuracy are shown in Table 5 and in Figures 1 to 4.

Table 5: The percentage of students making each gain in reading accuracy (frequency) for each intervention group and the good progress readers

Range of Gains	Phonological (n =22)	Orthographic (n =11)	Oral Comprehension (n =13)	Good Progress (n =55)
< -6	5	9	8	7
-6 to -4	5	0	8	5
-3 to 0	6	9	15	5
0 to 3	9	9	15	22
4 to 6	18	28	15	13
7 to 9	23	0	15	11
10 to 12	9	9	8	9
13 to 15	21	27	8	7
16 to 18	4	9	8	5
18+	0	0	0	16

Figure 1: Frequency of each gain in reading accuracy for phonological training

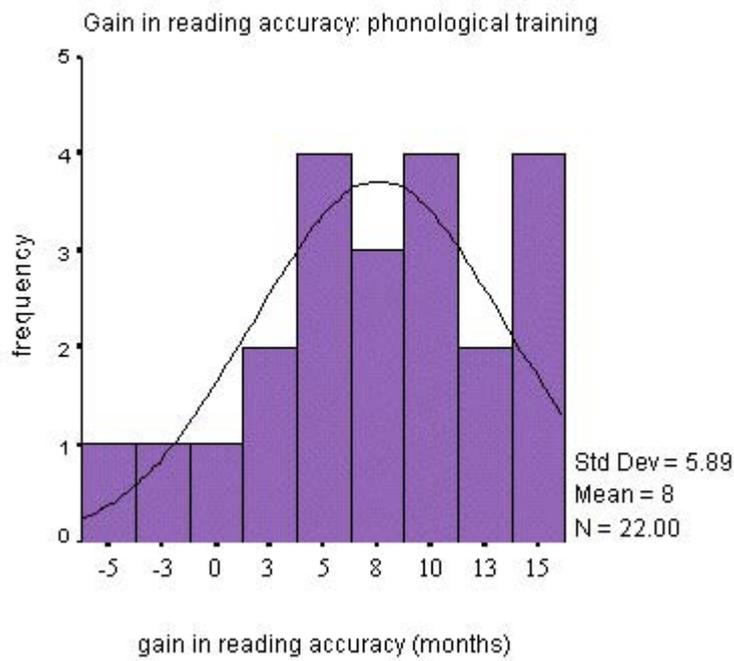


Figure 2: Frequency of each gain in reading accuracy for orthographic training

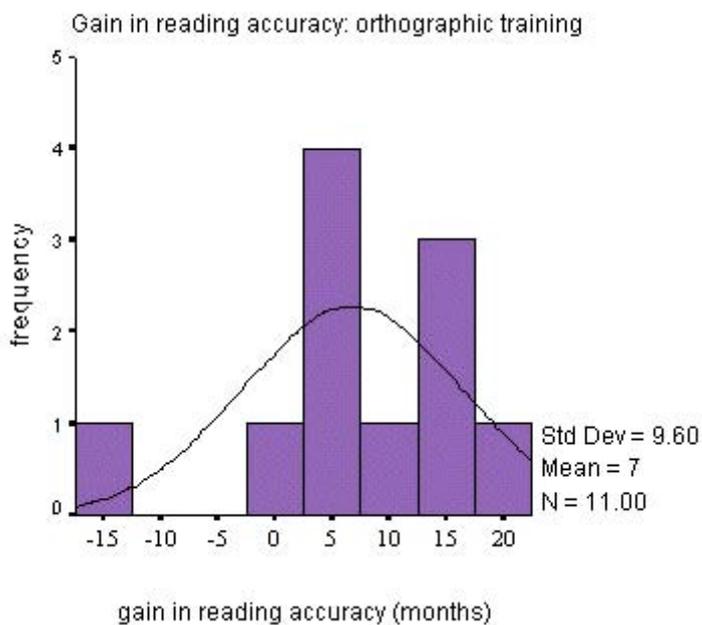


Figure 3: Frequency of each gain in reading accuracy for oral comprehension training

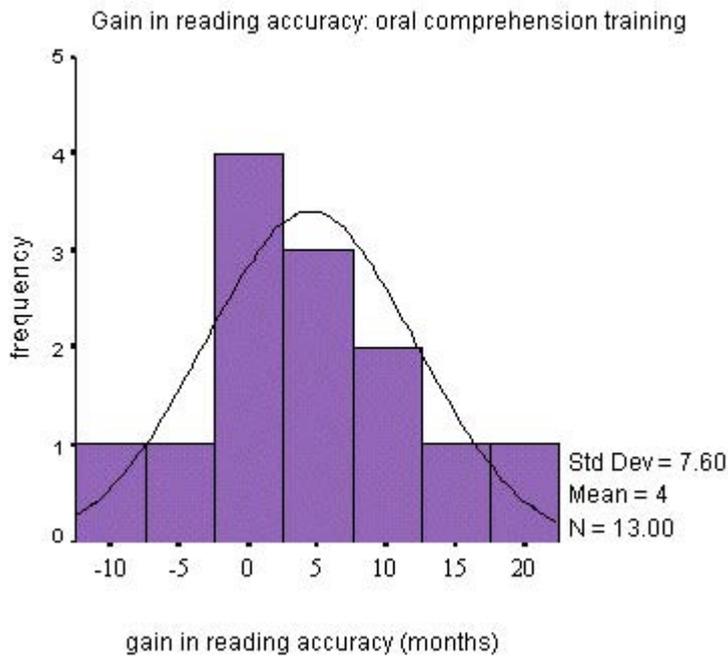
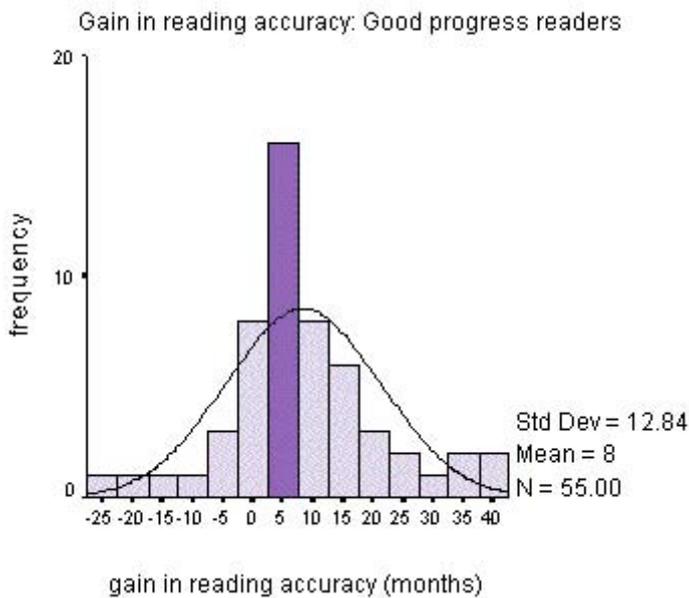


Figure 4: Frequency of each gain in reading accuracy for good progress readers



These data show that the interventions were associated with gains that were spread along the spectrum of achievement. A small portion of each intervention did not progress, while others made a substantial gain. The distributions were similar to that displayed by the good progress readers.

The students who had lowest gains

Both good progress and at risk readers showed apparent decreases in their reading accuracy. There are several possible explanations for this, one being that, for the at risk readers, the intervention did not target their approach to literacy learning.

To examine the literacy learning characteristics of these students further, differences in psycholinguistic and cognitive abilities between those who made greatest and least gains were examined by dividing each intervention group into three sub-groups of roughly equal size. The two groups were compared on all of the psycholinguistic or cognitive abilities using the independent samples t-test. It should be noted that the number of students in each group was comparatively small, restricting generalisation of the findings. Given this limitation, the following patterns were observed:

- for the phonological group, those students making least gains in reading accuracy performed lower than those making the greatest gains on verbal analogies ($t(13) = 3.09$, $p < .01$) and short term memory for a string of words ($t(13) = 2.15$, $p < .05$). These two areas of learning suggest that these students had, in addition, needs that were targeted by the oral comprehension intervention.
- for the orthographic group, the group making least gains in accuracy performed lower than the group making the greatest gains on expressive syntax ($t(6) = -2.55$, $p < .05$), phonemic segmenting for shorter words ($t(6) = -2.73$, $p < .05$) and orthographic processing of words ($t(6) = 2.41$, $p < .05$). The first two areas of learning suggest that these students had, in addition, needs that were targeted by the oral comprehension and the phonological interventions.
- for the oral comprehension group, the group making least gains in accuracy performed lower than the group making the greatest gains on receptive syntactic awareness ($t(7) = -2.45$, $p < .05$) and phonemic segmenting for longer words ($t(7) = -2.61$, $p < .05$). These areas of learning suggest that these students had, in addition, needs that were targeted by the phonological intervention.

These findings suggest that those who made least gains given each intervention had learning needs that were not covered by the particular teaching implemented.

The two sub-groups did not differ on any of the tasks assessing learning letter cluster knowledge.

Distribution in gains in reading comprehension

The percentage of students showing each gain in reading comprehension for each intervention group are shown in Table 6.

Table 6: The distribution of gains in reading comprehension (percent frequency) for each intervention group and the good progress readers

	Phonological (n = 22)	Orthographic (n = 12)	Oral Comprehension (n = 14)	Good Progress (n = 55)
< -6	0	8	0	7
-6 to -4	4	8	0	6
-3 to 0	0	0	0	8
0 to 3	9	17	0	20
4 to 6	13	17	14	13
7 to 9	13	0	0	5
10 to 12	17	0	21	7
13 to 15	4	8	22	3
16 to 18	18	25	21	7
19 to 21	4	0	7	9
22 to 24	10	8	14	1
> 24	9	0	0	14

Figure 5: Frequency of each gain in reading comprehension for phonological training

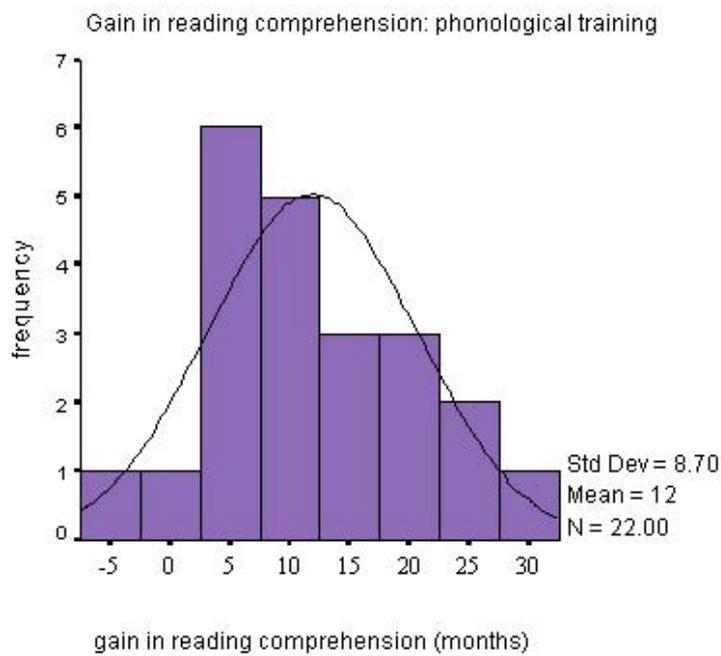


Figure 6: Frequency of each gain in reading comprehension for orthographic training

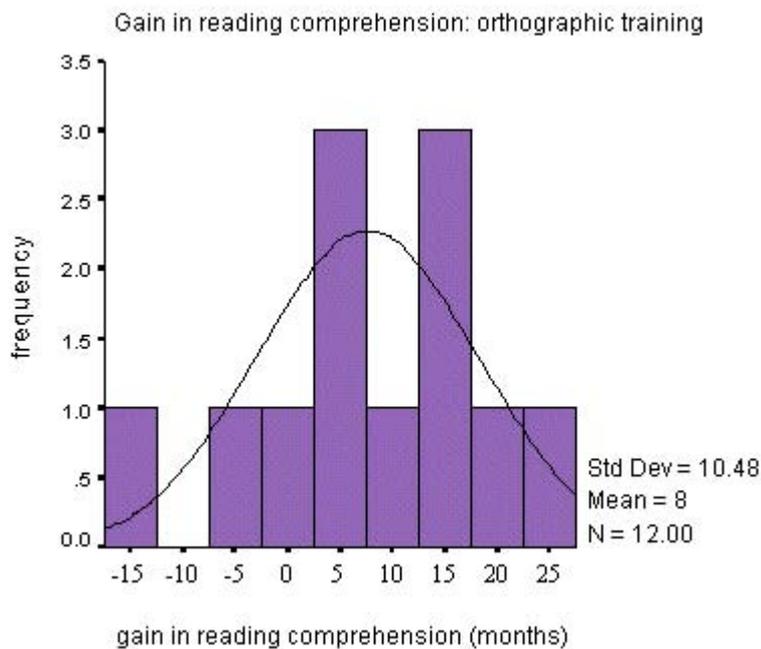


Figure 7: Frequency of each gain in reading comprehension for oral comprehension training

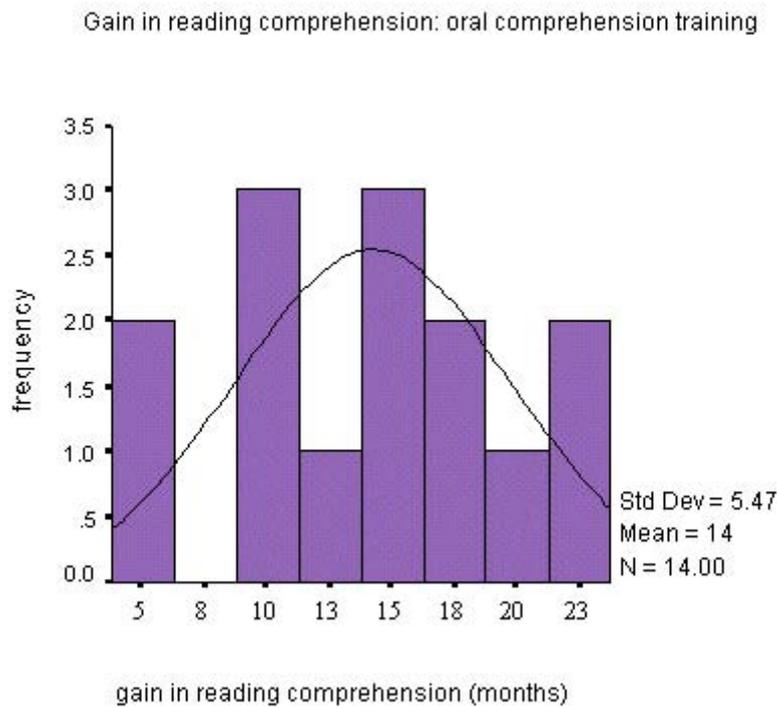
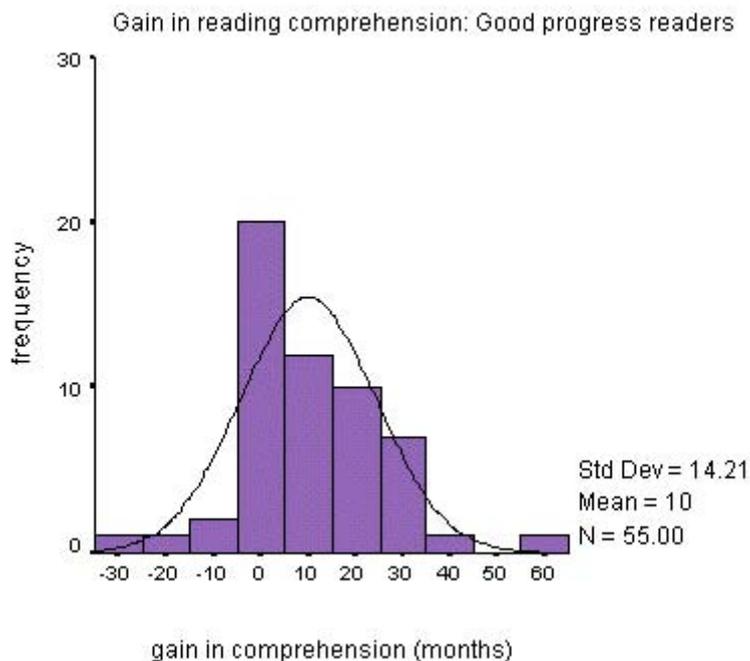


Figure 8: Frequency of each gain in reading comprehension for good progress readers



Differences in psycholinguistic or cognitive abilities between those who made greatest and least gains were examined by dividing each intervention group into three sub-groups of roughly equal size. The two groups were compared on all of the psycholinguistic or cognitive abilities using the independent samples t-test. It should be noted that the number of students in each group was

comparatively small, restricting the generalisation of the findings. Given this limitation, the following patterns were observed:

- for the phonological group, the group making least gains in reading comprehension performed lower than the group making the greatest gains on phonological short term memory ($t(14) = 2.77, p < .05$).
- for the orthographic group, the group making least gains in accuracy performed lower than the group making the greatest gains on nonverbal reasoning ($t(6) = -2.58, p < .05$).
- for the oral comprehension group, the two groups did not differ on any of the measures.

Explaining the lower reading comprehension performance for each of the interventions was more difficult than the lower reading accuracy. Further research may be necessary to identify the key influences here. The issue of whether the same students in each intervention achieved negative gains in both areas was investigated by examining the correlation between the gains in each area. The extent of association for the three interventions was generally low ($p > .05$). Of the six students who displayed negative gains in accuracy, two also displayed negative gains in comprehension.

The two sub-groups did not differ on any of the tasks assessing learning letter cluster knowledge.

Comparison of the relative effectiveness of the teaching formats

As noted earlier, each interventions was implemented in three teaching contexts; teaching students individually (or '1:1' teaching), teaching groups of two students or groups of three students. Students were allocated randomly to one of these contexts.

An anecdotal observation was the influence of the number of children in each intervention context on students' attitude to reading and themselves as readers. It seemed that students in the small group contexts learnt more easily than those in the individual interventions. Anecdotal teacher reports indicated (1) an observable improvement in students' confidence as readers (2) an increased tendency for the students to work co-operatively and to support and assist each other, (3) improved school attendance rates for some students involved in the study and (4) improved student sense of security in the regular classroom. Teachers described students in the small groups as 'feeding off each other' and modelling for each other how to learn to read. The students in the individual interventions were more likely to present as 'struggling'. The 1:1 intervention was seen as more effective for those students who displayed high level of behavioural and social interaction difficulties or severe pronunciation difficulties.

The present section examines the quantitative support for these anecdotal observations. The format or context for the teaching influenced the gain in reading ability for both prose reading accuracy ($F(2,37) = 6.40, p < .01$) and comprehension ($F(2,37) = 3.83, p < .05$). The interaction of teaching format x type of intervention did not influence the gain in reading performance.

Gain in accuracy in each context for each intervention

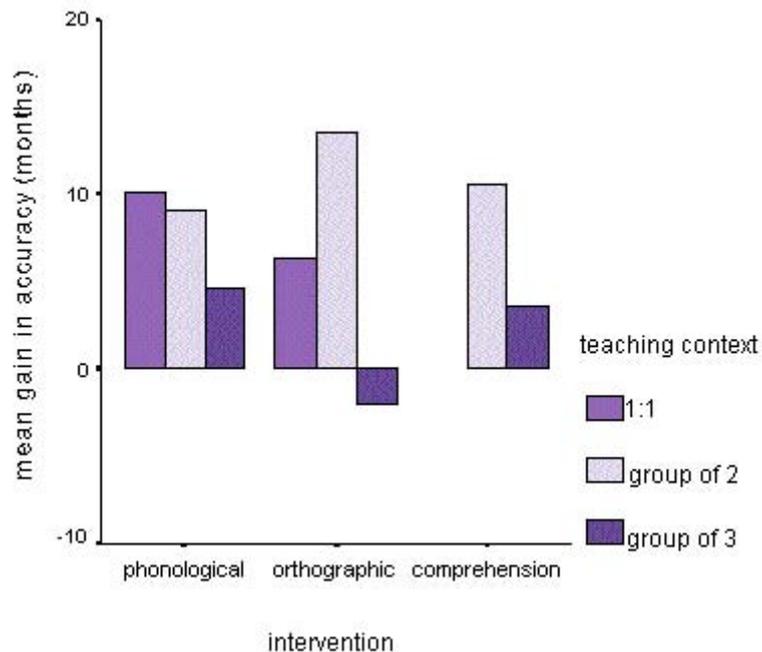
The mean gain score and standard deviation for each teaching context for each of the intervention conditions is shown for prose reading accuracy in Table 7 and Figure 9.

Table 7: The mean accuracy gain score (months) and standard deviation for each teaching context for each intervention condition

Teaching Context	Phonological (n = 22)			Orthographic (n = 12)			Oral Comprehension (n = 14)		
	mean	sd	n	mean	sd	n	mean	sd	n
1:1	10.14	6.64	7	6.33	4.93	3	no data		0
group of 2	9.00	5.40	6	13.50	7.06	6	10.50	8.06	4
group of 3	4.55	4.71	9	-2.00	12.16	3	3.60	8.07	10
Total	7.54	5.89	22	7.83	9.92	12	5.57	8.40	14

For phonological, orthographic oral language interventions, the three contexts did not differ gain in accuracy ($F(2, 19) = 2.26$ for phonological; $F(2, 9) = 3.70$ for orthographic and $F(1, 12) = 2.09$, multiple comparisons using Scheffe, $p > .05$).

Figure 9: Gain in reading accuracy for each teaching context in each intervention



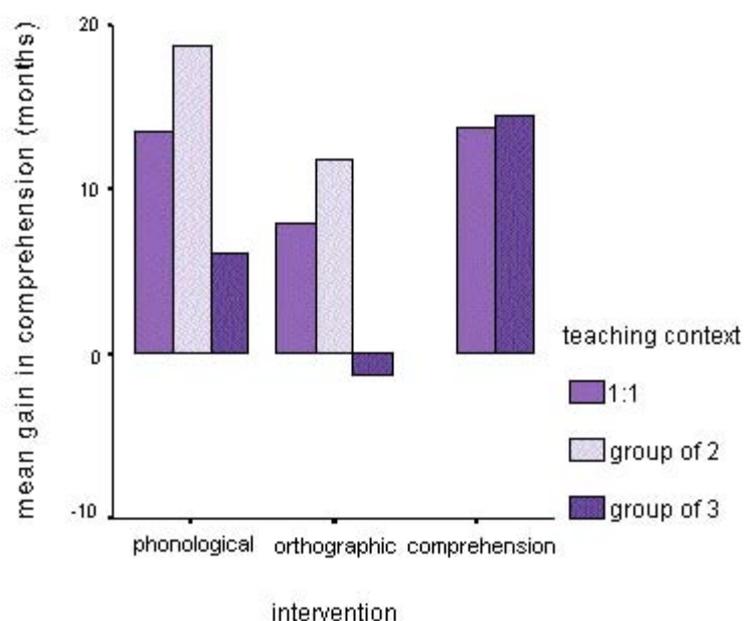
Gain in comprehension in each context for each intervention

The mean gain score and standard deviation for teaching prose comprehension in each teaching context for each of the intervention conditions is shown in Table 8 and Figure 10.

Table 8: The mean comprehension gain score (months) and standard deviation for each teaching context for each intervention condition

Teaching Context	Phonological (n = 22)			Orthographic (n = 12)			Oral Comprehension (n = 14)		
	mean	sd	n	mean	sd	n	mean	sd	n
1:1	13.42	7.37	7	8.00	7.00	3	No data		0
group of 2	18.67	8.59	6	11.83	10.34	6	13.75	6.55	4
group of 3	6.11	6.15	9	-1.33	10.69	3	14.40	5.35	10
Total	11.86	8.70	22	7.58	10.48	12	14.21	5.46	14

Figure 10: Gain in reading accuracy for each teaching context in each intervention



For phonological interventions, the three contexts differed in comprehension ($F(2, 19) = 5.642, p < .05$). Students who learnt in groups of 3 achieved lower comprehension gain than those learning in groups of 2 ($p > .05$). The contexts did not differ for orthographic interventions ($F(2, 9) = 1.82, p > .05$) or for oral language intervention ($F(1, 12) = .037, p > .05$).

Comparison of the three intervention contexts indicates that gains in the individual and student pair contexts did not differ in reading comprehension gains. The teaching context that differed most between the three interventions was the group of three students. It should again be noted that the teaching group for the orthographic intervention had only 3 students. Given this obvious restriction of data generalization, it nevertheless should be noted that comprehension gains were lower in the orthographic learning intervention than in the oral language comprehension intervention.

In summary, these data suggest that, for the small numbers of students involved in the present study, the three teaching contexts did not differ in their influence on literacy gains. Future research may investigate the generality of this finding and the learning and social–interactional characteristics of students who are more likely to benefit from individual versus small group literacy interventions.

This outcome would have implications both for individual students and for making most effective use of teacher time and expertise. If students in the early years who have severe reading disabilities learn equally effectively in small groups as individually, economy of time and resources may suggest the implementation of small group teaching regimes. By monitoring students' reading performance in small groups, teachers can ascertain when the small group processes are enhancing and restricting the progress of students and take appropriate action if necessary.

Implications for teaching and learning

This analysis has implications for teaching and learning. First, it shows that the at risk readers with interventions can make gains of the same size as good progress readers exposed to regular instruction. Accuracy was enhanced by each of the three interventions. Comprehension, on the other hand, was enhanced more by oral language training.

For each intervention, not all students will necessarily make the same level of improvement. Further, the performance of the lowest achievers in each intervention suggest that these students need instruction that targets more than area of knowledge.

Those students who made least gains in reading accuracy in the phonological teaching intervention would have benefited from teaching that targeted oral comprehension teaching as well, particularly knowledge to do with manipulating word meanings (verbal analogies) and short term memory for words. Corresponding students in the orthographic intervention context would have benefited from teaching that targeted expressive syntax and phonemic segmenting for shorter words. The lowest achievers in the oral comprehension intervention would have benefited from phonemic segmenting instruction.

For comprehension, on the other hand, those making least gains in the phonological intervention would have been assisted by teaching in phonological short term memory and those who made least gains in the orthographic teaching would have been assisted by teaching in areas of nonverbal reasoning.

The findings also have implications for how teachers organise students who have literacy learning difficulties into learning groups. They suggest that individual student instruction may not yield

greater improvement than teaching in small groups. They also alert teachers to the importance of social–interactions in the learning support context.

Influence of self efficacy on reading achievement

The influence of self efficacy on reading achievement was examined by assessing students’ self-efficacy as readers at Review Sessions 25 (self efficacy 1) and 39¹ (self efficacy 2). The distribution in self efficacy scores for each session is shown in Table 9 and in Figures 11 and 12. The maximum score was 74.

Table 9: The distribution in self efficacy scores for sessions 25 (self efficacy 1) and 39 (self efficacy 2)

	Self Efficacy 1			Self Efficacy 2		
	Frequency	Percent	Cumulative Percent	Frequency	Percent	Cumulative Percent
35-39	1	2	2	0	0	0
40-44	0		2	3	7	7
45-49	3	6	8	3	7	14
50-54	7	15	23	4	9	23
55-59	9	19	42	3	6	29
60-64	17	35	77	12	25	54
65-69	8	17	94	10	22	76
70-74	3	6	100	11	24	100
Total	48	100.0		46	100.0	

¹ While reading data were collected over the sessions to Review Session 75, the self efficacy data were collected on Review Sessions 25 and 39.

Figure 11: Distribution of self efficacy scores on first administration (teaching session 25)

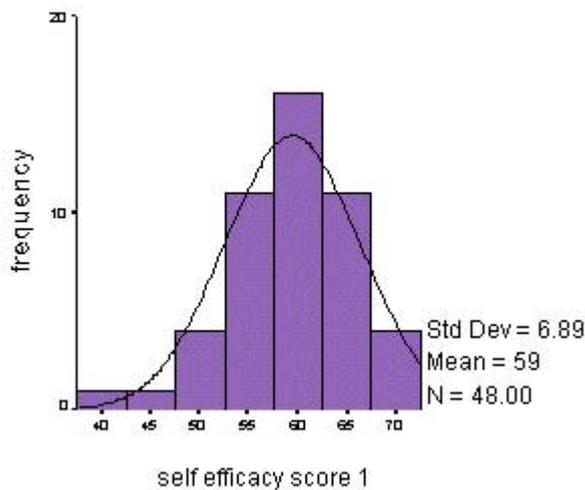
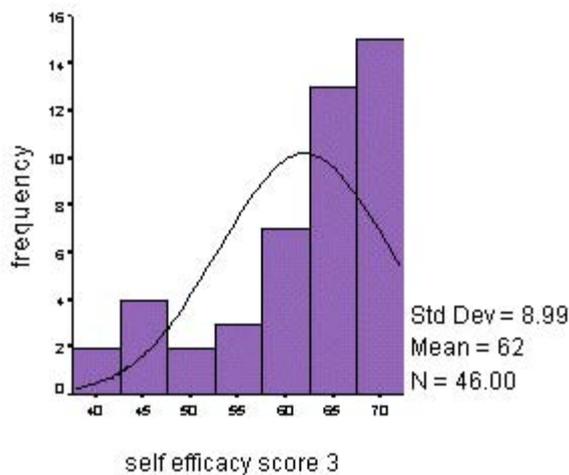


Figure 12: Distribution of self efficacy scores on second administration (teaching session 39)



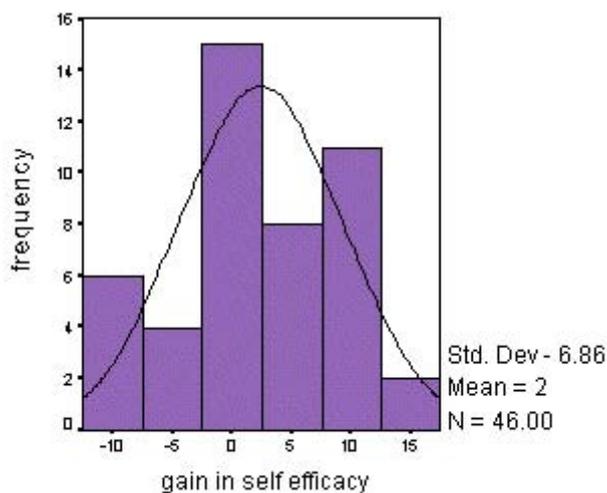
The three interventions did not differ in self efficacy at either the first ($F(2, 45) = .22$) or second measurement ($F(2, 45) = .41$). Multiple comparisons between the three interventions using Scheffe confirmed this interpretation.

Comparison of the trends in Figures 11 and 12 show how students' self efficacy as readers changed. A greater portion of the students reported higher levels of self efficacy on the second administration. The number of students with a more positive belief about their success as readers increased as they had more intervention sessions. Overall, the self efficacy of the cohort of at risk students was higher at the later session ($t(45) = 2.58, p < .01$). However, it did not improve for all students. The amount of gain was calculated for each student. This distribution is shown in Table 10 and in Figure 13.

Table 10: The distribution of the gains in self efficacy

Range of Gain	Frequency	Percent	Cumulative Percent
-14- -10	2	4	4
-9--5	2	9	13
-4-0	11	24	37
1-5	17	32	69
6-10	9	20	89
11-15	3	7	96
16-20	2	4	100.0
Total	46	100.0	

Figure 12: Distribution of self efficacy gain scores



These data show that approximately one third of the students had a lower belief about whether they could be successful as readers at the later session.

Students' initial self efficacy correlated with their pre-intervention reading ability (for accuracy $r(48) = .32, p < .05$ and for comprehension, $r(48) = .36, p < .05$). Neither gain in self efficacy nor final self efficacy correlated with final reading scores.

The relationship between self efficacy and change in reading ability is complex. As noted above, self efficacy increased for some students, remained unchanged for others and decreased for a third group. It is not sufficient to examine the link between increase in self efficacy and gain in

reading. Some of the students who show little increase in self efficacy may begin with a high self efficacy and retain this. To examine this relationship, students' self efficacy on each occasion was rated as either high, medium or low. This allowed the identification of seven groups, three of whom remained unchanged, two which had a decrease in self efficacy and two who had an increase.

The mean reading accuracy and comprehension ages in months before and after intervention and the reading gain for each group is shown in Table 10.

Table 10: The mean reading accuracy and comprehension ages in months before and after intervention and the reading gain for each type of self efficacy change

	Accuracy			Comprehension		
	initial	final	gain	initial	final	gain
self efficacy didn't change						
High initial and high final (n=11)	87.0	88.6	1.6	76.7	87.8	11.0
medium initial and final (n=7)	77.1	86.2	9.1	73.8	88.5	14.7
low initial and low final (n=10)	78.9	87.4	8.5	75.0	84.7	9.7
self efficacy increased						
low initial and medium or high final (n=5)	79.0	87.2	7.2	75.0	89.0	13.7
medium initial and high final (n=5)	79.6	88.0	8.4	74.8	89.2	14.4
self efficacy decreased						
High initial and medium or low final (n=5)	81.6	88.6	7.0	79.4	90.6	11.2
Medium initial and low final (n=3)	81.0	85.5	4.3	76.0	83.5	7.8

The interpretation of these data is restricted by the low number of students in each group, limiting the analysis of differences between groups. The trends suggest that reading ability increased independently of the change in self efficacy.

It is possible that the results are affected by the effectiveness of the tasks used to assess self efficacy. The correlation between the measure of self efficacy on the two occasions ($r(46) = .66$,

$p < .01$) indicates stability in the construct. It is also possible that the times of measurement were not sufficiently close to the pre- and post- intervention assessments.

Anecdotal observation of influences on early literacy learning

During the implementation of the interventions, the teachers recorded various anecdotal observation of influences on the early literacy learning of the underachieving students. These included the following and may be judged to merit consideration in future research.

The influence of predictable teaching routines

Several teachers reported that these students responded well to literacy teaching that has predictable routines. Many of the students indicated a preference for familiar types of activities and tasks. Some suggested, in their own words, that the regular routines allow them to manage and direct their learning better. With familiar activities they felt more comfortable predicting, monitoring how they are reading, changing their minds and reviewing what they had read. The regular classroom teachers of these students valued knowing this. Some had tended to introduce regularly new activities because they believed the underachievers may have become bored more easily.

Sentence level application of the visualisation strategy

Several teachers reported that teaching students in the oral comprehension intervention to apply the RIDER strategy on a sentence by sentence basis rather than either to sub-sentence units or to multiple sentence units was more successful. This seemed to help these readers use each sentence as a unit of meaning. As well, when encouraging students to draw as a component of RIDER, many students preferred to draw more than one picture, showing in sequence the development of ideas in the text.

Sound familiarity influences on learning phonological knowledge

Teachers reported that some 2-sound and 3-sound rimes were more difficult than others. For some of the rimes, many of the students had difficulty retaining the vowel, and substituted it, for example, they read “rim” as “ram”. Their difficulty suggested they needed to learn to distinguish between and to pronounce vowels accurately in the rime units before teaching them to use the sounds in phonological activities. The phonological intervention was modified to include auditory discrimination and pronunciations necessary to scaffold the phonological learning.

Teachers also noted that differed in the particular rimes they found easy to handle. This was linked with students’ personal earlier experiences with particular word. Teachers at the early literacy levels frequently overlook the prepotency of students’ idiosyncratic knowledge on the ways in which they learn to read and the comparative importance of words to them. It is not sufficient to assume that a particular sound pattern will be equally salient to all students that they can recognise, with equal facility, a particular sound or letter pattern. Students’ relative familiarity with words and the importance of the words in their existing experiential knowledge, influences how well the students can use them during learning. Teaching activities need to take account of this effect.

Teaching students to paraphrase or retell on a sentence basis

The oral language intervention pathway was modified to include teaching students to paraphrase or retell on a sentence basis. This strategy is taught after the students have acquired the RIDER strategy. The outline for this teaching is attached.

Discussion of the results in terms of its aims and objectives

The aim of this project was to evaluate the effectiveness of three intervention options for students in Year 2 who have been identified as at-risk of experiencing ongoing reading difficulties. The foregoing results have achieved this. The phonological, orthographic and oral language comprehension intervention pathways were compared and the outcomes described in terms of student gains in reading accuracy and comprehension.

How the project's specific outcomes contribute to the overall objective of the project

The project's specific objectives contribute to the overall objective of the Literacy and Numeracy Innovative Projects Initiative as follows:

- The project identifies teaching procedures for improving the literacy skills of Australian children potentially at risk of literacy failure. The three interventions provide a framework for integrating explicitly specific learning processes such as psycholinguistic and cognitive knowledge memory and the self management of literacy learning in literacy intervention programs.
- It is consistent with the National Literacy and Numeracy Plan, in its provision of a validated framework for the early assessment and identification literacy learning difficulties, for mapping these into literacy learning readiness profiles and for matching these with the most appropriate intervention. This framework, with further research, could easily be extended to meet the needs of students in the middle years of schooling who are not meeting the national literacy benchmarks.
- The project has shown how the reported causes of early literacy learning difficulties can be mapped into effective diagnostic and teaching practice. Early reading difficulties have been attributed to a range of causes:
 - phonemic and phonological awareness ability (Bus & van Ijendoorn, 1999; Velluntino et al, 1996);
 - orthographic knowledge (Berninger & Abbott, 1994) and the rapid naming of alphanumeric symbols (Lovett et al, 2000; Wolf et al, 1999);
 - visual encoding of alphanumeric symbols (Swanson & Alexander 1997);
 - linguistic competence (Catts et al, 2001; Morris et al, 1999);
 - nonverbal competence (ie visual-spatial awareness);
 - memory and learning competence (Watson & Willows, 1995); and

- Implementing teaching that targets this range of causes has been problematic (Ainley, Fleming & McGregor, 2002). The project examines the possibility that some of the generally effective teaching programs implemented in the early years of schooling (such as Success for All, Reading Recovery or ClaSS, (Crevola & Hill, 2001; Wasik & Slavin, 1993)) do not assist all literacy at risk students (Ainley, Fleming & McGregor, 2002; Askew et al, 1998; Shanahan & Barr, 1995) is because of the comparative mismatch in literacy learning readiness. The current project shows that the issue of finding a program that works for all students is not as appropriate as attempting to link particular interventions with particular students' learning needs at particular times. Specific factors may be more significant at particular times in the literacy learning process (Muter & Snowling, 1998); Hiebert & Taylor, 2000). The approach investigated in this study provides a framework for catering for these.
- The outcomes of the project provides school communities with the knowledge necessary for understanding early literacy difficulties, for identifying those aspects of an at risk student's knowledge that are 'in place' and for targeting specifically the literacy learning needs of a particular student at any time. A challenge for teachers, schools and the community is how to 'unpack' the literacy learning needs of any at risk student. In its integration of a range of learning processes into a literacy learning readiness profile, the project provides the necessary knowledge for this.

Overall effectiveness of the initiative

The initiative is based on the assumption that students differ in the ways in which they acquire early literacy knowledge. It compared three literacy intervention pathways, to match three major literacy learning profiles. It has shown the comparative effectiveness of these pathways.

More generally the initiative draws attention to the need to match the learning assumptions made by the teaching provided with the ways in which individual students learn. It has shown how alternative intervention pathways can lead to the same literacy learning outcomes for cohorts that differ in their approach to learning.

Areas in which further research would be most beneficial in improving the literacy learning outcomes of educationally disadvantaged students

The research has indicated various areas in which further research would be most beneficial in the context of improving the literacy learning outcomes of educationally disadvantaged students.

- The efficacy of matching the literacy learning readiness profiles of at risk readers with the most effective intervention pathway. The findings of this research are limited by the number of students that could be included. Future research may examine this for a larger number of students and for students in the middle years of education. It may also lead to improved (1) literacy learning readiness profiles in terms of the cognitive and psycholinguistic knowledge necessary for literacy and (2) more finely oriented and targeted alternative intervention pathways that could be compared.

The gain in reading comprehension for the oral comprehension intervention was substantial. Future research may investigate the efficacy of combining this intervention with the phonological and/or the orthographic interventions for students who need assistance in both areas.

It would also be necessary to examine the stability of the reading improvement achieved through each intervention over time. The interventions evaluated in this project included three components believed to enhance retention of knowledge: (1) an explicit pedagogic procedure to target efficient storage and retrieval from long term memory, (2) the gradual acquisition of self management and self direction strategies as readers and (3) self efficacy as readers. Future research may examine the influence of each of these on the retention of literacy knowledge over time by 'at risk' readers.

- Future research may investigate further the differences in psycholinguistic or cognitive ability more and least likely to be associated with gains in reading comprehension and accuracy for each intervention. The numbers of students in this study are insufficient to validate the literacy learning profiles as diagnostic tools. However, they provide a basis for developing possible procedures. The profiles could then be mapped into modified interventions and trialed. The learning characteristics of those students who did not progress for each intervention merit further research.
- Further research that targets the optimal conditions for teaching comprehending strategies such as the sentence level application of visualisation and paraphrasing and for teaching rime units could lead to improved teaching in each of the interventions. The implementation of teaching procedures that are supported empirically is recommended.
- Identification of the teaching context most and least likely to facilitate literacy learning merits future consideration. While the findings of the present study suggest possible interpretations, more numerous cohorts are necessary to examine this influence empirically. The focus, it is recommended, should not be on identifying the most effective teaching context but on matching the teaching context to literacy learning readiness profiles at any time. It would be useful to know, for example, which students were most likely to benefit from learning in a group of two and who would benefit more from individual teaching.
- The influence of self efficacy on the reading performance of at risk readers merits further research. This may examine the extent to which the gain in self efficacy is a consequence of factors such as involvement in the intervention, the feedback provided, level of success in recent literacy activity, for example, recent high levels of reading accuracy.

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