THE MATHEMATICS RECOVERY PROJECT — A PROGRESS REPORT: SPECIALIST TEACHERS WORKING WITH LOW-ATTAINING FIRST-GRADERS

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This paper provides a progress report of a four-year project which began in August 1992 and focuses on preparing specialist teachers in the provision of long-term, individualised, mathematics teaching programs for low-attaining first-graders (6- or 7-year-olds). The meaning of 'recovery education' is outlined as are theoretical bases and earlier research studies relevant to the current project. Using a five-stage model of early arithmetical learning, the progress of 24 participants in 1992 and 32 in 1993 is summarised and compared with that of counterparts, who like the participants, were initially prenumerical. The participants underwent eight-week teaching cycles consisting of 30-minutes of individualised teaching, four mornings per week. In both 1992 and 1993, almost all of the participants made major progress and overall, the progress of participants notably exceeded that of their counterparts. A planned implementation of the Mathematics Recovery program in the United States in 1995 is also outlined.

This paper focuses on aspects of the Mathematics Recovery Project (Wright, Cowper, Dyson & Stanger, 1993; Wright, 1993a), a four-year project which began in August 1992 and is being undertaken at Southern Cross University and government and Catholic schools on the NSW North Coast. The project has involved 20 teachers in 18 schools and more than 100 first-graders.

Project Aim. The aim of the project is to: (a) establish accredited, year-long, professional development courses for teachers and teacher-leaders; (b) which have as their focus a program of recovery education in early arithmetical learning; (c) through which selected first-grade children (6- or 7-year-olds) are placed in long-term, individualised teaching programs; (d) the purpose of which is to advance their arithmetical knowledge to a level at which they are likely to learn successfully in a regular class.

Recovery education. The term "recovery education" is closely aligned to but can be distinguished from "early intervention" because the latter applies to programs in the preschool years and to children for whom identification of potential learning problems has occurred in the first three years of life (Meisels & Shonkoff, 1990, p.xvi). Recovery education is distinguished

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from remedial education because the former involves: (a) identification after one year of school (i.e. 6- or 7-year-olds) of children who are apparently unable to benefit well from classroom teaching; and (b) intensive individualised teaching to advance the learner to an average level for their class. By way of contrast, remedial education typically applies to older children and often involves group teaching. Recovery education in undertaken by teachers who have undertaken a specialised, post-initial training program and is most well known in the area of children's learning to read (e.g. Clay, 1987; 1990; DeFord, Lyons, & Pinnell, 1991; Pinnell, Fried & Estice, 1990; Dombey, 1992; Smith, 1986). Calls for programs of recovery education and descriptions of the needs and potential benefits of these kinds of programs are increasingly prevalent (e.g. *The Literacy Challenge, 1993*; *Review of the Queensland School Curriculum — Overview, 1994*; Dyer, 1992; Levin, 1989; Slavin & Madden, 1989; Wasik & Slavin, 1993).

Theoretical bases. The theoretical bases of the Mathematics Recovery program are grounded in Steffe's extensive investigations of young children's arithmetical learning (e.g. Steffe, von Glasersfeld, Richards, & Cobb, 1983; Steffe & Cobb, 1988) and related work by Wright (e.g. 1991a; 1991b; 1992; 1994). Steffe's methodological approach — the constructivist teaching experiment (e.g. Steffe, 1991), features (a) selecting children who were regarded as the least advanced at their class level; (b) withdrawing these children from their regular class several times per week for individual teaching sessions; and (c) teaching children in such settings for extended periods — one or two school years. Videotaping of interviews and teaching sessions is a key investigative tool of this methodology. A comparable methodology has been developed for classroom-based interventionist studies by Cobb and colleagues (e.g. Cobb, Yackel & Wood, 1992; Yackel, Cobb, & Wood, 1991) and used by Wright (1993c). Radical constructivism (e.g. von Glasersfeld, 1984; 1991) provides an epistemological framework for all of this research.

First year of the project. In its first year (August to December 1992) the project operated in six schools and in each school a teacher worked half-time on the project for 18 weeks. One of the major objectives of the first year was to provide detailed information about the necessary contents of the proposed professional development courses for Mathematics Recovery teachers and teacher leaders. Additionally, the progress of children who participated in the project was documented and compared with non-participating counterparts. During the period from August to December the six participating teachers were introduced to the theoretical bases referred to earlier and were taught an interview-based assessment procedure which has the purpose of assessing young children's arithmetical knowledge. In each school, 15 first-grade children were selected in consultation with first class teachers for interview by the Mathematics Recovery Project teacher. From eight to twelve of these, depending on the school, were regarded as being among the least

advanced of the first-grade cohort in their arithmetical knowledge. On the basis of analyses of assessment interviews, four of the children in each school were selected for an eight week teaching cycle during the period October to December. The teaching cycles involved 30-minutes of individualised teaching, for four mornings per week. In each school all 15 children initially assessed were assessed again in December after the completion of the teaching cycles.

Second and third years of the project. The project operated in 10 schools in its second year (August to December 1993) and, as in 1992 this involved individualised teaching for four mornings per week, for an eight week teaching cycle. The third year of the project commenced in February 1994 in 11 schools. At the time of writing (April 1994) teaching cycles have begun with almost 50 children. The project will operate throughout the current school year (February to December) and it is anticipated that approximately 120 children will participate during this period.

Primary Theoretical Model — Stages of Early Arithmetical Learning

The primary model of children's acquisition of early arithmetical knowledge used in the Mathematics Recovery Project is labelled "The Stages of Early Arithmetical Learning" (see Table 1). This is adapted from the work of Steffe and colleagues (e.g. 1983, 1988) and related work by Wright (e.g. 1991a; 1993b; 1994). As well, several other models are used (see Wright, 1991c; Wright, Cowper, Dyson & Stanger, 1993; Wright, 1994), for example, models of children's facility with forward and backward number word sequences, ability to identify numerals and subitise (e.g. von Glasersfeld, 1982), and concepts of tens and one.

Table 1.

Stages of Early Arithmetical Learning

Stage	Behavioural Indicator
0 - Preperceptual	When attempting to count is unable to coordinate number words with items.
1 - Perceptual	Can count visible items.
2 - Figurative	Can solve additive tasks involving screened collections but counts from one when doing so.
3 - Initial Number Sequence	Counts-on to solve additive and missing addend tasks involving screened collections.
4 - Intermediate Number Sequence	Uses counting-down-to to solve subtractive tasks and can choose the more appropriate of counting-down-to and counting-down-from.
5 - Facile Number Sequence	Uses a range of strategies which include procedures other than counting-by-ones such as compensation, using addition to solve subtraction, and using known facts such as doubles and sums which equal ten.

An Overview of Results in 1992 and 1993

Wright, Cowper, Dyson and Stanger (1993) set out for each school, the progress of the 1992 Mathematics Recovery participants and comparisons with that of counterparts who, in their initial interview, were assessed as prenumerical (Steffe et al., 1983, p. 73), which is to say that they had not attained Stage 3. Similar analyses for the 1993 participants have been completed but are not included because of the limitations of space. Summary results of the progress of the 1992 and 1993 cohorts of Mathematics Recovery participants and counterparts are set out in Tables 2, 3 and 4. As stated earlier, in both 1992 and 1993, participants underwent teaching cycles of eight weeks duration involving a maximum of 32 teaching sessions.

Table 2.
Numbers and Percentages Progressing 0,1, 2, or 3 Stages.

Student Group	Number of Stages Progressed									
	0		1		2		3		Total	
1992 Cohort										
Participants	4	(17)	10	(42)	7	(29)	3	(12)	24	(100)
Counterparts	5	(39)	8	(61)	0	(0)	0	(0)	13	(100)
1993 Cohort										
Participants	4	(12)	14	(44)	7	(22)	7	(22)	32	(100)
Counterparts	18	(66)	8	(30)	1	(4)	0	(0)	27	(100)

Table 3.
Numbers and Percentages of Children Initially at Stage 0 or 1 Who Were at Stage 1, 2, 3, 4 or 5 at the Time of Their Final Interview.

Student Group	Stage Reached at Time of Final Interview											
	1		2		3		4		5		Tot.	
1992 Cohort												
Participants	0	(0)	1	(25)	3	(75)	0	(0)	0	(0)	4	(100)
Counterparts	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(100)
1993 Cohort												
Participants	0	(0)	5	(36)	6	(43)	2	(14)	1	(7)	14*	(100)
Counterparts	2	(29)	5	(71)	0	(0)	0	(0)	0	(0)	7†	(100)

Note: *Two of these 14 participants were initially at Stage 0 and 12 were at Stage 1.
†All 7 of these counterparts were initally at Stage 1.

Table 4.

Numbers and Percentages of Children Initially at Stage 2 Who Were at Stage 2, 3, 4 or 5 at the Time of Their Final Interview.

Student Group	Stage Reached at Time of Final Interview									
	2		3		4		5		Tot.	
1992 Cohort										
Participants	1	(5)	10	(50)	6	(30)	3	(15)	20	(100)
Counterparts	5	(39)	8	(61)	0	(0)	0	(0)	13	(100)
1993 Cohort										
Participants	3	(17)	8	(44)	3	(17)	4	(22)	18	(100)
Counterparts	12	(60)	7	(35)	1	(5)	0	(0)	20	(100)

Some Summary Points about the Results

1. Of the 1992 cohort, 10 of 24 participants advanced by two or three stages but none of the counterparts did so. Only four of 24 participants advanced by less than one stage as did five of 13 counterparts.
2. Of the 1993 cohort, 14 of 32 participants advanced by two or three stages but only one of the counterparts did so. Only four of 32 participants advanced by less than one stage as did 18 of 27 counterparts.
3. In 1993, nine of 12 participants who were initially assessed at Stage 1, reached Stage 3, 4 or 5 by the end of the program. They had progressed from being counters of perceptual unit items to counters of abstract unit items (Steffe et al., 1993). None of the counterparts who were initially assessed as being at Stage 1 made similar progress.
4. In 1993, three of 18 participants who were initially assessed at Stage 2 reached Stage 4 by the end of the program and four of these 18 reached Stage 5. These four progressed from being figurative counters to having constructed part-whole operations (Steffe et al., 1988, p. 231-2). Only one of 14 counterparts initially assessed at Stage 2 advanced to Stage 4 and none of these 14 advanced to Stage 5.

Putting aside comparisons between participants and counterparts made in Points 1. to 4. we claim that the progress of participants as summarised in Tables 2, 3 and 4 is on average, quite outstanding. Comparing their progress with that of the counterparts is to some extent problematic. This is because Mathematics Recovery teachers and their colleagues with our encouragement and support use adaptations of instructional activities from the Mathematics Recovery Project in their classroom teaching.

Mathematics Recovery — The Future

During the second half of 1994, the Mathematics Recovery professional development courses for teachers and teacher-leaders will be redeveloped. Our plan is to have these courses available for implementation from January 1995. Tasks for 1995 include completing for the three years of the project, data analyses relating to: (a) progress of participants and counterparts; (b) the teaching sessions; (c) the instructional activities; and (d) teachers' professional learning.

Implementation of Mathematics Recovery in the United States. Plans are well advanced for the implementation of the Mathematics Recovery program in South Carolina, commencing January 1995. This will involve 12 teachers in each of two school districts undertaking the professional development program. As part of this implementation an elementary mathematics consultant from South Carolina is completing an eleven-month Teacher-Leaders' program at Southern Cross University. This is funded in part by the South Carolina State Department of Education. We anticipate that many of the teachers who complete this program will undertake a subsequent program to prepare them to work as Mathematics Recovery Teacher-Leaders in South Carolina. This will involve each of the Teacher-Leaders teaching the professional development course to a group of up to 12 teachers. Thus over the course of a three-year period, several hundred elementary teachers will be able to undertake the professional development program.

The educo-political backdrop for Mathematics Recovery. What seems apparent is that, across the United States, many educational administrators, mathematics supervisors, principals and teachers are looking for new ways to tackle the problem of too many children experiencing chronic failure in school mathematics. In South Carolina there is a prevailing view that far too small a percentage of children identified in the early years of schooling as at-risk, and who therefore undergo specialised instructional programs in mathematics— typically, small group "pull-out" programs — go on to successfully complete high school. Additionally, at local, state and national levels in the United States, there is strong support for endeavours to significantly raise school achievement levels in areas such as mathematics and science because, with good reason, it is perceived that these do not compare favourably with those of many other nations. This is a brief overview of the educo-political backdrop for the introduction of the Mathematics Recovery Program.

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