

Kindergarten Students' Progress in the Count Me In Too Project

Rita Stewart, Bob Wright and Peter Gould

Southern Cross University and NSW Department of Education & Training

In 1997, 866 Kindergarten students, including 47 Aboriginal or Torres Strait Islanders, participated in the Count Me In Too Project. Their progress in early arithmetical strategies, forward number word sequences, and numeral identification was examined. Progress was compared with expected syllabus outcomes and it was found that the majority of the students met or exceeded those expectations. Consistent with earlier and smaller-scale studies, many students began the Kindergarten year with relatively high levels of knowledge and there was much diversity in levels.

In the state of New South Wales the primary mathematics curriculum which schools are expected to follow, is set out in the *Mathematics K-6* (1989) syllabus document. Included in this document are: aims, a statement of principles, information about assessment and evaluation, and mathematical content organised into the three strands of space, measurement and number. The document also outlines expected learning outcomes and includes teaching and learning units, which are grouped into three broad levels and which aim to support the realisation of the learning outcomes. Of particular interest to this report are those learning outcomes associated with number which are expected of students at the end of Kindergarten (their first year of school). These learning outcomes are more comprehensively outlined in a later document which deals with the three broad levels set out in the syllabus as well as *Early Stage 1* outcomes which "relate specifically to the expected achievement of students by the end of Kindergarten." (Board of Studies, 1997, p.2). Outcomes included which relate to number are:

- sorts and describes objects in terms of their features such as size and shape;
- recognises, describes, makes and continues simple number and spatial patterns;
- recognises and compares the sizes of groups through a variety of strategies such as estimating, matching one-to-one, counting;
- divides groups into parts of equal and unequal size through sharing, matching and counting;
- represents numbers in a variety of forms, including the use of a calculator;
- asks and responds to mathematical questions using drawing, making, describing, acting, guessing and checking, and retelling;

During the last decade the appropriateness of current mathematics curricula for young students has been questioned by several researchers. Young-Loveridge (1989) conducted interview-based assessments of 81 beginning-school students in New Zealand and found that these students were being taught certain concepts, such as pattern recognition, even though they already knew them. Similarly, Aubrey (1993) reported concern about the UK curriculum where students in their first year of school "clearly enter school having acquired already much of this mathematical content" (p.39). Wright (1994) reports that generally school programs typical of the first year of school fail to take adequate account of the prior knowledge those students bring to school. Indeed the NSW syllabus itself supports the importance of challenging students "to achieve each task they undertake to the best of their ability" (NSW Department of Education, p.41) as does the national statement on mathematics when it claims that "(m)athematics learning is likely to be enhanced by challenge within a supportive framework" (Australian Education Council, p.20).

This paper focuses on the levels of knowledge of Kindergarten students towards the beginning and end of their first semester, and comparisons of these with expected syllabus outcomes. This leads to a consideration of the appropriateness of the NSW curriculum. The students were the Kindergarten cohort of participants in the Count Me In Too (CMIT) Project in NSW government schools. As well, the levels of knowledge of

47 Kindergarten students who were identified as Aboriginal or Torres Strait Islanders (ATSI) is considered at the beginning and end of the same period.

The Count Me In Too Project

Count Me In Too (CMIT) is a major school-based and systemic initiative of the NSW Department of Education and Training (DET) focusing on assessment and teaching in early years mathematics. Its basic goal is for teachers to better understand children's mathematical strategies and their development from less sophisticated to more sophisticated strategies. CMIT began in 1997 as a project subsequent to a project in 1996 (entitled Count Me In) which was piloted in four districts and involved at least three schools per district (Bobis, 1997). CMIT has been implemented in several schools in each of the 40 NSW school districts. Implementation of CMIT involves the district mathematics consultant working with all K-2 teachers in the school. CMIT does not take the form of a packaged program. Rather, it is a continually developing and evolving initiative. CMIT initially focused on the early number strand but this has been extended to include multiplication and division, and is currently being extended to include the early space strand. Development of Count Me In and Count Me In Too drew significantly on the theory and methods of the Maths Recovery Program (Wright, Stanger, Cowper & Dyson, 1996; Wright, Cowper, Stanger & Stewart, 1995). Key parts of CMIT adapted from Maths Recovery are the Learning Framework in Number (DOSE, 1997; Wright, 1997) and the Schedule for Early Number Assessment (see below).

Method

One aspect of CMIT in 1997 involved all participating schools administering initial and final assessments to selected students in Kindergarten, Year 1 or Year 2. The schools involved in Count Me In Too were selected by each school district. The criteria used in the selection of schools emphasised identifiable low socio-economic indicators, such as those used to identify schools on the Disadvantaged Schools Component of the National Equity Program. Assessment data was obtained on a total of 2288 students from 47 schools. This paper focuses on the assessment data from the Kindergarten cohort of this group — 866 students in all, whose ages ranged from 4.1 to 6.0 years. The 866 students included 47 students (or 5%) who were identified as Aboriginal or Torres Strait Islanders (ATSI). In selecting the ATSI students no attempt was made at using a stratified random sample or even a representative sample of disadvantaged schools. However, 2622 Kindergarten students were identified as ATSI out of 66 011 Kindergarten students in government schools in 1997 (i.e. 4%). Thus, the proportion of ATSI students involved in the 1997 Count Me In Too project was commensurate with that in all departmental Kindergarten classes. The ATSI students came from both country and metropolitan areas with the majority from the North of NSW. Assessment involved use of the Schedule for Early Number Assessment (SENA), which is individually administered and involves videotaping of student responses for subsequent analysis. SENA is a shortened version of the Maths Recovery assessment procedure (eg Wright, in press; Wright, 1996; Wright et al., 1996) and includes the determination of the student's levels of achievement on various aspects of early number. This paper focuses on the levels of achievement on three aspects, viz Early Arithmetical Strategies, Forward Number Word Sequence (FNWS) and Numeral Identification. Initial assessments occurred around March 1997. During 1997, the Kindergarten teachers in the participating schools, revised their mathematics programs with the support of their district consultants. This involved teachers participating in school- and district-based professional meetings, and taking account of relevant aspects of CMIT, including the Learning Framework in Number and related video- and text-based material. Each of the three aspects which are the focus of this paper is explicated in tabular form via a progression of stages or levels of student achievement (See Tables 1-3 below).

Syllabus expectations in terms of these three aspects: Given that typical classroom practice in the first year of school is to focus on sorting and classifying activities, and to spend extensive amounts of time in studying numerals and number

words up to "ten", then it seems reasonable to claim that syllabus expectations in terms of the above three aspects are as follows: Early Arithmetical Strategies – Stage 1, can count perceived objects; FNWS – Level 3, facile with forward number words up to "ten"; Numeral Identification – Level 1, can identify numerals in the range "one" to "ten".

Table 1

Model for Development of Early Arithmetical Strategies

Stage 0: Emergent Counting. Cannot count visible items. The student either does not know the number words or cannot coordinate the number words with items.

Stage 1: Perceptual Counting. Can count perceived items but not those in concealed collections. This may involve seeing, hearing or feeling items.

Stage 2: Figurative Counting. Can count concealed items but counting typically includes what adults might regard as redundant activity. Thus, when presented with a collection partitioned into two parts (both screened), told how many in each part and asked how many counters in all, the student will count from "one" instead of counting on.

Stage 3: Initial Number Sequence. Student counts-on rather than counting from "one", to solve addition or missing addend tasks. The student may use a count-down-from strategy to solve removed items tasks (eg 17-3 as 16, 15, 14; — 14) or count-down-to strategies to solve missing subtrahend tasks (eg 17-14 as 16, 15, 14 ; — 3).

Stage 4: Facile Number Sequence. The student uses a range of non-count-by-one strategies. These strategies involve procedures other than counting by ones but may also involve some counting by ones. Thus in additive and subtractive situations, the student uses strategies such as compensation, using a known result, adding to ten, commutativity, subtraction as the inverse of addition.

Table 2

Model for the Construction of Forward Number Word Sequences (FNWSs)

Level 0: Emergent FNWS. The student cannot produce the FNWS from "one" to "ten".

Level 1: Initial FNWS up to "ten". The student can produce the FNWS from "one" to "ten". The student cannot produce the number word just after a given number word in the range "one" to "ten". Dropping back to "one" does not appear at this level. Students at Levels 1, 2 and 3 may be able to produce FNWSs beyond "ten".

Level 2: Intermediate FNWS up to "ten". The student can produce the FNWS from "one" to "ten". The student can produce the number word just after a given number word but drops back to "one" when doing so.

Level 3: Facile with FNWSs up to "ten". The student can produce the FNWS from "one" to "ten". The student can produce the number word just after a given number word in the range "one" to "ten" without dropping back. The student has difficulty producing the number word just after a given number word, for numbers beyond ten.

Level 4: Facile with FNWSs up to "thirty". The student can produce the FNWS from "one" to "thirty". The student can produce the number word just after a given number word in the range "one" to "thirty" without dropping back. Students at this level may be able to produce FNWSs beyond "thirty".

Level 5: Facile with FNWSs up to "one hundred". The student can produce FNWSs in the range "one" to "one hundred". The student can produce the number word just after a given number word in the range "one" to "one hundred" without dropping back. Students at this level may be able to produce FNWSs beyond "one hundred".

Results

Of the 866 Kindergarten students the following data was available: data on Early Arithmetical Strategies was available for 859 students; data on FNWS was available for 859 students; and data was available on Numeral Identification for 844 students. The data of 47 ATSI students who were part of the preceding larger sample, were also separately considered. Student progress in terms of each of the three models is examined. The results are reported in the form of summary tables. Table 4 shows the progress made by

Kindergarten students in terms of FNWS, Table 5 shows the progress made by Kindergarten students in terms of Numeral Identification and Table 6 depicts students' progress in terms of Early Arithmetical Strategies. Tables 7 to 9 show similar information for the 47 ATSI students. Each table depicts numbers and percentages of students assessed at a particular Level or Stage, at their initial interview around March, and at their final interview after at least ten weeks of teaching, typically early August. The results of an analysis of combined ATSI data have also been included.

Table 3

Model for the Development of Numeral Identification

Level 0: Emergent Numeral Identification.

Cannot identify some or all numerals in the range "1" to "10".

Level 1: Numerals to "10"

Can identify numerals in the range "1" to "10".

Level 2: Numerals to "20"

Can identify numerals in the range "1" to "20".

Level 3: Numerals to "100"

Can identify one and two digit numerals.

Level 4: Numerals to "1000"

Can identify one, two and three digit numerals.

Table 4.

Numbers of Kindergarten Students at Given FNWS Levels on Initial and Final Assessments.

	Number of students at a given level						
	0	1	2	3	4	5	Total
Initial assessment	237 (28%)	276 (32%)	93 (10%)	156 (18%)	74 (9%)	23 (3%)	859 (100%)
Final assessment	50 (6%)	141 (16%)	112 (13%)	211 (25%)	196 (23%)	149 (17%)	859 (100%)

Table 5.

Numbers of Kindergarten Students at Given Numeral Identification Levels on Initial and Final Assessments.

	Number of students at a given level					
	0	1	2	3	4	Total
Initial assessment	410 (49%)	283 (34%)	69 (8%)	51 (7%)	12 (2%)	844 (100%)
Final assessment	130 (15%)	295 (35%)	129 (15%)	250 (30%)	40 (5%)	844 (100%)

Points Arising From The Tables Involving The Kindergarten Cohort

FNWS initial: Table 4 shows that a large number of students (28% of the total sample) were Level 0 at the time of their initial interview. These students were unable to produce the FNWS from "one" to "ten". Twenty nine percent of the students were

already at Level 3 or higher. In their Kindergarten year these students had met or exceeded syllabus expectations by March.

FNWS final: At the time of their final assessment 25% of students had reached Level 3 and 40% had reached Level 4 or Level 5. However, 35% of students, including 6% who were still at Level 0, remained below Level 3. They were not facile with the FNWS up to “ten” and, thus had not yet met the syllabus expectations for the end of Kindergarten.

Numeral Identification initial: Table 5 shows that at the time of the initial interview 49% of students were at Level 0. Thirty four percent of students were already at Level 1, that is able to identify numerals in the range one to ten, ie they had reached expected syllabus outcomes. Seventeen percent of students were initially at Level 2 or higher and had exceeded syllabus expectations.

Table 6.

Numbers of Kindergarten Students at Given Stages of Early Arithmetical Strategies on Initial and Final Assessments.

	Number of students at a given Stage					
	0	1	2	3	4	Total
Initial assessment	369	388	69	27	6	859
	(43%)	(45%)	(8%)	(3%)	(1%)	(100%)
Final assessment	101	416	187	122	33	859
	(12%)	(48%)	(22%)	(14%)	(4%)	(100%)

Numeral Identification final: At the time of their final assessment 35% of students had reached Level 1 and 50% had reached level 2 or higher. However, 15% of students remained at Level 0 at their final assessment. These students had not yet attained expected syllabus outcomes for the end of Kindergarten.

Early Arithmetical Strategies initial: Table 3 shows that at the time of the initial interview a large number of students (43% of the total sample) were at Stage 0, ie the Stage of Emergent Counting. The remaining 57% were already at Stage 1 or higher, thus meeting or exceeding syllabus expectations for Kindergarten students.

Early Arithmetical Strategies final: At their final interview 48% of students had reached Stage 1 and thus had met syllabus expectations. Forty percent of students reached Stage 2 or higher. However, 12% of students had not yet progressed beyond the Stage of Emergent Counting at the time of their final interview.

Progress of students identified as Aboriginal or Torres Strait Islanders

Table 7.

Numbers of ATSI Kindergarten Students at Given FNWS Levels on Initial and Final Assessments.

	Number of ATSI students at a given level						
	0	1	2	3	4	5	Total
Initial assessment	7	21	3	13	3	0	47
	(15%)	(45%)	(6%)	(28%)	(6%)		(100%)
Final assessment	0	9	4	10	14	10	47
		(19%)	(9%)	(21%)	(30%)	(21%)	(100%)

Table 8.

Numbers of ATSI Kindergarten Students at Given Numeral Identification Levels on Initial and Final Assessments.

Number of ATSI students at a given level						
	0	1	2	3	4	Total
Initial assessment	29	16	2	0	0	47
	(62%)	(34%)	(4%)			(100%)
Final assessment	8	19	4	16	0	47
	(17%)	(40%)	(9%)	(34%)		(100%)

Table 9.

Numbers of ATSI Kindergarten Students at Given Stages of Early Arithmetical Strategies on Initial and Final Assessments.

Number of ATSI students at a given Stage						
	0	1	2	3	4	Total
Initial assessment	24	22	1	0	0	47
	(51%)	(47%)	(1%)			(100%)
Final assessment	6	33	6	2	0	47
	(13%)	(70%)	(13%)	(4%)		(100%)

FNWS initial: Table 7 shows that only 15% of students were Level 0 at the time of their initial interview. These students were unable to produce the FNWS from “one” to “ten”. Thirty four percent of the students were already at Level 3 or higher. In their Kindergarten year these students had met or exceeded syllabus expectations by March.

FNWS final: At the time of their final assessment 21% of students had reached Level 3 and 51% had reached Level 4 or Level 5. However, 28% of students remained below Level 3. They were not facile with the FNWS up to “ten” and, thus had not yet met the syllabus expectations for the end of Kindergarten.

Numeral Identification initial: Table 8 shows that at the time of the initial interview 62% of students were at Level 0. Thirty four percent of students were already at Level 1, that is able to identify numerals in the range one to ten, ie they had reached expected syllabus outcomes. Four percent of students were initially at Level 2 and had exceeded syllabus expectations.

Numeral Identification final: At the time of their final assessment 40% of students had reached Level 1 and 43% had reached level 2 or higher. However, 17% of students remained at Level 0 at their final assessment. These students had not yet attained expected syllabus outcomes for the end of Kindergarten.

Early Arithmetical Strategies initial: Table 9 shows that at the time of the initial interview a large number of students (51%) were at Stage 0, ie the Stage of Emergent Counting. Forty seven percent were already at Stage 1, thus meeting syllabus expectations for Kindergarten students.

Early Arithmetical Strategies final: At their final interview 70% of students had reached Stage 1. Seventeen percent of students reached Stage 2 or higher, thus exceeding

syllabus expectations. However, 13% of students had not yet progressed beyond the Stage of Emergent Counting at the time of their final interview.

In addition to the analysis of ATSI data appearing in Tables 7-9, a simple summary analysis of ATSI data not appearing in those tables was undertaken. This data dealt with each student's performance in terms of all three aspects, ie FNWS, Numeral Identification and Early Arithmetical Strategies. The analysis examined the students' performance in a combined way on all the three aspects. The expected performance was defined as Level 3 on FNWS, Level 1 on Numeral Identification and Stage 1 on Early Arithmetical Strategies. Thus, a student identified as Level 2 on FNWS but Level 1 on Numeral Identification and Stage 1 on Early Arithmetical Strategies, was classified as having not yet achieved the syllabus expectations in numeration. A combined performance beyond the expectations of the syllabus would, for example, be attributed to a student assessed as Level 3 on FNWS, Level 2 on Numeral Identification and Stage 2 on Early Arithmetical Strategies. Defined in this way, the combined results for ATSI students involved in the project were as follows:

At the initial assessment:

- 11% were performing beyond the expectation of the Kindergarten syllabus, ie had numeral knowledge beyond "ten".
- 19% were meeting the expected performance, ie were perceptual counters with knowledge of numerals and number words up to "ten".
- had not yet met the syllabus expectations in numeration.

At the final assessment:

- 57% were achieving beyond the expectation of the Kindergarten syllabus, ie had numeral knowledge beyond "ten".
- 9% achieved the expected performance in all three aspects, ie were perceptual counters with knowledge of numerals and number words up to "ten".
- 34% had not yet met the syllabus expectations in numeration, ie demonstrated knowledge of numerals and number words up to "ten".

Discussion

The results of the 47 ATSI students will not be discussed specifically, since they were part of the larger Kindergarten sample and are, thus automatically included in the discussion. The results indicate that beginning-school students bring with them a diverse range of mathematical knowledge. For example, at the initial assessment 28% of students were unable to produce the FNWS from "one" to "ten", whereas 3% of students were facile with the FNWS up to "one hundred". Similarly, whilst nearly half of the students were unable to identify all or some numerals in the range "one" to "ten", 7% of the total sample of students was able to identify one and two digit numerals. However, despite this diversity, progress was made by the majority of students and syllabus expectations were not only reached but exceeded by many of these students coming from disadvantaged backgrounds.

At the time of their final assessment 25% of the Kindergarten cohort had met syllabus expectations in terms of FNWS, 35% of the cohort had met syllabus expectations in terms of Numeral Identification and 48% of students had met syllabus requirements in terms of Early Arithmetical Strategies. Forty percent of students exceeded syllabus expectations in terms of FNWS, approximately half of the students exceeded syllabus expectations in terms of Numeral Identification, and 40% of the students were at Stage 2 or higher at their final interview, thus exceeding syllabus expectations in terms of Early Arithmetical Strategies. Progress on such a large scale across such a geographically diverse range of 47 schools suggests that CMIT is a viable program for advancing many beginning-school students beyond expected syllabus outcomes. However, concern still remains for those students who had not met syllabus outcomes at the time of the final assessment.

At their final assessment 35% of Kindergarten students were not facile with the FNWS to “ten”. Similarly, 15% of students were unable to identify all or some numerals in the range “one” to “ten”. These students had not met syllabus requirements at the time of the final assessment. This was also the case for 12% of students who were unable to count visible items and thus remained at a stage of Emergent Counting. Other factors such as teaching style, learning environment or specific student attributes may have contributed to these students’ apparent lack of success.

Finally, from the results it appears that, early in their first year of school a significant number of Kindergarten students were already able to complete the tasks, that were expected end-of-year syllabus outcomes. Thus 29% of students had already met or exceeded syllabus expectations in terms of FNWS, 51% of students had already met or exceeded syllabus expectations in terms of Numeral Identification and 57% of students had already met or exceeded syllabus expectations in terms of Early Arithmetical Strategies at the time of their initial assessment. This suggests that many students are under-challenged in their first year of school. This finding is consistent with earlier research (see Aubrey, 1993; Wright, 1994 ; Young-Loveridge, 1989).

References

- Aubrey, C. (1993). An investigation of the mathematical knowledge and competencies which young children bring to school. *British Educational Research Journal*, 19 (1), 27-41
- Australian Education Council. (1990). *A national statement on mathematics for Australian Schools*. Melbourne, Vic: Curriculum Corporation.
- Board of Studies (1997). *Mathematics K-6 Outcomes: Stages 1-3 and Early Stage 1*.
- Bobis, J. (1996). *Report on the evaluation of the Count Me In project..* University of Western Sydney, Macarthur, November.
- N.S.W. Department of Education. (1989). *Mathematics K-6*. Sydney: N.S.W. Department of School Education.
- N.S.W. Department of Education. (1997). *Count Me In Too*. Sydney: N.S.W. Department of School Education.
- Wright, R. J. (1994). A Study of the Numerical Development of 5-year-olds and 6-year-olds. *Educational Studies in Mathematics*, 26, 25-44.
- Wright, R. J., Cowper, M., Stanger, G. & Stewart, R. (1995). *Third year report of a project focusing on advancing the arithmetical knowledge of low-attaining first-graders*. Paper presented at the Eighteenth Annual Conference of the Mathematics Education Research Group of Australasia, Darwin, 7-10 July.
- Wright, R. J. (1996). Problem-centred mathematics in the first year of school. In J. Mulligan & M. Mitchelmore (Eds.), *Children’s number learning*. (pp. 35-54) Adelaide, Australia: The Australian Association of Mathematics Teachers.
- Wright, R. J. (in press) An application of the methods and results of a radical constructivist research program to professional development in recovery education (20pp). In P. Thompson (ed.), *Interdisciplinary perspectives on directions for constructivism in mathematics and science education*. Dordrecht, The Netherlands: Kluwer.
- Wright, R. J., Stanger, G., Cowper, M. & Dyson, R. (1996). First-graders’ progress in an experimental Mathematics Recovery program. In J. Mulligan & M. Mitchelmore (Eds.), *Children’s number learning*. (pp. 55-72) Adelaide, Australia: The Australian Association of Mathematics Teachers.
- Young-Loveridge, J. (1989). The development of children’s number concepts: The first year of school. *New Zealand Journal of Educational Studies*, 24(1), 47-64.