Abstract
Although New Zealand has been named in the top six countries in the world for achieving consistently highly in Mathematics, Reading and Writing according to PISA findings, 2009, there remains concern that a significant number of children are underachieving in Mathematics. Whilst it could be argued about the exact numbers it is patently clear that Maori and Pasifika children are over represented in the bottom 20%. This paper outlines a New Zealand pilot ‘Accelerating Learning in Mathematics’ (ALiM), trialled in 2010. The purpose was to support children by using a variety of approaches to accelerate children’s mathematical learning over a short term period, thereby giving the children an equitable opportunity to achieve at their appropriate level.
Within the context of this paper the use of the word children is used to define primary school age children (5 – 13 years) as opposed to the older secondary students.

Introduction
It was not until the results from the Third International Mathematics and Science Studies were released in 1996 showing New Zealand children (in the studies) were found to be below the International average in mathematics that the government sprang into action by forming a Mathematics and Science Taskforce group, in 1997, to address the problem. Of special concern were the lower results of Maori and Pasifika children who are destined to become a significant component of the future workforce. Also, at that time, it was noted that teachers in New Zealand were experiencing difficulties with implementing problem solving reforms in mathematics teaching.
Although there were some strong mathematics educators in New Zealand they were few in number and disparate. Four of the Auckland College of Education mathematics lecturers and mathematics advisers from each of the regions in New Zealand under the guidance of the Ministry of Education formed the basis of the first co-ordinated numeracy community covering the whole of the country. The New South Wales Department of Education and Training initiative ‘Count Me In Too’ was seen as a worthwhile project to trial. An experienced team was brought out from Australia to demonstrate the work they had introduced to teachers of junior classes. That particular project provided a well researched base from which to develop the New Zealand Numeracy pilot in 2000, and later the growth of the Numeracy Development Project (NDP). Its aim from 2001 – 2009 was to raise children’s achievements in mathematics by improving teachers’ professional knowledge, skills and confidence. During those years every teacher was allocated 12 hours professional development time as part of NDP. Facilitators, principals, and teachers were interdependent in effectuating the successful implementation of the Numeracy Project. Schools were encouraged to either work in the project by syndicates or as whole school professional development. Having several teachers involved at once meant the commitment was easier to maintain, through the support they gave each other.
From 2000 to 2010 milestone reports and evaluations annually documented evidence from teachers, facilitators, researchers and policy analysts and those continued to inform any further development of the Numeracy Development Project and beyond 2009. Today the project has moved from phase 1 which was implementing the project into phase 2; sustainability. Whilst funding limits the number of school facilitators
Why Accelerating Learning in Mathematics (ALiM)?
Although there have been great successes in the Numeracy Project in New Zealand there remains an important issue. One of the aims was to close the gap, (identified through TIMSS and PISA reports) of the lowest performing students (NZ) as compared to the top performers (NZ) and this has not been sufficiently attended to. Maori and Pasifika students, after ten years in the numeracy development project, still remain a significant number of the ‘below expectations’ group. In an attempt to focus on the issue the government has released funding solely to address such a problem. Along with the funding National Standards were introduced in 2010 to highlight at each school year (Year 1-8) the expected levels of achievement for Mathematics, Reading and Writing. National standards were put in place to help counteract the slowly diminishing tail with urgency. The numeracy development project was about raising children’s achievement through improved teacher capability whereas ALiM is about attending to the child.

ALiM
The purpose of the pilot was to see if the children’s learning could be accelerated with targeted teaching and learning for a period of ten weeks. The project involved thirty nine schools with funding from the Ministry of Education. Numeracy facilitators were given twenty hours to offer support and guidance per teacher. In the Otago/Southland region four schools were involved in the pilot and were selected by facilitators on the basis that the classroom teachers were good classroom teachers but still had small groups of children who were not achieving to expectations.

The children were selected for this project by principals and classroom teachers in consultation with numeracy facilitators. Factors that were taken into consideration were: regular school attendance, status in relation to the national standards, behavioural issues and a desire to learn. The teachers were selected for their effective classroom teaching practice, and had demonstrated a willingness to be part of the project.

At a national meeting, mathematics education researchers were called to present research ideas about accelerating learners who were not achieving to expectations. Several aspects arose from the discussion. Alton-Lee mentioned the emotional environment, “children will not learn if they do not feel safe and that we need to strengthen valued social outcomes and that an ethic of care needs to be created” (A. Alton-Lee, personal communication, April 26, 2010). Bullying is a huge issue in primary and secondary schools and scared children often think of the next break outside the classroom when they are at their most vulnerable rather than on the tasks at hand. Anthony shared her thoughts that making connections is central to the learning process and learning mathematics is not a linear process as children do not move along the same path (G. Anthony, personal communication, April 26, 2010). Attention was drawn to other researchers outside the group such as Mulligan’s work on patterning which can lead to a significant improvement in mathematical outcomes, the importance of building harmonious relationships between school, families and communities which can have reciprocal benefits for all concerned (Ministry of Education, 2008, p.3) and reference to Wright’s address at a numeracy conference in Auckland where he stated any teaching/tasks must develop their number knowledge to support non-count-by-ones strategies (R. Wright, personal communication, February 20, 2008).

With those considerations in mind facilitators wrote 16 small resources that could be used as a basis for planning with teachers. An initial two day ministry funded seminar was held where teachers and facilitators, from all over New Zealand, worked together to look at effective pedagogy and select an appropriate intervention which was then
tailored to meet the particular needs of the targeted children. Throughout the months teachers and facilitators were mainly guided by ten principles:

- An ethic of care
- Arranging for Learning
- Building on students’ thinking
- Worthwhile mathematical tasks
- Making connections
- Assessment for learning
- Mathematical communication
- Mathematical language
- Tools and representations
- Teacher knowledge (Anthony & Walmshaw, 2009)

The principles focus on effective teaching and although intended to be ‘nested within a larger network’, in general teachers found some practices were more applicable to their children’s needs.

The most common mathematical concepts covered were place value in the senior classes and addition/subtraction in junior classes. Most teachers chose to run an extra four or five sessions for the targeted children, over and above the normal classroom mathematics programme. The sessions ranged from an extra 20 – 30 minutes depending on teachers’ release time. Teachers were assigned a facilitator who would mentor and support them, and on their return to school began to implement their planned intervention.

**Success of ALiM**

The New Zealand Council for Educational Research (NZCER) was contracted to supervise the data gathering, analysis and evaluation of the exploratory study. The children were assessed using NumPA (a diagnostic interview), a Progressive Achievement Test (norm-referenced assessment tool) and an attitudinal survey. These assessments were administered prior to the intervention and at the end of the intervention (usually about ten weeks later). The PAT assessment was debated as to the appropriateness of having the children, who usually were at the lowest percentile; sit a test in exam like conditions. PAT involves a significant amount of reading therefore teachers were encouraged to read the questions for the children.

Findings showed that achievement levels increased (NZCER, 2010). Most of the children moved at least one numeracy stage, and surprisingly in the PAT Mathematics test, scores increased by an average of 80% of a year’s growth over the ten weeks involvement in the pilot. When comparing ethnic groups results Pasifika children also averaged 80% with Maori children increasing by 40%. An achievement gain for Maori children but the questions remaining unanswered were; why was it that they didn’t make the same gains and what were some of the variables that impacted on their lesser achievement?

Children’s attitudes to mathematics also showed a positive shift, their confidence and self-belief showed gains.

Reasons identified by teachers and facilitators for these successes were; regular well-structured sessions which made effective use of concrete materials, repetition of material learned at previous sessions, connections between knowledge and strategy, knowledge gaps identified and addressed, small groups where the children were actively involved and could take risks and be free from other children’s/ teachers preconceived notions of their ability in mathematics, more complex mathematical language being explored and used by the children to explain their thinking, teachers reflecting on their practice and having an active involvement from their facilitator, communication and support from whanau (family).
ALiM as Seen Through One School’s Success

Throughout New Zealand thirty nine schools implemented the project in 2010 but for the purpose of this paper the picture can be seen through the story of one of the four schools in the southern reaches of the country and how they implemented ALiM (further stories can be found on the website www.nzmaths.co.nz).

One School’s Story

The small school is situated about one and a half hour’s drive north of Dunedin with a population of approximately 13,000. It is a decile 4 school (decile 10 relates to a high socio-economic area), with 156 pupils, 25% of the students identifying as Maori and 20% identifying as Pasifika. It is a contributing school which has children from five years old to eleven years old. The school has a high emphasis on family values and has very strong connections with the community. With the downturn in the economic climate in NZ there has been a greater transience of pupils in the last three years.

Participants and Data Gathering

Two groups of students were chosen. Six children who were five years old in one group (Group A) and five children, seven and eight year olds, were in the other group (Group B). The small sized groups were deliberately chosen as the teacher felt they were more likely to take risks and were able to make better interactions with the teacher and other children.

Group A was taken by a teacher aide and happened for 38 of the sessions over the same period. This teacher aide (TA) has a TA certificate and was guided by the teacher. Those sessions were held from 2.30pm to 3.00pm, therefore, the children received extra mathematics lessons as they had their own class session daily from 12.40pm to 1.40pm.

Group B was taken by the teacher responsible for this project and happened on 40 x 30 minutes sessions. This was the highest possible number of sessions that could be taken over the eight week period. The sessions were held from 9.00am to 9.30am with those children also receiving extra mathematics lessons as they had their own class session daily from 12.40pm to 1.40pm.

Initial and final data was collected, as set out by NZCER and teachers administered the Numeracy Diagnostic Interview which they were very familiar with because of their involvement in the Numeracy Development Project. PAT assessment was not administered in this school due to the age of the young children. Records taken were put onto the school’s files for future reference and target setting.

Facilitation of the Exploratory Study

The teacher, an experienced teacher of nearly 40 years chosen by the Principal, was coupled with a numeracy facilitator who also had many years in the classroom environment. The teacher was able to offer many ideas and worked well with the facilitator to fine tune the plans for both groups. Assistance to the teacher was also given through visits, email and phone.

As the support resource for ‘children after one month at school’ was well structured the experienced teacher felt that her teacher aide would be able to follow the format with encouragement from the teacher. The focus for that work was a) to increase students’ every day and mathematical language through exploratory activities and b) to develop an understanding of numbers to 5. The lesson structure was based around six short 5 minute periods and always included: counting, matching, physical, sorting and copying activities as well as action rhymes (see nzmaths.co.nz\ALiM for further information).

Four resources for Group B children were used: after 6 months, after 9 months, after 18 months ‘moving children to simple additive strategies’ which the group had just been introduced to when they finished in the study.

The teacher and the teacher aide started each lesson with tasks the children had already experienced success with and made opportunities to connect their knowledge with other ‘harder’ aspects. An example was to use their knowledge of counting backwards 9-0 to connect with bigger numbers. If the children started at 27 the
teacher would point to the 7 then the 6 with 26 and 5 with 25 and so on. A variety of activities were required to be adapted and made for the children’s use. This proved to be a time consuming effort but worthwhile as the end products were able to be used time and time again.

In the 7th week both the teacher and the teacher aide were videoed working with the children and gave interviews. The DVD has proved an inspiration to many other teachers who have used and adapted many of the ideas the teacher, teacher aide and facilitator worked on.

**Results**

The results (see Table 1) show where the children were at the start of the programme on the New Zealand Framework, and where they were after 8 weeks. All stages are counting stages from Stage 0 where children cannot one to one count, to Stage 4 where they can ‘hold a set in their head’ and count on. For example, to solve $8 + 5$ they would say 8 and count on 9, 10, 11, 12, 13 to solve the problem. In New Zealand children are expected to reach Stage 2 or 3 by the end of Year 1 and Stage 4 by the end of Year 2.

<table>
<thead>
<tr>
<th>Number of students</th>
<th>Year</th>
<th>Initial stage Add/Sub</th>
<th>Final stage Add/Sub</th>
<th>Time in programme</th>
<th>Predominant Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A 6</td>
<td>0/1</td>
<td>3 students - stage 0</td>
<td>6 students - stage 2</td>
<td>5x30mins weekly</td>
<td>Language development &amp; Number Knowledge to 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 students - stage 1</td>
<td></td>
<td>7.5 weeks</td>
<td></td>
</tr>
<tr>
<td>Group B 5</td>
<td>2/3</td>
<td>1 student - stage 1</td>
<td>5 students - stage 4</td>
<td>5x30mins weekly</td>
<td>Number Knowledge &amp; Strategy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 students - stage 2</td>
<td></td>
<td>8 weeks</td>
<td></td>
</tr>
</tbody>
</table>

The group A children in 7.5 weeks were able to reach a stage on the New Zealand Framework which is an expectation for a child who has been at school for a year. The group B children who were well below expectation for their year group managed to achieve at a comparative stage with their peers. In 8 weeks they made the equivalent progress of 12 months at school.

**Reasons for success**

The teacher identified several factors for success:

- Extremely supportive principal and facilitator
- Parental involvement with close communication between the teacher and the parents
- The interest, involvement and support of other teachers in the school. They observed some lessons and were able to apply some of the concepts to their own classroom practice
- The environment where the sessions took place was set up specifically for mathematics and showed mathematics was valued
- The group size was ideal, children were able to take risks without other children making value judgements. Problem solving and working together as a group increased the children’s confidence in their own ability. The children’s image of themselves as being able to solve problems became much more positive
Connections between known material and new material were made explicit. The children became much more confident to share their thinking using more complex mathematical language.

Having a variety of materials was essential so that children had a great deal of repetition of the same concept but in a variety of ways so concepts were able to be generalized

**Conclusion**

The teacher gave several reasons why ALiM was successful in the small school but failed to mention the pivotal factor and that was, of course, herself. She is a highly effective, experienced classroom teacher and was prepared to take on a challenge to improve outcomes for children in mathematics.

The exploratory study was so successful in her school that the principal has decided that all five year olds will be given the opportunity of ‘after one month at school’ sessions and the ALiM resources will be made available for other teachers on their staff. The TA has decided to enter teacher training through an online course with practicum in the school where she is familiar. The teacher has since incorporated many of the ideas into her teaching approaches. The school’s story is only one small part of the wider exploratory study but it is a story that is repeated in many other schools.

Following the successful report from NZCER the Ministry of Education through the government has secured funding for a pilot to be held in 2011 involving 160 schools working in ALiM. A new component is the appointment of specialist mathematics teachers in each region who are appointed 0.5 time in their schools and will work with the ‘well below expectations’ children who have had few or no opportunities for mathematics interventions. New approaches need to be found for those children as opposed to serving the same ‘diet’ year after year with little success.

As ALiM showed that children’s learning could be accelerated after interventions it is with interest that mathematics educators await the next evaluations. From the work in 2010 one factor stands out: When principals, teachers, parents, and outside facilitators work together, alongside the children, achievement improves.

**Acknowledgements**

Further information on ALiM exploratory study, 2010 and ALiM pilot, 2011 can be found on [www.nzmaths.co.nz](http://www.nzmaths.co.nz) The views expressed in this paper do not necessarily reflect that of University of Otago College of Education or the Ministry of Education. Thanks are conveyed to the school involved, the staff and the children whose story has been told in this paper.

**References**

