Basket Range Primary School
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‘WELCOME TO OUR WORLD’

Buddy Maths to improve student attitudes towards Mathematics.
Basket Range Primary School is a very small one, having just 49 students R-7, with 3 multi age group classes. It is a very close-knit community and students see each other out of school nearly as much as in school. To a very large extent, the distinction between home and school is a blurry one for many of the students.

For 2007, part of the school’s site learning plan involved developing our Maths teaching and learning and we’d always been aware of the way older students were keen to help younger or less able class-mates during maths sessions. Sometimes younger students would make comments along the lines of, “I didn’t understand it when you explained it but she explained it differently and I understand how to do it now.”

1. Our Question.

Does peer support, in the form of cross-age tutoring, help students develop a deeper understanding, greater self-confidence and more engagement in maths?
Small schools sometimes hit the news because of what they lack, but in this case it is one of the strengths of a small school that we believed we could capitalize on, namely the collegiate and peer support culture so dominant in a small school. Students necessarily work in multi age groups and are able to support younger students to develop understanding of ideas and concepts as they are being introduced. As a staff we believed this would have benefits in developing more positive attitudes and achievement in mathematics.

The school is R-7 with a greater proportion of students in the R-3 group than the 4-7. There is a strong, clearly articulated culture of support for younger students especially. It is part of the culture of the community, and certainly the school, that older students take care of younger ones. This applies in all areas of daily life and is so embedded in the school’s culture that younger students move seamlessly into the role of carer as they move up through the year levels.

Maths is an area that we have identified as a school priority in the SLP, focusing on developing teaching skills and practice as well as buying resources. Staff undertook 1st Steps Maths training the previous year and this action research project was a natural progression to reflect on our own teaching practices and student responses to these. The idea was to improve student attitude and self-perception as capable mathematicians.

As teachers we are aware of the need to accommodate a variety of learning styles, but we have tended to subsume the responses of our students in relation to the types of lessons we do – boys as a group tend to prefer active, hands on activity maths, girls as a group tend to prefer a collegiate classroom, but this can’t always be organized. It was a chance to have our beliefs about successful teaching confirmed or contradicted by comments and input from the kids.
We found that older students loved the opportunity to work with younger ones in literacy and art activities, with some wonderful work and social spin-offs from these activities. We reasoned that this should also be possible in maths lessons, making use of the students’ own skills in relating to peers and enriching their own understanding through teaching concepts to younger students.

- **Planning**

Our belief that peer tutoring would help to improve attitudes towards maths and therefore enable greater learning was based on our observations of peer tutoring in other curriculum areas and in play. Our reading and practices strongly supported this belief. The quote attached best summarizes the findings of much current research.

There are three commonly cited benefits of peer and cross-age tutoring: the learning of academic skills, the development of social behaviors and classroom discipline, and the enhancement of peer relations (Greenwood, Carta, and Hall 1988, p. 264). Researchers have also identified improvements in self-esteem and one of its components--internal locus of control. It is important to note that all such benefits accrue to both tutor and tutee.

Some writers also cite broader benefits. Hedin, for example, cites "a more cooperative, pleasant classroom atmosphere" and "[recruiting] promising future teachers into the profession" (1987, p. 44). Still other potential benefits are better-adjusted students with skills transferable to parenting when they mature (Strayhorn, Strain, and Walker 1993). The focus of this report is direct benefits for tutors and tutees, but it also touches briefly on some indirect effects of interest to parents, teachers, and administrators.


[www.nwrel.org/scpd/sirs/9/c018.html](http://www.nwrel.org/scpd/sirs/9/c018.html)

Most of the web-based literature is American and relates only to Literacy experiments or, in maths, to older students with an intellectual disability working with younger students. There seemed to be little similar to what we were planning to do. As a staff we discussed the idea that this “buddy program” would only work as a support to normal classroom maths sessions. There was still the imperative that teachers were responsible for the delivery of the overall maths programme.

We believed that the buddy programme would support younger students to work 1:1 with a more experienced person.

We also believed that students would be able to use “student talk” to offer explanations in a way that we might not.

We believe strongly that older students would benefit from consolidating their own knowledge and developing a deeper understanding of concepts through explanation to younger people. How often have we had the experience as adults when something we learned, perhaps without any understanding, suddenly “clicks” as we try to explain it to someone else.

When we began, we elected to do the buddy class (BC) intensively over 4 consecutive lessons, but this was changed for the final section as it proved too difficult to manage. In hindsight it could never have worked, but like our students, we had to find out by having a go! After much discussion and observation, we chose to operate the final cross-age tutoring sessions on a Friday, a day when we traditionally set aside time for BC activities. These have focused on literacy, multimedia, sport and cooking in the past. Three groups operate in the BC time, with teachers selecting the buddy pairs based on understanding of each student’s strengths and weaknesses, their friendship preferences and personality matches. Each group has one hour per activity and then the groups
rotate so that at the end of a 3-hour period, all students have been involved in all activities. This time, maths was one of the activities.

We chose a simple topic that would focus on process rather than content, addition. Deciding that it was important to have an appropriate starting point, we undertook to test all of the junior buddies, using the Victorian Mathematics Online Interview from the Early Numeracy Project (See Appendix 5). This was modified so that we were only testing the concepts directly related to addition. One of the teachers went through the test and highlighted all the addition, subtraction and counting questions, then arranged them in developmental order. She also undertook the training of some of the older buddies to administer the test. The concepts we took from the Victorian test were then matched to the SACSA outcomes. The matching was pretty straightforward, although this was not key to our planning at this point because we were primarily looking at attitude shift rather than immediately measurable knowledge or skills outcomes. This entire process was exceedingly time consuming.

Once student starting levels were established, we supported the coaches, or older buddies (OB) to develop activities which would help the younger buddies (YB) to develop understanding in number and addition. The OBs then spent some time making and/or gathering resources for their lessons.

- **Strategic observations**

We decided initially to begin with a manageable, easily understood task that lent itself to lots of hands on activities and games. We chose addition, because we believed that older buddies would already have a solid understanding of the concept.

We began by pairing students and asking the older buddy to complete a survey, for both their younger buddy and themselves, which would clarify for us their attitudes towards maths and their understanding of maths in general.

2 of the teachers spent 2 lessons working with the older buddies to develop a teaching plan. This involved looking at each child’s plan, based on the outcomes identified for their JP buddy and finding resources to support the lessons. We were planning only 2 or 3 lessons ahead at most. Our initial plan was to run 4 consecutive sessions on consecutive days. After 2 sessions we found that this was unmanageable because older students had such a narrow focus imposed on their work that they felt unsure about where to go next once they had worked through their immediate plan – sometimes finding that their buddy learned much faster or slower than anticipated. We also found that the older students tended to rush some of the younger ones through the learning, introducing material which was developmentally inappropriate rather than reinforcing or expanding the experience at the younger student’s level.

We thought that more resources, especially activity-based resources, would support both the teaching and learning. To this end we accessed some of the New Zealand Maths materials and grabbed appropriate games for the units of work we were using and which could be aligned with SACSA outcomes. Teachers of the older students familiarized their “coaches” with the new resources and asked them to select appropriate games for their buddy. We then tried 2 more sessions with the games as a focus.

These proved of limited popularity although they did provide a less formal and more enjoyable structure for learning, which was still focused on addition.

Our initial thinking was that we would see an improvement in students’ engagement in maths, but it soon became apparent that the intensive approach was creating problems because the tutors did not have the skills or understandings to be able to deliver a balanced and appropriate programme – they didn’t know where their work was leading or what came next. The formal structure of the lessons and the narrow scope of our outcome objectives meant there was little room for the creativity we were to see in later, more successful sessions. We retired, chastened, to our classrooms to reflect on the process to date. After a break of some weeks from the process, we talked about using games as a vehicle for BC maths. These would allow concepts to be taught and
learned in an informal yet highly structured environment, but not one that had limited outcomes identified. There was room for a lot of creativity and spontaneity.

The last phase of the experiment involved using games as a focus for mathematical thinking and discussion. We asked all students to suggest games they’d like to play – board games, computer games, outdoor games and cooking. As the suggestions were made, we asked the coaches to identify the sorts of maths embedded in the games. They were able to identify many of the skills we’d been working on in our formal lesson programme, as well as many others that we as teachers may have overlooked. Many of the games and activities we were talking about had already been used as part of the maths programme, but not in the format of BC or with such a variety of learning outcomes to be identified from each game.

We planned to use the games as a part of our normal Friday buddies programme for at least 4 weeks.

The response from the students was overwhelmingly positive. The first session saw children not bothering with recording, however this became more rigorous as the novelty (but not the fun) wore off. Observation and anecdotal records, plus comments from the students, form the basis of our assessment of the effectiveness of this part of the programme.

- Evaluated the evidence, gathered data.

Our most affective data has come from our own observations, anecdotal notes and student comments. The attitude audit we repeated at the end of the programme did not show any change of ideas, yet the way students approached the games, discussed their thinking and kept asking when we were going to be doing Buddy Maths again, was an indication that it was both popular and engaging.

One student, yr 2, was standing at one end of a spiral hopscotch game at lunchtime, a game he’d been playing during the maths period. He spoke with the teacher on yard duty after looking at the drawing for about 5 minutes, “If I went back to the start after I’d finished this, my score would be doubled wouldn’t it?” He then sat down, in his play time and worked out that doubling 29 would give him 58.

One of the year 7 boys came bustling in after recess and asked if he was doing Buddy Maths in the next session and when told he was, said, “Cool, I can’t wait.”

Older students were asked to measure out a variety of grids for games in the playground, quite sophisticated maths in itself, and then place numbers on them so that they could be used for games. These were to be painted over by staff with a line marker. The students spent some considerable time discussing all the options so that they could use the grids for a wide variety of counting games with their YBs.

Trends with such a small cohort are difficult to see and often unreliable, hence LaN data is often unsurprising in a small school environment and whole school trends are not generally evident. With our students, the unchanged attitude audit did not match what we saw and heard both during the activities and afterwards. The tool itself did not give us the information we needed, so the data we did collect, whilst interesting, is not especially useful.

Some of the early data used to place students was helpful and remains useful as a measure of growth. This was not the point of our project – we already assess this sort of growth through appropriate testing and observation in classrooms.

Conclusions – our learning.

Our initial idea, that the cross-age tutoring would make an appreciable difference in the attitude of students towards maths, was flawed. There was an assumption that the attitude was not strongly positive, but following our attitude audits this was not seen to be the case as the vast majority of our students have very strongly positive concepts of maths in their lives and their ability to use it.
What was not evident was the recognition that they are surrounded by maths and maths was a tool for everyday living.

We discovered very quickly that the essence of Cross-age tutoring is its ability to tap into the different relationships that exist between students when compared to that between teacher and student. One of the important elements is the random, unpredictable nature of the learning and discoveries the children are making. These are a reflection of what they learn in the more formal classroom environment, or may help shape future learning, but it is not possible to plan for “just in time” learning on a whole school scale in standard classrooms with just one teacher.

The survey tool we used did not elicit responses that showed what we had observed – that students were strongly engaged in the activities and were asking questions, solving problems and using maths whilst having fun.

- Where to next?

The activities will go on into our BC programme for 2008. Students have reacted very positively to the maths buddy classes and we will have the opportunity to match some of these activities more closely to current formal work in the planning stages of each term. Our thinking about how the Cross Age tutoring impacts on student learning is much clearer and this perception of the value of BCs is not confined to Maths. Our current classroom organization will continue to make use of cross-age tutoring as a positive learning tool, and we will continue to use the Buddy Class programme in Maths as a powerful support for our more outcome-driven maths programme.

The value of the inquiry project has been demonstrated for us because we had strong beliefs about the power of cross-age tutoring which were affirmed in many ways, but also needed to be rethought. The reasons for the effectiveness and affectiveness of CAT were not well understood and probably still need further teasing out, but we have at least generated a starting point for further exploration.

- Appendices
Appendix 1

Student comments made after the first addition teaching session.

On working with a buddy.

Comments made by the younger buddy:
I like it when my buddy is next to me and helping me.
The buddy gives you different work.
More fun and you get to make games and it’s not so challenging.
My buddy is nice to me.
Buddies are not as strict and it’s fun.
They give more attention.
Not so bossy, she makes my work fun.
It was good because it was easier and you get everything done on time.
It’s easy because you can speak to your buddy all the time but the teacher has to keep going around.
I reckon kids understand kids better than kids understand adults.
Adults use more words that kids don’t understand. (this was only felt by a few to be the case.)

Comments made by the older buddy:
You are doing the teaching and you are in control.
Being able to understand what teaching is like.
Different ways of teaching and one on one work.
I think I learn a bit more with a teacher but working with a buddy is fun.
Not as many rules, it’s more relaxed and I’m teaching.
I like working with a teacher because it’s harder but I also like working with my buddy.
It makes me feel higher when I’m teaching them and I like passing on the skills that I learnt.
I enjoy working with a buddy teaching them what I know, but I also like to extend my own knowledge by someone else teaching me.
It teaches you how to teach someone else.

Appendix 2

Developing Addition Skills

1. Sort into small groups
2. Rote count to 5
3. Recognise numerals to 5
4. Write numeral to 5
5. Touch count to 5
6. Conserve numbers
7. Recognise simple patterns
8. Rote count to 10
9. Recognise numerals to 10
10. Write numerals to 10
11. Touch count to 10
12. Subsitise (recognise without counting) small numbers ie to 5
13. Know numbers before and after a given number to 10
14. Recognise simple patterns
15. Develop number skills as before to 20, then 50, then 100 and higher
16. Begin counting from different numbers
17. Begin using concrete materials to explore tens and units – hundreds

**Addition Skills**

18. Can compare two small groups
19. Count both groups together
20. Count on
21. Add single digit numbers up to 5, then 10, then 20, then higher, using double digits
22. Understand that it is most effective to start counting from the highest number, and that the answer will still be the same.
23. Learn basic addition facts to 10
24. Understand that these facts don’t change
25. Develop other strategies such as doubling, adding tens etc.
26. Continue to use concrete materials to explore and develop understanding of tens and units.
27. Begin to record tens and units
28. Use a variety of techniques to explore and develop these concepts ie oral stories, concrete materials, pictorial recording and written number sentences.
29. Make sure problems can be handled from a variety of perspectives ie $2 + ? = 5, \ ? + 3 = 5, \ 2 + 3 = \ ?$, then extend to higher numbers.
## STUDENT ATTITUDE AUDIT - MATHS

**Date:** __________________  **Name:** ________________________________

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is Maths?</td>
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<tr>
<td>What are the three most important things in Maths?</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
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<tr>
<td>2.</td>
<td></td>
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<tr>
<td>3.</td>
<td></td>
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<tr>
<td>How do you feel when you do Maths?</td>
<td></td>
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<tr>
<td>Why?</td>
<td></td>
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<tr>
<td>Do you use Maths -</td>
<td></td>
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<tr>
<td>(a) At School</td>
<td>Yes</td>
</tr>
<tr>
<td>If yes, how</td>
<td></td>
</tr>
<tr>
<td>(b) At home</td>
<td>Yes</td>
</tr>
<tr>
<td>Question</td>
<td>Yes</td>
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<td>-------------------------------------------------------------------------</td>
<td>-----</td>
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<tr>
<td>If yes, how</td>
<td></td>
</tr>
<tr>
<td>(c) When you play?</td>
<td>Yes</td>
</tr>
<tr>
<td>If yes, how</td>
<td></td>
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<tr>
<td>When is Maths easy?</td>
<td></td>
</tr>
<tr>
<td>When is Maths difficult?</td>
<td></td>
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<tr>
<td>What do you do when you can’t work out something in Maths?</td>
<td></td>
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<tr>
<td>Do other people from your family use Maths at home or at work?</td>
<td>Yes</td>
</tr>
<tr>
<td>If yes, how</td>
<td></td>
</tr>
<tr>
<td>Do you think Maths is important?</td>
<td>Yes</td>
</tr>
<tr>
<td>Why?</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 4
Student comments about outside games.

Outside Games

Student Comments

- More fun.
- Better than maths on paper.
- Start to enjoy maths more.
- Younger students are unaware they are doing maths - they only know if they are told. (OB comment)
- Adding up outside is better because it’s fun.
- Difficult to choose between classroom / buddy maths. (YB comment).
- Knocking down the cones was the best.
- Both types of maths help you learn. (YB comment)
- Playing games makes it easier to learn maths.

(See Appendix 5 below)
Appendix 5
Placement test

C. ADDITION AND SUBTRACTION STRATEGIES

18. Counting on (circle strategy used)
a, b, c. Answer ________
   • Count on (either 9, 10, 11, 12, 13 or 4, 5, 6, 7, 8, 9, 10, 11, 12, 13)
   • Known fact
   • Count all 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
   • Other
   d. Answer ________
   • Count all 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
   • Other

19. Count back/modelling all (8-3) (circle strategy used)
a. Answer ________
   • Known fact or fact family (eg., 5 + 3 = 8)
   • Count back all, in head (7, 6, 5 or 8, 7, 6, 5)
   • Count back all, with fingers used to keep track only (7, 6, 5 or 8, 7, 6, 5)
   • Modelling all (shows 8 fingers, then takes away 3)
   • Other
   b. Answer ________
     • Modelling all (shows 8 fingers, then takes away 3)
     • Other

20. Count down to/count up from (12-9) (circle strategy used)
   Answer ________
   • Known fact or fact family (eg., 9 + 3 = 12)
   • Count down to (12, 11, 10, 9)
   • Count up from (9, 10, 11, 12)
   • Fingers used during ‘count down to’ or ‘count up from’ to keep track only
   • Count back all (12, 11, 10, 9, 8, 7, 6, 5, 4, 3)
   • Modelling all (shows 12 ‘things’, then takes away 9 ‘things’, leaving 3)
   • Other

21. Basic strategies (circle strategy used)
a. 4 + 4 ________
   • Doubles or known fact
   • Count on (4, 5, 6, 7, 8)
   • Other
   b. 2 + 10 ________
   • Commutativity and count on (19, 20, 21)
   • Known fact
   • Count on 2 (2, 3, 4, ..., 21)
   • Other
   c. 4 + 6 ________
   • Tens fact or known fact
   • Count on (6, 7, 8, 9, 10 or 4, 5, 6, 7, 8, 9, 10)
   • Other
   d. 27 + 10 ________
   • Add 10 (27, 37)
   • Build to next 10 (to 30 then 7 more)
   • Count on by 1s (27, 28, 29, 30, ..., 37)
   • Other

22. Derived strategies (circle strategy used)
a. 12 - 6 ________
   • Using doubles or known fact
   • Count back (12, 11, ..., 6)
   • Other
   b. 7 + 8 ________
   • Near doubles or known fact
   • Count on (7, 8, 9, ..., 15 or 8, 9, 10, ..., 15)
   • Other
   c. 19 - 15 ________
   • Fact family or known fact
   • Count down to (19, 18, 17, 16, 15)
   • Count up from (15, 16, 17, 18, 19)
   • Count back all (19, 18, 17, ..., 6, 5, 4)
   • Other
   d. 16 + 5 ________
   • Build to next ten (to 20 then 1 more)
   • Known fact
   • Add units, then plus 10 (11, 21)
   • Other
   e. 36 + 9 ________
   • Add 10 take 1 (36, 46, 45)
   • Build to next ten (to 40 then 5 more)
   • Known fact
   • Count on
   • Other

23. Multi-digit strategies
a. 68 + 32 ________
b. 25 + 99 ________
c. 100 - 68 ________
d. Half of 30 ________
e. Double 26 ________

24. How many digits? (circle strategy used)
   a. 134 + 589 ________
   b. Explanation
   • Focus on 100s digit
   • Other
c. 1246 - 558 ________
   d. Explanation
   • Focus on 100s digit
   • Other

25. Estimating and calculating addition
   a. Estimate (within range 800-1000) ________
   b. Mental answer: ________
   c. Written answer: ________

26. Estimating and calculating subtraction
   a. Estimate (within range 200-300) ________
   b. Mental answer: ________
   c. Written answer: ________