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Better Implementation of Calculators in the Classroom Through Parental Involvement

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**BETTER IMPLEMENTATION OF CALCULATORS
IN THE CLASSROOM
THROUGH PARENTAL INVOLVEMENT**

by
Jennifer S. Kemp

**A Thesis submitted in partial fulfillment
of the requirements for the degree of
Bachelor of Education (Primary) Honours
Edith Cowan University
Mount Lawley Campus**

Principal Supervisor: Brian Farrell

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ABSTRACT

This study examined the changes in parental attitudes towards calculator use in the classroom during their involvement in calculator activities with students. The study also investigated the effectiveness of involving parents in mathematics activities as a support mechanism for calculator implementation in the school as a whole.

A class of year 6 students and their parents were chosen for the study. Parents were first given a questionnaire to evaluate their attitudes towards the use of calculators in schools. Interested parents were consequently invited to participate in one fifty-minute lesson per week for eight weeks. During these lessons, calculators were used for a variety of purposes.

The changes in parent attitudes were analysed based on the initial questionnaire, initial interview, journal entries during the eight weeks, and the final interview at the conclusion of the study. The researcher's journal was used to identify the researcher's attitude towards calculator use and the effectiveness of parent involvement in the activities.

It was concluded that the attitudes of the parents changed over the course of the study. They discovered the potential of calculators as tools and teaching aids and were able to identify more benefits following the study compared with their comments before the study. The benefits that they perceived during the study had a direct effect on their reservations about the use of calculators in the primary classroom. These were significantly reduced by the conclusion of the study and primarily related to the way in which calculators could be used rather than

if they should be used. The study revealed that involving the parents in the calculator activities gave them a clearer idea of how they could be used, and that their misconceptions and reservations were minimised as they discovered the potential of calculators for their child's learning.

DECLARATION

I certify that this project does not, to the best of my knowledge and belief:

- (i) incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education;
- (ii) contain any material previously published or written by another person except where due reference is made in the text; or
- (iii) contain any defamatory material.

Signature

A large black rectangular redaction box covers the signature area.

Date

16/12/99

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CHAPTER 1

INTRODUCTION

1.1 Background to the study

"The evidence is in. The potential is clear. The next millennium will judge us by the inaction of this decade."

(Williams 1998 p.25)

Much research has been conducted into calculator use in primary classrooms over the last twenty-five years and has clearly shown that calculators do not hinder students' ability with arithmetic (Swan & Sparrow, 1998b, p.28). Current policy and curriculum documents clearly state the importance of calculator use at all year levels (CDC & AAMT, 1996, p.1; Curriculum Council, 1998, p.187).

Even with the enormous amount of positive feedback about calculator use in primary classrooms, studies indicate that calculators are not being used to their potential. In some schools they are not being used at all. Some impediments to calculator use include their availability, teacher reluctance to try new ideas, lack of resources, and parental objections to their use (Swan & Sparrow, 1998b, p.28; Williams, 1998 p.21).

After completing research into the myths about calculators currently held by parents Swan & Sparrow concluded that teachers should not focus on whether or not calculators should be used, but rather they should focus on how to make the best use of them. This can be achieved through such support mechanisms as 1) whole school policy development; 2)

allocating resources; 3) communication between schools and parents; and 4) encouraging students to develop number sense and make sensible choices about when to use a calculator (Williams, 1998 p.23).

1.2 Significance of the study

While much research has been carried out as to whether calculators should be used in the classroom, and how they can be used with respect to changing teacher attitudes, there is little research into the area of changing parent attitudes towards calculator use in the primary classroom.

This study will examine the effect that working with students and calculators has on parent attitudes. With the support of curriculum documents that advocate calculator use at all year levels, this study will provide information about effective ways that calculators can be used in the classroom. The issue of parental objections to calculators being dealt with in this study will provide practical ideas for reducing the fears of anxious parents rather than quoting research findings which has proven to be ineffective (Swan & Sparrow, 1998b, p.29).

The effectiveness of school support mechanisms for calculator use (Williams, 1998, p.23) will be demonstrated in this study. The participating school already has a policy on calculator use that follows the guidelines of the National Statement, and resources have been allocated for calculators to some degree. This study will add to those resources, develop communication between parents and the school, and encourage

children to develop number sense and make sensible choices about calculators.

1.3 Purpose of the study

The purpose of this study was to examine changes in parental attitudes towards calculator use in the classroom during their involvement in calculator activities with students. The study also investigated the effectiveness of a “parents as partners” approach to mathematics involving calculators.

Parent attitudes have an influence on student attitudes and learning, therefore understanding how parents feel about calculators and making them increasingly aware of how they can be used effectively is an important step in enhancing student attitudes and learning.

1.4 Research questions

What attitudes do parents have towards calculator use in the mathematics classroom?

1. What potential benefits do parents see in the use of calculators as tools and instructional aids?
2. What criticisms and reservations do parents have about the use of calculators in the mathematics classroom?
3. Does involvement in classroom activities involving calculators change the attitudes of parents towards their use?

CHAPTER 2

LITERATURE REVIEW

This literature review includes information about constructivism in the classroom, the history of calculator use in primary classrooms, recent calculator research and attitudes towards calculators in the school and community. Ways that calculators can be used in the classroom, parent involvement in mathematics and literature on methodology will also be discussed.

2.1 History of calculator use in primary schools

Calculators have been a controversial issue in schools for the last three decades, however they are still not being used much by students (Powell, 1996, p.4). The controversy began in the 1970s with the introduction of the pocket calculator. It was viewed with distrust by most people concerned with mathematics education (Swan & Sparrow, 1998a, p.156) because educators realised that its incorporation would result in changes to what was taught in mathematics and how mathematics was taught in schools.

At this stage the implementation of the calculator in the classroom was a foreign idea to many people. During the 1970s and 1980s extensive research was devoted to calculator use and its impact on the achievement of students. Although it was a relatively new concept, some academics were beginning to realise and document its place in mathematics education. In 1977, Girling supported calculator use when he concluded that

sensible use of a calculator was integral to basic numeracy (cited in Sparrow, Kershaw & Jones, 1994, p.4).

By 1980, the National Council of Teachers of Mathematics (NCTM) had reached its own conclusions about the potential of calculators for mathematics education. It published "An Agenda for Action" which proposed the integration of calculators at all levels but particularly in the area of problem solving. This document was able to summarise the recommendations of the research being conducted during the 1970s.

This affirmation of calculator use was not enough to revolutionise the way mathematics was being taught in Australia. Educators were still skeptical of the benefits of their inclusion in teaching and learning and most teachers opted to ignore the research findings.

During the 1980s and early 1990s several academics conducted meta-analyses of numerous research projects on the topic of calculators. In 1982 Suydam reviewed 75 studies with conclusions that showed achievement as high or higher in students using calculators when compared to students who were not using them. Reys and Reys (1987) demonstrated that calculator use does not hinder mathematical achievement during their discussion of results from 200 studies into calculator use (cited in Swan & Sparrow, 1998a, p.159).

Previously Hembree and Dessart conducted a meta analysis of 79 studies and found that mathematical achievement was as high or higher in students using calculators (Sparrow, Kershaw & Jones, 1994, p.18). Later additions to their work supported these findings as they noticed large potential benefits from

calculator use but little impact on the curriculum (Hembree & Dessart, 1992, p.23).

The Calculator Aware Number (CAN) project in the United Kingdom also showed calculators in a positive light. It began in late 1986 and involved twenty classes of six year olds (Sparrow, Kershaw & Jones, 1994, p.36). Although it was not set up as a research project, it provided insight into the mathematical development of the children over a longer period of time than the usual studies. The Calculators in Primary Mathematics project began in Australia in 1990 and demonstrated that students who used calculators were more able to solve real-life problems, chose calculating methods sensibly, and were able to interpret their answers more easily.

It wasn't until 1987 that Australia followed suit with its own recommendations for calculator use in schools with "A National Statement on the Use of Calculators for Mathematics in Australian Schools" (Williams, 1998, p.20). This document summarised five main recommendations regarding calculator use in Australian schools:

1. All students should use calculators at all year levels
2. They should be used as instructional aids and computational tools in the learning process
3. Teachers should be actively involved in curriculum change in content and methods arising from calculator use
4. Teachers should take advantage of the potential of calculators for mathematics within the total curriculum
5. Teachers should initiate discussion locally regarding the role of calculators in the school and society

(CDC & AAMT, 1987, p.1)

Research and controversy did not conclude with the production of either of these documents. NCTM extended its recommendations in 1991 by suggesting the integration of calculators in homework and evaluation as well as classwork. Calculators were viewed by academics as essential tools for the learning of mathematics at this time. The following year NCTM published a yearbook to co-ordinate calculator research from around the world (Williams, 1998, p.20). The community was still not entirely convinced and so the research continued. An American study in 1994 showed that half of teachers were using calculators sometimes and a third of teachers were not using them at all (Wheatley, 1994, p. 115).

In 1994, the Education Department released the Mathematics Student Outcome Statements in Western Australia. Calculators were given equal consideration to mental and written computation in this document (EDWA, 1994, p.12,22,34,44). Student Outcome Statements were a new concept for teachers to grasp but at least the presence of calculators gave weight to the many years of recommendations in policy documents.

By 1995 it seemed that calculators were at last having an impact in Australian schools with the results of a nation-wide survey of primary school teachers by Len Sparrow and Paul Swan. They received 1297 survey responses in which over seventy percent of teachers said that all students should use calculators.

Details of the research put this statistic into perspective. Many teachers commented that the use of calculators only occurred at certain times e.g. for checking, for older students only, or for formal calculators lessons. Only eleven percent of

teachers gave their students free access to calculators and over fifty percent of teachers chose when calculators should be used (Sparrow & Swan, 1997, p.31) (see Table 2)

Table 1
Survey Question 7

How frequently do students use calculators in your classroom?

Never	Rarely	Sometimes	Often	Free Access
157	162	500	335	143
12.1%	12.5%	38.5%	25.8%	11.0%

Table 2
Survey Question 9

Who decides when students in your class use calculators?

Other	No response	Teacher	Student	Teacher / Student
2	130	727	69	369
0.2%	10.0%	56.1%	5.3%	28.5%

The lack of freedom that students have with calculators according to this study directly opposes the recommendations of the CAN project (Calculator Aware Number). The CAN project recommended that students should be able to choose when to use calculators (Williams, 1998, p.22). It appeared that calculators were still not being as widely accepted as they should have been.

The "Statement on the Use of Calculators and Computers for Mathematics in Australian Schools" was published by the Australian Association of Mathematics Teachers in 1996. This document updated the 1987 version in recommending that calculators become a priority as a natural medium for mathematics learning (CDC & AAMT, 1996, p.1). It also recommended that students have access to calculators in assessment as well as learning.

1. All students have ready access to appropriate technology as a means both to support and extend their mathematics learning experiences;
2. Priority be given to the use of calculators and computers as natural media for mathematics learning within a technologically-rich learning environment;
3. Teachers at all levels be actively involved in exploring ways to take full advantage of the potential of technology for mathematics learning within the total curriculum;
4. Students who use calculator and computer technology in their learning of mathematics have access to the same technological resources when their understanding of mathematics is being evaluated;
5. Education authorities make available to teachers professional development opportunities to support the development of knowledge and skills necessary for the successful use of calculator and computer technologies in classrooms.

(CDC & AAMT, 1996, p.1)

Mathematics policy documents clearly indicate the need for calculator implementation in mathematics education and their recommendations have been based on the wealth of research conducted in the last two decades.

The latest impact for calculators in mathematics education has occurred in the 1998 release of the Curriculum Frameworks by the Curriculum Council of Western Australia. The document is the result of involvement from a range of people including teachers, parents, academics, students and other members of the community (Curriculum Council, 1998, p.3). The "Working Mathematically" strand contains mathematical outcomes relating to calculators:

"Choose mathematical ideas and tools to fit the constraints in a practical situation, interpret and make sense of the results within the context and evaluate the appropriateness of the methods used." (Curriculum Council, 1998, p.185)

The explanation of this outcome outlines the way students should make appropriate use of their calculations using current technology and reinforces the fact that calculators are not doing the thinking for the students, rather the students must make sense of what they are doing and make decisions based on the construction of that knowledge (Curriculum Council, 1998, p.185).

Another mathematical outcome relating to calculators from the "Number" strand is:

"Choose and use a repertoire of mental, paper and calculator computational strategies for each operation, meeting needed degrees of accuracy and judging the reasonableness of results." (Curriculum Council, 1998, p.187)

The following explanation of this outcome discusses the need for students to make sensible choices as to when they should use a calculator (Curriculum Council, 1998, p.187). It goes further to state that students should be able to use calculators efficiently and interpret the displays accurately.

From the structure given in these recent curriculum documents, it is clear that not only are calculators being recommended for mathematics education in Western Australia, but active measures are now being taken to implement them in the curriculum for students of all ages.

2.2 Teacher and parent attitudes to calculators

"There are very few issues in mathematics over the past twenty-five years that have caused more debate among teachers, parents and the community than the use of calculators in schools" (Swan & Sparrow, 1998b, p.28)

It has already been established that teachers have not always readily used calculators in their classrooms. The attitude

of teachers towards calculators has changed with time, however the change has been slow.

Some teachers feel that calculator use is "cheating" and is limited to activities such as checking work. Other teachers find that calculators are beneficial with less able children and are useful to extend investigations by including data normally too large or complex to handle with mental or written methods. Many teachers find that calculators encourage children to use mental calculations more often, particularly when they are encouraged to estimate before calculating, and that calculators help create a positive attitude as well as confidence in mathematics tasks (Sparrow, Kershaw & Jones, 1994, p. 14-15).

Three teachers of Year 1 students developed a study to explore what their students thought about calculators, what they chose to do with them and what questions they asked (Marley, Skinner & Kenny, 1998, p.6). The teachers' attitudes at the conclusion of the study were positive, with delighted surprise that students were able to do much more than they were usually given credit for, including making decisions about when to use a calculator.

Another teacher was asked to trial a new calculator in his classroom, the outcome being that calculators were seen by this teacher as powerful tools (McCann, 1997, p.10). He was pleased to see that the discussion generated through the use of calculators led to much mathematical language in the classroom.

Teachers involved in the CAN project were also enthusiastic about the effects of calculators in their teaching program (Williams, 1998, p.22). Teachers were finding that the

omission of more traditional pencil-and-paper methods had provided more time for teachers to promote their students' understanding of mathematics. These teachers were surprised to find that the students using calculators were further on in their work and were showing understanding of much larger numbers than students who had not been using calculators.

With the vast amount of research and positive feedback from classroom experiences, it seems strange that so many teachers are still reluctant to pursue calculator use in their classrooms. The reasons for this are varied but essentially relate to a reluctance to change from what is familiar, the lack of community support and the lack of resources.

Teachers are concerned about the lack of security that a change in their teaching methods will produce (Sparrow, Kershaw & Jones, 1994, p.15). This may be attributed to the lack of curriculum resources and direction in how to use them in the classroom.

Other reasons for the slow introduction of calculators include a lack of calculators and other resources in the school (Reys et al, 1990, p.29). Some schools keep class sets of calculators that often fall into disrepair. Others insist on students purchasing their own calculator, which brings problems such as students having different kinds of calculators.

Another teacher excuse is a lack of time with a crowded syllabus however this is really no excuse at all. Calculators should not be considered an "add-on" to the syllabus, but rather as an integral part of it.

A lack of parent support is another reason cited by teachers for their reluctance to include calculators (Reys et al,

1990, p.29). It appears that teachers aren't the only people who have demonstrated reservations about calculator use. Parents perhaps have even more reason to be wary of calculators because they don't usually have access to research findings or experiences that show calculators being used effectively with positive outcomes. Their children's classes are the only fields of experience that most parents have with calculators since many would not have had access to calculators while at school themselves.

Paul Swan and Len Sparrow outline several myths about calculators that are still believed by some parents and teachers today. The first myth is that calculators rot the brain. There is a misconception here that students will lose the ability to calculate mentally and with paper and pencil. Secondly, a myth exists that students will become dependent on calculators and they will become a crutch to prop up students with weak mathematical ability. A popular myth is that students won't have to learn their basic number facts if they use calculators when in fact students will have even more reason to be confident with their basic facts.

Some parents also feel that students won't have to think when they use a calculator (Swan & Sparrow, 1998b, p.30). This may be attributed to the way many adults use their calculators – to calculate tedious sums to save time. The picture parents may have is that of students mindlessly punching numbers into their calculator and recording results on a page.

A common justification for not using calculators is that the "good old days" were good enough. Parents support their own education without the use of calculators without realising that

much has changed in their own lives since they were at school. This is the time of mobile phones, email, internet and telephone banking. These aspects of modern society do not necessarily mean we are becoming lazy, rather people are using current technology to improve mobility, communication and resource management. A misconception that students won't cope in the real world (Swan & Sparrow, 1998b, p.28) is quite false because students will actually have to cope with quite complex calculators in secondary school and beyond as well as other more complex technologies.

Parent attitudes have not changed much over the years of calculator implementation in mathematics classrooms. While some are content to "go with the flow" of what their child's teacher is promoting, others are quite opposed to the use of calculators at all. It is the responsibility of teachers to make decisions about how calculators are going to be used in conjunction with parents following realistic experiences with calculators on both sides.

2.3 How calculators can be used in the classroom

Many of the reservations teachers and parents have about calculator use come about because they are not aware of how calculators can be used. Their view is often limited to checking work and number crunching. Calculators can actually be used for a number of purposes in a variety of contexts.

Four potential roles in which calculators can be used are as a recording device, as a counting tool, as a tool to investigate

numbers and as a computational tool (Marley, Skinner & Kenny, 1998, p.5). Results of the Australian CAN project also show calculators being used in games, in pattern finding and creating, and as a natural setting for discussion (Sparrow, Kershaw & Jones, 1994, p.39).

Calculators perform several functions in the mathematics classroom that were previously unattainable (e.g. manipulating very large and very small numbers). When the calculator is used for certain calculations, students are able to concentrate on developing patterns and relationships (Ings, 1997, p.13) thus increasing their understanding of number. As this develops, there is a move in students' understanding from merely being able to perform the calculation to actually understanding what they are doing.

Powell believes that students' understanding of mathematics is similar to their grasp of language concepts in that they move from a general understanding of the whole concept to a more refined, structured understanding of the whole concept. With this in mind, it is possible to introduce symbols via the calculator even before the concept is fully understood e.g. the square root symbol. Students can look for patterns when they use this function and construct their knowledge based on their results. This builds on their experiences rather than restricting them to what the teacher allows them to learn. An exposure to these numbers may not necessarily teach the students the meaning, however it can give them an idea of what numbers are able to be explored (Powell, 1996, p.5-7).

When introducing calculators to students with little or no previous exposure to them, there are three main stages of

progression that the teacher should be aware of (McCann, 1997, p.11). The children will usually ignore the task given to them to begin with and simply experiment with their calculator. After some time the students will begin trying to find parts of the task that can be completed using the calculator. , Finally, in their optimum role, calculators become a secondary part of the activity, used as a tool only.

With these roles in mind there are several strategies that teachers can employ when involving calculators' in the classroom. All students, but particularly those with little experience with calculators, should have time to freely explore what they can do and share their results and ideas with others (Bitter & Hatfield, 1992, cited in Sparrow, Kershaw & Jones, 1994, p.49). Students should also use calculators after and in conjunction with concrete materials (Williams, 1998, p.22). It is important for teachers to allow students to see that they value the child's construction of learning by encouraging and accepting their invented algorithms.

Children should be allowed to use them in a variety of real world contexts with opportunities to work with others as well as individually (Bitter & Hatfield, 1992, cited in Sparrow, Kershaw & Jones, p.49). The emphasis should always be on developing sensible ways to perform calculations, whether they are mental, written, estimations or done with the calculator. Teachers should teach students the limitations of the calculator in order for them to judge appropriate ways to choose when to use it (Swan & Sparrow, 1998b, p.30).

2.4 Parents as partners in mathematics

“If we are all pulling in the same direction, we can achieve much more!” (Nierop, 1996, p.5)

Having parents as partners in mathematics is an effective way to improve the confidence of students, the consistency between what happens at school and at home, and the communication between the home and school.

The focus of all parent-teacher relationships is the child, therefore the attitudes and achievements of the students are of utmost importance to both parties. Studies show that parent involvement in their child’s learning benefits student achievement through an improvement in motivation and confidence (Peressini, 1998, p.321). Parents are able to help their children at home and reinforce a joint ownership of shared activities (Ford, Rollmer & Litz, 1998, p.310).

Parents as partners also improves the consistency between what is taught at school and what happens at home. Teachers reaffirm their own belief system by discussing the reasons for mathematical activities with parents which leads them to refine what is done at school to better meet the needs at home (Ford, Rollmer & Litz, 1998, p.311). In this way students are not divided between the teacher’s way of doing tasks and their parents’ way of doing tasks and students feel more comfortable with all parties pulling in the same direction.

Communication between the home and school is vital in all areas of schooling, not just mathematics, but its application to the area of mathematics can help overcome students’

apprehensions about the subject because parents can communicate to the child its importance and value (Ford, Rollmer & Litz, 1998, p.311). Parent involvement encourages mathematical communication through dialogue between parents and students (O'Connell, 1992, p.11; Peressini, 1998, p.321) which is fundamental to developing the mathematical language skills necessary to facilitate understanding of the concepts. Communication is also important because parents are able to share what they learn about their child's understandings with the teacher (Ford, Rollmer & Litz, 1998, p.311). The teacher also learns valuable information about the families of their students through such open lines of communication.

There are a variety of ways in which teachers can involve parents as partners in their mathematics programs. The important first step is to plan for communication with parents. The plan should have a clear purpose and be easily integrated into class routines. An example of this would be communication through a child's diary, which is seen by the teacher each day. The plan should involve students as well as teachers and parents and there should be a desire for some action to take place rather than merely being a token gesture (Nierop, 1996, p.5).

Meeting parents is another essential part of effective communication and may be formal, for example an interview, or informal meetings before or after school (Carey, 1998, p.314). These opportunities should include lots of encouragement and reinforcement of the parents' role in helping their children to show them how important they are to the process of education.

Some helpful written communication ideas include producing parent questionnaires to find out what happens at home with homework and other activities (Nierop, 1996, p.5). This can assist the teacher in establishing profiles of their children in order to best meet their needs. Parent newsletters are another method of letting parents know about what is happening in their child's mathematics lessons. Newsletters can also inform parents of how they can help their child at home as well as at school.

Special mathematics mornings or evenings are an enjoyable way to involve parents in school mathematics (Peressini, 1998, p.322). A successful example of this was a family night with a "math power" theme for a Year 4 class (Hall & Acri, 1995, p.8). The success of this evening came from the freedom for all participants to explore the activities at their leisure with no time pressure placed on them. Many students were able to demonstrate class procedures or activities to their parents.

Another way to involve parents is to organise home activities that are designed for parents and children to work on together. An example of such a program is the "Math Pairs" program in which parents first attended a workshop run by the teacher (O'Connell, 1992, p.10). The teacher demonstrated particular activities and gave tips on how to question and probe their child's thinking. This led to the parents being able to effectively work with their child at home and give feedback to the teacher about the child's progress. A similar program was put in place in a Year 2 class with the addition of a pre-test and post-test to see the effect of having parents as partners (Carey, 1998, p.314).

2.5 Literature on methodology

Quantitative research methods are designed to establish general laws or principles while qualitative methods explore the subjective experiences of individuals (Burns, 1997, p.3). Most researchers recognise that these two methods are complementary and often incorporate aspects from both methods that are relevant to their work. The survey method from which this project stems can serve as a data-gathering instrument for both kinds of research. There are many ways of measuring the attitude of participants including the Thurstone type, the Likert method and the semantic differential (Burns, 1997, p.462). Closed and open-ended questions in structured interview and questionnaire surveys are other ways of gathering quantitative and qualitative data. There is no one "right" way to gather research data, rather the researcher must evaluate the goals of the research and select methods that will meet those goals most effectively.

The grounded theory method is a systematic method of obtaining data that involves participant observation and interviewing. Studies that use grounded theory methods usually come from questions that have been asked about people in specific contexts, for example, "What do parents think about calculators in primary schools?" Not only must the researcher observe the behaviour of the participants, but also his own behaviour in order to "become aware of his own preconceptions, values, and beliefs" (Hutchinson, 1988, p.130). The combination of quantitative and qualitative methods in grounded

theory research serve to broaden the study's perspective, making it relevant to education and educators.

CHAPTER 3

METHOD

3.1 Design

This study investigated both quantitative and qualitative data collected from the participating parents. The quantitative data was obtained through the initial questionnaire to all parents of the class. The qualitative data was obtained from the verbal and written observations of the six parents who participated. It was collected through interviews and written journals.

A questionnaire was distributed to each parent before the commencement of the classroom activities in order to evaluate their attitudes toward calculators in the primary classroom. One of the steps in survey research is to pre-test the instrument to determine whether it will obtain the desired data (Burns, 1997, p.469), therefore a trial questionnaire was administered the previous year with parents of a class of Year 5 and 6 students. Parents of the current year's class were then invited to join the class for a series of mathematics lessons involving calculators.

An informal briefing interview was conducted prior to the session, which also served as a means to evaluate the attitudes of the volunteer parents further. The parents kept a written journal of their impressions of the mathematics lessons and the use of calculators in them. After the final session, an informal interview to discuss the activities as a whole was conducted, with a further opportunity for the researcher to evaluate their attitudes to calculators and whether they had changed.

Observations of the mathematics lessons, parent/student interactions and parent comments were recorded in a researcher

journal in order to evaluate changes in the parents attitudes and assess the effectiveness of calculators in the lessons.

3.2 Participants

The research was conducted in an independent primary school in metropolitan Perth containing over 400 students. The participants involved in the research included Year 6 students in one mathematics class, parents of the students, and teachers and staff within the school. The class was not randomly selected, rather it was chosen on the basis of convenience. The participating students included 13 males and 17 females. There is a range of mathematical ability among the students.

Of the 18 parents who returned questionnaires, 5 were male and 13 were female. All six parents who volunteered for the calculator activities were female. These parents were primarily homemakers, which explains their availability during the school day, however they had previously been employed in a range of occupations.

The school employs staff with varying levels of experience. Nine of the fifteen full-time staff graduated in the last six years, with five being in their first or second year of teaching. The staff developed a mathematics policy in 1994 that recommended calculator use in all years. Calculator use in the school occurs rarely, particularly in Pre-primary to Year 4 where a single class set of calculators is shared between eight classes.

3.3 Materials

The students had access to their own four-function calculator for the weeks prior to the research as well as during

the study. Additional calculators were provided by the researcher for the parent volunteers. The attitudes of the parents were evaluated using a questionnaire that had been tested the previous year (see Appendix 1). The students and volunteer parents were given guide sheets for each of the mathematics lessons (see Appendix 3). The volunteer parents were also given a brief lesson plan prior to each session (see Appendix 2). They were given some sample questions to answer in their journals (see Appendix 2). At the conclusion of the study, the researcher used the three main reservations of parents about calculator use as a basis for discussion in the final interview (see Appendix 2).

3.4 Sources of data

This section will discuss the four sources of data used to complete the analysis of the topic.

Questionnaire

A questionnaire was used to determine the parents' attitudes towards calculator use. A covering letter accompanied each questionnaire to explain its purpose, confidentiality issues and other issues. The questionnaire contained some general questions to identify the parents' backgrounds (ie occupation, ages of children in the school etc). Parents were asked to indicate when and how they thought children should use calculators at school. There was ample opportunity for them to comment on the perceived benefits of calculator use, as well as their reservations about calculator use in primary classrooms. At the conclusion of the questionnaire, parents were asked to indicate whether they were interested in finding out more about

calculator use in the school. The primary point of interest was the perceived benefits and reservations about calculator use from which the researcher was able to evaluate the parents' attitudes to calculator use in general.

Interviews

An interview was conducted with the six interested parents prior to the commencement of the calculator sessions. The parents were invited to share what they thought of calculators with each other as well as their experiences with their children so far. The parents were also given a brief explanation of the first two sessions with time to answer their questions and concerns about their role in the sessions.

At the conclusion of the study, the parents participated in a follow-up interview. This was an informal "debriefing" session during which the parents were able to discuss and debate several issues relating to the perceived benefits and reservations about calculators. The parents discussed the changes to their opinions on the topic and commented on how they would respond to someone who asked them what they thought of calculator use in the primary classroom.

Parents' writing

The journal kept by the parents was a major source of data. Each parent wrote their impressions on calculator usage following each session they attended. After the third session, the researcher provided a journal guide with some example questions to answer in the journal because some parents expressed concern that what they were writing was not appropriate. Some parents wrote their initial thoughts about calculators prior to the study and some final comments at the

conclusion of the study. These journals were used to analyse the changing attitudes of parents during the study.

Researcher's journal

The researcher's journal was used to comment on the calculator sessions including the effectiveness of the activities and the researcher's perception of the parental attitudes. Comments of the students, parents and the researcher's own feelings about the activities were also noted in the researcher's journal. It was used to evaluate the changing attitudes of the parents and the researcher during the study and link with the comments about the activities made by the parents in their journals.

3.5 Procedure

A written proposal of the planned study was given to the Principal of the school and permission was granted prior to the commencement of the study. Teachers within the school were approached informally with brief details of the proposed research. Some of the teachers commented on the use of calculators in the school and their own perspective on the issue. On the first day of Term 1, questionnaires were sent out to parents and these were returned by the end of Week 2. Further information was given to parents at the annual parent meeting which occurred in Week 3. This was an opportunity for parents to ask questions and find out what was happening during the sessions.

Later in the term a form of consent was sent to parents for permission for their children to participate in the sessions. Parents were also invited to join the sessions as participants. Of

the eight parents that responded, six were able to come at the same time of the week and became the actual participants. These parents came to the initial interview and briefing session in Week 6.

The study took place during Term 1 and 2, with two calculator sessions at the end of Term 1 and six sessions at the start of Term 2. Each lesson was taught by the researcher. The lessons were conducted on Monday afternoons for about forty-five minutes each time. At the commencement of the study the students were told that some parents were coming in to help with some mathematics activities that involved using calculators. They were not given details about the exact purpose of the research other than the fact that it was linked to a study being carried out by the researcher.

The first session was used to find out what students could do with their calculators. Students had received opportunities for free play earlier in the term and had been encouraged to make use of their calculators when they thought it was efficient to use them. The second session extended this idea with a competition between using mental calculations (the 'brain') and using a calculator. The session included a discussion about when it is sensible to use a calculator. The next six sessions involved calculators in a variety of roles. They were used to teach and consolidate concepts, as tools and instructional aids, and as checking devices.

After the final session, parents were invited to an afternoon tea to discuss their comments about the activities. The parents' journals were collected by the researcher so that they had an

opportunity to make final comments about the use of calculators in the activities.

3.6 Method of data analysis

The parent questionnaires were analysed to identify the attitudes of parents towards calculator use. Responses to questions 1, 4, 5, 6, 7, 8 and 10 were summarised with a tally and percentage as well as text, while responses for questions 2,3 and 9 were summarised in text form alone.

The responses from each parent's journal were organised into a table to clearly show the attitudes for and against calculator use. Only comments directly relating to the benefits of calculators or reservations about them were included in point form in the tables. From these tables the data was discussed for each session, as well as pre- and post-session data, in order to discover any common attitudes between the parents for each stage of the study. The attitude of each parent was discussed individually in order to specifically identify any changes in attitudes towards calculator use over the course of the study.

3.7 Validity and reliability

It is important that issues of validity and reliability are taken into account when preparing a research study in order for the results to be meaningful. Validity refers to a judgement measuring what it is supposed to measure while reliability is concerned with giving a consistent result in similar conditions (Burns, 1997, p.293).

Reliability was assured by outlining the full purpose of the study to the participants. The parents were given a lesson

outline before each session to ensure that they clearly understood the purpose and procedure of each activity. Reliability was enhanced by giving the parents a range of students to work with during the study. Each parent volunteer was therefore exposed to the full range of mathematical ability and confidence levels in the class from which to make observations. The trial questionnaire conducted the previous year also enhanced the reliability of the study by confirming that the attitudes of parents in the study are generally indicative of other parents unrelated to this particular study.

This study addresses the question of internal validity by using multiple techniques to collect data – interviews, questionnaires, journals and participant observation. This triangulation of data collection is the best way to argue that data is valid if these different methods of assessment produce the same results (Burns, 1997, p.294).

3.8 Limitations

It is difficult to translate what is observed with this relatively small sample group to other situations because the study is confined to a single setting. A large sample group was not feasible for this particular study because the researcher preferred to analyse a more in-depth perspective of a few parents rather than skim the surface of the perspective of many parents. The class chosen for the study was not randomly chosen and may not be a good representation of students of that age. A short time span of one school term for the sessions is another limitation of the study as is the lack of a control group of participants. Finally, the lack of any kind of quantitative data

can be considered a limitation because the data analysis becomes highly subjective.

CHAPTER 4

CALCULATOR SESSIONS

4.1 Session 1

Before the parents arrived, the researcher organised the children into friendship groups with two, three or four students in each group. The children were told that the parents were going to come each week to help them with some mathematical activities that involved calculators. They seemed excited about having some parents involved in their lesson and were looking forward to the experience.

When the parents arrived, the researcher introduced each parent to the class and welcomed them to the classroom. A class discussion about calculator functions was initiated, in which the children identified addition, subtraction, multiplication and division. Some children mentioned other 'funny' keys on the calculator but were unsure of their purpose. The researcher then explained that the groups would be investigating the things that calculators can do, then sharing their results with the class. The groups settled with their parent helper and began the activities.

All groups managed the first three activities with ease, being familiar with all the concepts being demonstrated. The children did not seem to be generating as much discussion about the activities as the researcher would have liked until they reached the last three activities – percentages, constant function and memory function. The groups spent a lot of time discussing why the decimal point was two places to the left when the percentage key was used.

The memory function caused a great deal of confusion at first, however as they followed the steps with guidance they began to feel confident using the function and even showed the researcher the 'magic' memory key which mysteriously made large numbers appear with a single key stroke.

The parents were enthusiastically involved with their groups and were comfortable working with the group assigned to them. The researcher had intentionally given them a group that included their own child to help them feel more confident when working with the children for the first time. The children particularly saw the parents as fellow group members during discussion of the memory function because it was new to most of the parents as well.

After the groups had spent some time on the memory function, the researcher brought all the students and parents back together to discuss the results. The children shared the answers they had found and their responses to the discussion questions. Some discussion was made on the 'moving' decimal place in the percentage activity and the whole class did the memory activity again as a class. Some students commented that there was more to a calculator than they had realized while others were disappointed that using a calculator still required them to think! The parents afterward commented that the children could see that they needed to have an estimate of the answer before calculating in case of mistakes. Two of the parents continued experimenting with the memory function after school in order to gain a better understanding of it and the other parents spent time discussing the progress of their group and their impressions of the activities.

4.2 Session 2

This session was introduced to the students as a competition between their 'brains' and their calculators. The first part of the session was teacher-directed with the researcher selecting students to take turns being on the 'brain' team and the 'calculator' team. They were given mathematical problems verbally and the first team to write the correct answer on the board received a point for their team. The children were all enthusiastic about this activity with much cheering and other encouragement for the 'brain' team in particular. Following this, the class discussed why some problems were solved faster with the calculator and some were solved faster with mental calculations.

The students and parents conducted their own 'Brain vs Technology' game in small groups with mathematics problems supplied by the teacher. As the researcher observed the groups, it was interesting to note that most of the students wanted to be the 'brain' during the game rather than use the calculator. They seemed to gain an amount of satisfaction in being able to beat the calculator.

After the teams had completed most of the mathematical problems, the researcher brought the students and parents back together to discuss the activity. The groups were asked which team had the most points, and they were pleased to say that the 'brains' had won in most cases.

The class then discussed which problems were faster with the 'brain' and which were faster with a calculator. They concluded that problems with large numbers or difficult numbers (e.g. decimals) were faster with a calculator, while basic facts

and simpler numbers were faster with the 'brain'. One child said that you would need to know your times tables to do well as a 'brain' in this game. The researcher asked the students if it was important to know the times tables if you could use a calculator any time. Another student replied that it made sense to know them because it is faster than using a calculator. A student commented that sometimes the 'calculator' team member pushed the wrong button because they were trying to be quick and that was why the 'brains' had gone faster. The researcher asked them how they would know if an answer was right or not when using a calculator. The students responded by saying that you should check it again to make sure. When the researcher asked if there were any other ways to be sure, a student said that sometimes they "kind of knew the answer before" so they were able to notice if the answer was wrong. The researcher asked them if it was important to estimate an answer when using the calculator and the students agreed although they said they didn't do it very often.

Following the session the parents and the researcher discussed the activities for a few minutes. One parent expressed surprise that the students preferred being the 'brain' instead of using a calculator. She said that it was encouraging to see that the use of calculators had not turned the children's mental skills into mindless number crunching. Another parent commented that mental skills would need regular practice to stay at a high standard.

4.3 Session 3

This session also began with a whole class focus as the researcher asked the children to enter a three digit number (e.g. 856) into their calculator to play 'Destructo'. The students were asked how they would 'destroy' the 5 – would it work if we subtracted 5 from the number? The students easily recognised that this would not work and suggested subtracting 50. The class all performed this task and were then asked why it worked. The students came up with various answers such as "5 is not really 5 in this number" and "it's in the tens place".

The researcher repeated the exercise with larger numbers, then with smaller numbers that had up to three decimal places. At the end of this activity the students seemed to have consolidated their initial understandings of place value and the groups were formed for the main activity with the parents. The students and parents played the game 'Destructo' using a variety of large and small numbers. The guide sheet was divided into three levels to cater for the range of abilities in the class and to assist the movement of the childrens' understanding from simple tasks to more complex ones.

The activity generated a great deal of discussion among the groups, particularly when the desired result was not obtained on the first try. Many students came back to the front of the room to have another look at the place value chart on the wall. Although the children became increasingly competent with the language of place value, particularly decimal places, it seemed that many of the children did not have a clear understanding of the relative size of digits in the decimal places.

Following the activity, the researcher introduced a revision game called 'Zip Zap' which was an effective and motivational way to revise the concepts from the lesson. The students were confident in 'destroying' digits from even the most complex numbers given. Even the students who were least confident in mathematics had a few attempts during the game and were successful. The parents seemed to enjoy the game, and they particularly commented on the enthusiasm with which the students were participating and calculating the answers.

4.4 Session 4

This session integrated many aspects of mathematics as well as the class theme of newspapers. The researcher began the session by revising how to calculate area, since many children had not fully grasped this concept. The newspaper investigation was explained and demonstrated before the students and parents moved off into their groups.

The students' first task was to calculate the total area of an A3 newspaper page. Some groups used the whole page while others decided to trim off the white space at the edge of the page. The students then cut up the page into rectangles of news and rectangles of advertisements. They calculated each piece of news and advertisement separately and recorded the total news area and total advertisement area on their guide sheet. The use of calculators encouraged some of the groups to use accurate measurements to the millimetre rather than just rounding the answer to the nearest centimetre. Some students were unsure whether to add or multiply to find the total area of

news or advertisements. This demonstrated the fact that they need to know what they are doing to use a calculator effectively.

The next stage of the activity was to represent their result as a fraction by comparing each category with the total page area. This part of the session provoked a great deal of discussion about what fractions actually represented. The researcher spent more time with the groups that didn't have a parent helper therefore was not able to observe the progress of the groups with parents quite so much. Changing the fractions to decimals proved a new concept to the students. It seemed that although they recognised the relationship between decimals and fractions on a simplistic level, they did not understand that all fractions could also be represented as decimals by a simple calculation.

After most groups had tackled the fraction and decimal section of the activity, the researcher brought the class back together to discuss percentages. The children agreed that a percentage was an easier way to represent the amount of advertisements or news on a page. One group said that it was not necessary to calculate the percentage of news and advertisements, just calculate one of them then subtract from 100%. Another group was concerned with the accuracy of the measure since some of the page is blank space (around the edge). The groups that had trimmed the page explained how they had solved this problem. Although this session had a focus on calculators, the researcher felt that it provided valuable foundations for the development of equivalence between fractions, decimals and percentages.

4.5 Session 5

This session allowed the students to explore the direct relationship between fractions and decimals. The researcher explained that they would be looking for a pattern so they would know how to change fractions to decimals. The students were asked to recall how they changed fractions to decimals in the previous session and this information was given immediately by the students. The students were told that any fraction could be changed to a decimal in the same way.

When the students and parents moved into their groups for the activities they used their calculators to discover the relationship between tenths as fractions and decimals. The students 'caught on' straight away and were confident to complete the rest of the first activity without using calculators. The previous session had been the first lesson in which these students had ever been able to demonstrate the equivalence of fractions and decimals, and their competency during this activity was very encouraging.

The extension page asked the students to investigate other patterns with tenths and hundredths. The groups were able to follow the patterns without their calculators after some time, however the meaning behind what they were doing did not seem quite so obvious to them. It did not seem that the students had grasped the relatively large difference in size between the tenths and the hundredths, in fact, many students seemed to feel that the hundredths were larger numbers. The only perceived benefit with the calculators was in finding the patterns quickly. The calculations on their own did not provide the students with much understanding on the topic, however the resulting discussion

enhanced their understanding. Perhaps the greatest benefit of this activity from a teacher's perspective was the diagnosis of students' understanding of what fractions and decimals are.

4.6 Session 6

This session focussed on place value ideas, particularly to do with decimal places. Before the group activities, the researcher revised how to use the constant function on a calculator. The students all seemed confident with this function.

Some children chose to complete the activities on their own, while others were more comfortable moving with the group's pace. The first four exercises involved whole number place value and the children managed to predict these accurately and quickly saw the patterns. When the first decimal place activity was attempted ($.8 + .2$), the students predicted a variety of outcomes including $.10$, 10 and 1.0 . The actual result caused a great deal of surprise among the group and generated much discussion as to the size of the numbers in general.

The children were now more attentive when it came to predicting the next two patterns. One of the students experienced a feeling of great success after correctly predicting the outcome of $.008 + .002$ after studying the patterns in the previous two examples. The students eventually seemed to grasp the idea that the numbers became smaller as more zeros were placed after the decimal point before a digit (ie $.02$ is bigger than $.002$).

The involvement of calculators in this activity was important because the calculator provided the accurate answer

from which the students could generate an understanding of what they were doing. Without the use of technology, a teacher would simply have to tell the children what comes next, instead of letting them discover it for themselves.

Following the group activities, the researcher revised what had been done using real-life examples with money. The students seemed to understand the money examples more easily because it was within their experience. This conclusion helped the children consolidate the knowledge they already had with the new knowledge from the group activities. Several parents commented afterwards that they understood the decimal concepts better for having the money examples presented as a conclusion. They felt that the children had a better grasp of what they were doing following these examples.

4.7 Session 7

The purpose of this session was for students to understand further the function of decimal places as points between given decimal numbers. The researcher began the session with a simple demonstration of how to play the game 'Target'. The students were given the target number 100 and were asked what two numbers would multiply to become the target. The students readily responded with 10×10 , 20×5 , 50×2 and 25×4 without using their calculators. The students were then asked how they could reach the target number if one of the multiplying numbers must be 11. The students decided that 11×9 was closer than 11×10 . They were asked if it was possible to obtain an even closer amount and one student suggested multiplying it by "nine and a bit". The class experimented with some decimal

numbers before coming to 11×9.1 being the closest. The researcher suggested that there might be an even closer answer and asked what number was more than 9 and less than 9.1 with a correct response of 9.09 after some discussion.

The students and parents then moved into their groups to try some more target numbers. Each child in the group had five tries to get the closest possible to the target number and the closest answer received a point. Some groups chose to work together while others treated it as a competition between members of the group. The concentration and enthusiasm was intense throughout the activity as the students persisted to reach the target.

The researcher observed all the groups, stopping at the groups without a parent to ask them for their results so far. Many of the students were able to explain that 4.35 came between 4.3 and 4.4 after repeated attempts to multiply 23 by a number to reach the target 100. One of the more able students in the class was working in depth on the first target: $11 \times ? = 100$ and came up with $11 \times 9.090909 = 99.999999$. He suggested that a calculator that had a larger display area would enable him to make his answer even more accurate.

Following the activities, the groups shared their most accurate responses with the class. The accuracy of the answers was quite amazing with many groups going to four decimal places to achieve the desired result. The session seemed to open up all possibilities to the children as they explored the concept of decimal place value. The researcher felt that this was the most successful lesson to date, in that the students

actually seemed to understand the relative size of decimal numbers.

4.8 Session 8

The calculators were used as a tool for speed and accuracy during this session. The researcher again revised the constant function on the calculators with the children, who seemed familiar and comfortable with this function. Multiples of 2 had been written on the board in order and the children identified the patterns in the two times tables. They noticed that all the numbers were even, they went up in two's, and that there was a repeating pattern in the ones column (0,2,4,6,8). The researcher pointed out the repeating pattern in the tens column (five zeros, five ones, five two's etc) and then explained the group activity.

Each group chose a times table to investigate first – either $4x$, $9x$ or $3x$. They used the constant function on their calculator or their mental addition skills to write all the multiples of that number in order on a strip of paper, then studied the patterns in order to describe them. Some students used calculators the whole time while others abandoned them as they found doing it mentally was quicker and just as easy. The children saw the obvious patterns straight away, such as whether the numbers were even or odd, and the repeating patterns in the ones column. Most groups found at least five patterns for each times table by looking at the tens and hundreds columns also. The groups that worked on the nine times table were intrigued by the complex repeating patterns found there.

It was interesting to see that some groups wanted to know exactly how many patterns there would be before they started

so they knew if they had found them all. Other groups were keen to "discover" them for themselves, and it seemed that these groups got the most out of the activity. The calculators became secondary to the task although they provided an element of speed and accuracy particularly to less mathematically confident students.

At the end of the session, the students shared the patterns they had found with the class and added to their own descriptions after listening to other groups' ideas. More time would have been helpful as this last part of the session was a little rushed for time. The students were able to see that there is order in mathematics and that tables are repeating patterns rather than random numbers.

CHAPTER 5 DATA ANALYSIS

5.1 Questionnaire analysis

Of the twenty-eight possible responses, seventeen questionnaires were returned. The opinions and points of view were varied among the respondents and the questionnaires provided the researcher with a clear and informative summary of the attitudes of the parents prior to the calculator sessions. The majority of respondents were female (13) with three male and one questionnaire in which both parents were represented.

Table 3
Question 1

Is there a calculator in your home or workplace available for your use?

home	workplace	home & workplace
4	1	12
23%	6%	71%

The responses indicate that all but one family has access to a calculator at home and most parents (77%) also have access to a calculator at work.

Question 2

For what purpose(s) do you use a calculator in your home?

The parents named a variety of uses for calculators in the home including budgets, taxes, book-keeping, calculating quantities and tasks related to study. The majority of responses were banking or finance-related tasks.

Question 3

For what purpose(s) do you use a calculator in your workplace?

The range of responses for calculator use in the workplace reflected the range of occupations held by the parents. The responses included engineering calculations, budgets, sales calculations, tax calculations and quotes. Again, the most common response was financial calculations.

Table 4

Question 4

Do you agree with the use of calculators in mathematics for year 5 and 6 students?

strongly agree	agree	disagree	strongly disagree	other
1	9	4	1	2
6%	53%	23%	6%	12%

The responses indicate that a majority of parents agree with the use of calculators in year 5 and 6 (Year 5 is the first

year that parents are required to purchase calculators for school use). In spite of the clear school policy of calculator use at all ages, quite a number of parents disagree with their use or did not indicate a category. The parents who indicated "other" on the questionnaire commented that students "should know the answer mentally first" and "calculators should be used to check answers".

Table 5
Question 5

At what year level do you feel that students should begin using calculators for mathematics at school?

PP	1	2	3	4	5	6	7	8+	Other
0	1	0	2	2	2	1	1	6	2
0%	5%	0%	12%	12%	12%	6%	6%	35%	12%

The responses to this question were spread quite evenly over the year levels particularly from Year 3 and upward. Although the policy encourages use of calculators in all year levels and requires students to have their own calculator in Year 5, thirty-five percent of parents still felt that they were unnecessary before high school.

Table 6
Question 6

*Which mathematical activities do you feel should involve the use of calculators? (you may indicate more than one) **

mental computation	problem solving	place value	long multiplication	long division	measurement	none
1	6	2	8	9	6	3
6%	35%	12%	47%	53%	35%	18%

Around half of the parents who responded felt that long multiplication and long division should involve the use of calculators. About a third of parents thought problem-solving and measurement should involve calculators. Although an example of each category was given to further explain what they were, it is possible that some parents did not completely understand what was involved with each category, therefore these results do not necessarily reflect the parents' attitudes accurately.

Some parents also commented that the calculators should only be used to check answers for these categories, while others felt that they should only be used for large amounts or difficult calculations. One parent asked the question "Will use of calculators prevent estimation?".

*Percentages shown indicate percentage of parents that hold the particular point of view, not percentage of total responses

Table 7
Question 7

*What possible benefits do you see for calculator use in primary mathematics? **

speed in routine tasks or checking	7	41%
familiarity with technology	2	12%
time for teaching logical thought processes	1	6%
increased student understanding	1	6%
no benefits	5	29%
no comment / don't know of any benefits	2	12%

The most common benefit perceived by the parents was speed, for example, quicker checking of work or completing routine tasks faster. This was mentioned by forty-one percent of the parents who responded. Twelve percent of parents felt that the use of calculators would ensure that technology was being used to its optimum and give the students familiarity with common technology. One parent perceived that calculators would help the students understand what they were doing while another thought that more time could be given to teaching logical thought processes when calculators are used. Twenty-nine percent of parents felt that there were no benefits in calculator use in primary mathematics and twelve percent gave no comment.

Table 8
Question 8

*What reservations do you have about the use of calculators in mathematics?**

lack of understanding	5	29%
dependency	7	41%
skills will suffer	7	41%
no comment	1	6%

Forty-one percent of parents felt that children could become dependent on calculators and that they would struggle without them for basic calculations. The same percentage of parents were also concerned that the students' mental and written computation skills would suffer as a result of calculator use. Twenty-nine percent of parents thought that students would not understand what they were doing when they used calculators and therefore would not recognise errors. Some also felt that the students would assume that the calculator was right rather than estimating an answer and challenging what they saw on the calculator display.

Question 9

Are there any further comments you would like to make about the use of calculators in primary school mathematics?

Some parents commented that calculators should only be used to check work or for mathematics involving complex formula. One parent suggested that if a child didn't grasp a

concept and this was keeping him back from what he could achieve, a calculator would be beneficial. One parent felt that dependency on machines was unhealthy, while another felt that calculators promote laziness in teaching mathematics. Another parent commented that the teacher should ensure that the students develop their mental computation as well as their calculator skills.

Table 9
Question 10

Are you interested in finding out more about how calculators are being used in your child's mathematics class?

yes	no	no response
14	2	1
82%	12%	6%

A majority of eighty-two percent of parents were interested in finding out more about calculator use in their child's class. The researcher decided that in view of this majority, information about the calculator sessions would be sent to all parents of the class. This included a response form for parents who were interested in participating in the sessions.

5.2 Calculator session analysis

Pre-session analysis

Parents G and H both completed the initial survey while the other four parents had spouses who completed it. It was not assumed that the couples necessarily held the same point of

view therefore these four questionnaires were not included in the data. All parents except Parent E were able to attend the interview before the sessions began. The parents articulated a range of opinions about the use of calculators prior to the calculator sessions through the interview (Parents A, G, H, J, and S), their first journal entry (Parents J and S) and the initial questionnaire (Parents G and H).

The major purpose perceived by the parents for calculator use in primary school is preparation for the future. Three of the parents (A, J and S) felt that children should use basic four-function calculators in primary school because they would need to use a scientific calculator when they went to high-school. Three of the parents (A, H and S) also felt that calculators should be used in order to "keep up with technology". Parent J added that "children should be taught how to use technology appropriate for life in the 'real world'". Parent A saw the value of being competent with calculator use from the perspective of her husband's employment as an engineer in which he is required to use high level maths. Parent H commented, "Learning to use calculators is an advantage; in some areas it is essential".

Other benefits perceived by the parents before the calculator session include speed and ease of use. Parent G also felt that they could benefit students who are being held back because they don't grasp the concepts.

The parents voiced several reservations about the use of calculators in primary schools. Three parents (G, H and J) felt that children would rely on calculators instead of using "brainpower". Parents G and S were concerned that students would not know if they had the wrong answer if they used a

calculator. Parents H and J thought students would become lazy and go to the calculator before trying a problem in their heads. Parents A and H were concerned that students would not estimate before calculating and that they would not understand what was happening because of the lack of estimation. Parent S also felt that a lack of practice with basic facts would decrease their ability to use them. She cited a personal example concerning the use of cash registers in an earlier place of employment.

Session 1 Journal analysis

Two of the parents (E and S) noticed that the students were keen and enthusiastic about the first calculator activity even though it was mathematics in an afternoon timeslot. Parent J felt that the reason for this might be that the students were allowed to use their calculators not their 'brains'. Parent A felt that the students could see that they needed to understand what they were doing in order to use a calculator effectively. She also commented that the students learned not to trust a calculator blindly, particularly from the activity about the memory function. Parent S thought that the students' awareness of calculator functions was expanded through this activity.

The parents also noted their current reservations about calculators following the session. Parent G commented that calculators should not be encouraged at this stage of schooling. Parent J noticed that the students were not estimating before calculating and commented that a reliance on machines makes our brains lazy.

Session 2 Journal analysis

Parents E, G and J commented on the enthusiasm and enjoyment of the students during the the 'Brain vs Calculator' session. Parent E and J noticed that the students in their groups wanted to challenge the calculator and prove that their brains were better. Parent J was pleased that the children in her groups proved that their brains were better than calculators for simple to medium level questions. It was interesting to note that Parent J was initially concerned that students would go to the calculator first rather than use their brain. Parent S was working with a lower ability group for this session and noticed that they found this activity difficult and a little threatening. She felt that in contexts other than this game, writing the problem down would be helpful for lower ability students.

Parent A commented that the students could see the value of learning their tables and other mental maths because of the relative speed of the brain when compared with keying such simple sums on a calculator. Parent G felt that the session was mentally stimulating for the 'brains' but that calculators did not need to be introduced in primary classrooms.

Session 3 Journal analysis

Parent E and J felt that the students responded with enjoyment to using the calculators for games. They commented that the students had particularly enjoyed using them for the review game at the end of this session. Parent A commented that this activity did lend itself to using the calculator effectively. She felt that the students were focussed on what they were

causing the calculator to do. Parent S felt that the calculators made the decimal places more obvious and the students were able to concentrate on the concept instead of the calculations. Parent J commented that the calculators were an aid for checking answers while Parent A found them to be beneficial for teaching the concept of place value.

Session 4 Journal analysis

Parents E and J found that calculators improved the students' accuracy because they were able to use exact measures to the nearest millimetre instead of rounding off to the nearest centimetre. The calculators made it possible to multiply these measurements with ease. Parents E and G found that calculators increased the speed of calculations which enabled the students to spend more time on the investigation and finish it rather than becoming bogged down in lengthy calculations. Parent J commented that the students were able to calculate fractions and proportions that would have been beyond them without the use of a calculator. She felt that the calculators had taken them further than they would ordinarily be able to go with the mathematical concepts of percentage, fraction and decimal relationships. Parent G had no reservations about the use of calculators in this activity.

Parents E and J were concerned that the students did not estimate before calculating in order to judge the reasonableness of the result. Parent E was also concerned that the students used the calculator for all calculations, regardless of how simple they were.

Session 5 Journal analysis

Parents A, E and G found that the students expressed positive attitudes towards the decimal and fraction equivalence activity. Parent E commented that her group was apprehensive at first, then found it easy and enjoyable. Parents A and G noticed that the calculators helped the students understand the relationship between decimals and fractions. Parents E and J felt that the calculators were beneficial for checking answers and reinforcing the process to find decimals. Parent E also noticed that the students were not relying on the calculator for simple calculations but were following the pattern mentally. Parent A found the calculator to be a good tool in which the students could see each step and its consequence.

Parents A and G were concerned that the calculators hindered the students' reasoning because of inaccuracy in pressing keys that led to incorrect answers. Parents E and J felt that the activity could be done with a calculator without any real understanding of the concept. Parent G was concerned that the students were relying on the calculator to give the answers for some activities.

Session 6 Journal analysis

Parent J noticed that the students' confidence was improving when using the calculators. Parent A found that the students had to think about what they were doing with the numbers and the calculators provided immediate feedback about the results of their thinking. Parent S commented that the activity was a useful exercise in practising decimals and becoming familiar with them, while Parent J felt that calculators

helped show the students the correct answer and progression of decimal place value. Parent A found the calculators to be a great reinforcement as well as a teaching tool.

The only reservation about this session was Parent A's statement that some of the students needed more concrete materials before being able to fully comprehend the concept being taught.

Session 7 Journal analysis

Parents A and J felt that calculators were important and essential tools in teaching the concept of decimal place value in this activity. Parent S commented that the calculators taught the concept of decimal places as parts of numbers, one of the objectives of the session. Parent J was pleased that the students had to estimate before using the calculator while Parent A commented that the immediate feedback given by the calculator led the students to modify their thinking before proceeding. Parent S felt that this task would be beyond Year 6 students without the use of calculators because the onerous task of multiplying decimal numbers was removed. Parent J felt that the students' understanding of decimal numbers was increased during this session.

Parents G and S commented that the students were not always thinking about what they were doing and were relying on the calculator to supply the solution. Parent G didn't feel that her group was using the calculator to its fullest benefit. Parent A noted that some mathematical knowledge of the concept would need to be in place first so that the students could

understand what they were doing. She felt that this activity shows that estimation is important and tables are essential.

Session 8 Journal analysis

Parent J felt that the calculator was useful for speed in this activity and Parent G noticed that the students perceived the patterns faster by using a calculator. Parent J also found that the children were more confident to use numbers when a calculator was being used. She commented that maths didn't seem so unpredictable or scary when order in tables could be seen.

Parent S felt that the calculators were superfluous in this activity since most students were able to continue the patterns without needing a calculator.

Post-session analysis

Parents A, E and J made final comments in their journals about their thoughts on calculator use following the eight sessions. Parents A, E, H, J and S also participated in a post-session interview to discuss their impressions and thoughts about the use of calculators during the sessions.

Parent A said "Calculators are one of many methods that should be taught creatively to help teach concepts". Parent E also commented that a range of 'methods' are needed to consolidate the concepts. Parent J felt that calculators could be used in many and varied ways, not just checking or making life easy. She found that teaching mathematical concepts using a calculator as a tool and aid has been interesting and exciting and that calculators have been valuable tools in the sessions. Parent

S found that the children were exposed to numbers they would not ordinarily use at this age level through the use of calculators.

One of the main reservations that parents held about calculators from the initial questionnaire was that students would become dependent on calculators. Following the sessions, Parent A commented that the students would not become dependent on calculators if the concepts were taught competently and they had practice using them. Parent E also felt that students would not necessarily become dependent on calculators while Parent J commented that everyone becomes dependent on technology (e.g. washing machines) and that it is a fact of life.

Another major reservation about calculator use by the parents in the questionnaire was that students' understanding of mathematics would be hindered through the use of calculators. Parent S felt that the processes that hinder understanding of concepts (e.g. complex manual calculations) are removed from contention in order for the students to have the opportunity to understand the concepts. Parent E agreed by commenting that the tediousness of some work is simplified by using a calculator. Parent A commented that calculators should not be used unless the purpose of the activity is to teach another concept. Parent E noticed that the children did not always understand what they were doing during the sessions, while Parent J felt that this was the case in only one of the sessions. She stated that calculators can be used for speed and understanding. Parent H commented that the students may understand what they are doing better by writing it out.

The third major reservation held by parents from the initial questionnaire was that students' basic skills would suffer. Parent E felt that the students must be well grounded in tables and written methods and Parent J commented that basic skills should be taught diligently. Parent E also felt that the students' basic skills would suffer if calculators were used all the time.

5.3 Individual parent attitude analysis

The six parents participating in the study expressed a range of opinions about calculators before, during and after the sessions. These were observed through the interviews, informal discussion between sessions and the journals.

Parent A

Parent A is a home maker who works part-time as a special needs teacher. Her son in Year 6 is of average mathematical ability and she has two other children in high school and one in Year 2.

Parent A did not express many reservations during the initial interview other than that students won't estimate before calculating. She was positive about the use of calculators, particularly because she saw the relevance for high school and further education. She felt that the students should keep up with technology.

During the sessions, Parent A made many insightful comments about the specific teaching and learning benefits of calculators. She felt that students could see that they had to understand the concepts before using calculators rather than trust the calculator blindly. She also felt that the students were

able to focus on the results of their calculations. The immediate feedback given by a calculator that caused the students to think about what they were doing was another benefit described by this parent. The students could see each step and its consequence.

Parent A expressed two reservations during the study including the fact that inaccuracy on the keys led to incorrect answers which confused some students. She expressed concern that some of the students needed concrete materials first.

At the conclusion of the study, Parent A had expanded her ideas of the benefits of calculators to include them as one of many 'methods' that must be taught to the students. She felt that calculators could be used creatively to help teach concepts and that the students would not become dependent on them if the concepts are taught competently and the students have practice using them. Parent A also offered comments to balance these benefits by describing what skills need to be taught alongside mathematics involving calculators. She feels that estimation and tables are important skills to develop and that the students should understand what they are doing.

Parent E

Parent E is a homemaker who does relief teaching in primary schools. Her daughter in Year 6 is of average mathematical ability and her other children are in high school and Year 4.

Parent E was unable to attend the pre-session interview but from informal discussion it was possible to obtain a general impression of her thoughts about calculator use in primary schools. This parent felt that calculators had a place in primary

schools, primarily for checking work, but was unsure as to further possible functions for mathematics education. She was interested to find out how they would be used in this study.

During the first three sessions, Parent E noticed the enthusiasm of the students for the activities but was concerned in Session 3 that the children didn't really understand the concept of place value. She found that the calculator improved accuracy and speed in the next two sessions and that the students were not relying on the calculator for the pattern making activity in Session 5. The understanding of the students was still a reservation held at this time. Parent E was unable to attend Sessions 6, 7 and 8 due to teaching commitments.

Following the sessions, Parent E commented that students would not necessarily become dependent on calculators but that they should be well grounded in tables and written methods. She felt that their basic skills would suffer if calculators were used all the time. Parent E noticed that the tediousness of some work is simplified with a calculator but suggested that a range of methods are needed to consolidate learning. She still had reservations that the students did not always understand what they were doing.

Parent G

Parent G is a homemaker with children in highschool and Year 4. Her daughter in Year 6 is of above average mathematical ability.

In the initial questionnaire, Parent G expressed a number of reservations about calculator use in primary schools. She commented that she saw no benefits for primary school use of

calculators and feels that there is too much reliance on calculators. Parent G also expressed concern that the students wouldn't know if they had the correct answer. One possible benefit mentioned was for students who are being held back because they don't grasp the concepts being taught.

After the first two sessions, Parent G felt that calculators should not be encouraged or introduced in primary schools. During Session 4, however, she felt that the calculators gave the students more time to work on their investigations and she had no reservations about their use in this activity. She felt that the students understood the concept of changing fractions to decimals in Session 5 and noticed positive attitudes among the students for traditionally tedious fraction/decimal relationships. In the same session, Parent G also felt that the students were relying on the calculator to give answers and that they hindered their reasoning when they made mistakes. She also felt that students were relying on the calculators in Session 7 and that they were not being used to their optimum potential. Parent G felt that the students were able to perceive patterns faster by using the calculator in Session 8.

Parent G was unable to attend the post-session interview, however, she did comment that there were aspects to calculator use that she had not considered previously. Although she still had reservations about the use of calculators, she felt better about the way they were being used in this classroom having now experienced the activities.

Parent H

Parent H is currently studying at TAFE and has one son in Year 6 who is of average mathematical ability.

Parent H held many reservations about the use of calculators in the pre-session interview and initial questionnaire including the reliance of some students on calculators. She felt that students can become lazy from using calculators instead of their 'brains' and that they might use them without understanding what was happening or estimating first. Parent H felt that it was important to keep up with technology and that learning to use a calculator is an advantage. She commented that in some areas, competent calculator use is essential.

During the study, Parent H was willing to discuss with the researcher and the other parents her thoughts on the activities. She noticed the enthusiasm of the students, particularly in the games and challenges. Unfortunately, Parent H had to fly overseas immediately after the final session for family reasons and therefore the researcher did not have the opportunity to obtain her journal. During the post-session interview, Parent H still expressed some concern that the students did not understand what they were doing all the time.

Parent J

Parent J is a homemaker who also helps run a family business. Her daughter in Year 6 is of average mathematical ability and she also has a child in Year 4.

Parent J was full of enthusiasm for the calculator sessions in the pre-session interview and was outspoken about her interest in finding out any potential benefits for the students.

She felt that primary students should be familiar with a basic calculator and that they should be taught how to use technology appropriate for life in the 'real' world, but didn't like the idea of calculators taking over brainpower. Parent J was concerned that students would go to the calculator first before trying a problem in their head.

Parent J commented after the first session that the students were not estimating before calculating and that reliance on machines makes our brains lazy. During Session 2, she was pleasantly surprised that the children were more keen to be the "brains" than use the calculators. She noticed that the children proved their brains better than calculators for simple to medium level questions. She commented on the obvious enjoyment and challenge for the students in this activity. During Session 3, Parent J found that the calculators were an aid for checking answers and that the students responded to games involving the calculator. She also commented that the session could have been as successful without calculators and that working by hand could bring better understanding.

Although she was concerned by the lack of estimation on the part of the students in Session 4, Parent J noticed that they were able to use exact measures instead of rounding off answers to simplify the multiplication task. She also found that the students were able to calculate the fractions and proportions because they had the use of a calculator. Again in Session 5, she found calculators beneficial for checking answers and reinforcing the process to find decimals however she felt that the activity could be done without the students really understanding the concept.

Parent J noticed that the students' confidence was improving with calculators as she was placed with the same group as in the first session. She commented that calculators helped show the correct answer and progression of decimal numbers. In Session 7, Parent J found calculators to be an important and essential tool for the exercise. She commented that the students had to estimate before using the calculator and that their understanding of decimal place value consequently was increased. Parent J felt that finding order in tables during Session 8 helped the students make links between mathematics concepts. She commented that mathematics didn't seem so unpredictable or scary with these links in place. Parent J found the calculators useful for speed in this activity and noticed that the students were more confident to use numbers when using a calculator.

Following the sessions, Parent J discussed many benefits that she had perceived throughout the activities. She commented that calculators could be used in many and varied ways, not just for checking or making life easy. She saw calculators as valuable tools through which the teaching of mathematical concepts had become interesting and exciting. Parent J felt that students understood the concepts better with calculators in all of the sessions except one. She commented that although basic skills should still be taught diligently, calculators can be used for speed and understanding. She felt that a degree of dependence on technology was inevitable – a fact of life.

Parent S

Parent S is a homemaker who has previously worked in the retail industry. Her son in Year 6 is of above average mathematical ability and she has children in high school as well as a three-year-old.

During the pre-session interview, Parent S commented that students need to use scientific calculators in high school and therefore should learn to use a basic calculator first. Her initial reservations were that students would not know if they had the wrong answer when using a calculator and that a lack of practice with basic facts would decrease their ability to use them.

During the first session, Parent S noticed that the students' awareness of calculator functions was expanded. She saw that they enjoyed conquering the challenging activities although they began the activity thinking it would be easy and boring. Her group in the second week was of a lower mathematical ability and she commented that they seemed threatened by being the 'brain'. She felt that writing the problems may have helped although she understood that it would not have worked in the context of this activity.

During Session 3, Parent S was concerned that students were using the calculator for all the problems – even the simple ones. She commented that the calculators made the decimal places more obvious and that the students were able to concentrate on the concept instead of the calculations. Following Session 7, Parent S commented that the calculators taught the concept of decimal places as parts of numbers. She felt that this task would be beyond Year 6 students without the

use of calculators and that the onerous task of multiplying decimal numbers was removed. Her reservation following this activity was that the students were not always thinking about what they were doing. She found that calculators were superfluous to the activity in Session 8.

Parent S was positive about her experiences in the post-session interview. She felt that the students were not bogged down by complex manual calculations and had the opportunity to understand the concepts. She had noticed that the students were exposed to numbers not usually used in primary school mathematics.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

This study has provided some useful data about parent attitudes towards calculators in primary schools. It has identified how parents' attitudes can change after exposure to a realistic classroom environment in which calculators are being used. This conclusion will summarise the changes observed in the parents' attitudes towards calculators over the course of the study with respect to the perceived benefits of calculators and the reservations held about their use.

It became obvious from the analysis of the questionnaires and the pre-session interview that the parents were a little skeptical of the benefits of calculator use in their child's classroom. The main benefit that was observed in the data was that children should be prepared for the future with regard to technology, which portrays calculators in a limited role as a tool alone. The only other perceived benefit prior to the activities was the speed and ease of use that calculators provide.

Over the course of the study, many benefits became apparent to the parents who were participating in the study. They observed that students were unusually enthusiastic for their Monday afternoon mathematics lessons and this enjoyment was having positive effects on their learning. The parents also observed that the children were able to focus on the concepts they were learning rather than being caught up in tedious calculations. They discovered that the students were able to apply their maths to real life more readily by using exact measurement rather than simplified problems to match their

manual computational ability. Another benefit described by the parents was the immediate feedback that a calculator provides, allowing students to keep a train of thought while working.

By the conclusion of the study, the parents had identified the benefits of calculator use in the primary classroom. They had discovered the variety of uses that calculators have, not being restricted to checking or just making life easy. They realised that the students had been exposed to numbers they would not ordinarily experience at this age and that the calculators were valuable tools in allowing this exposure.

There were three main reservations held by parents in the initial questionnaire and pre-session interview. The first was that students would become dependent on calculators and not be able to use their 'brain' for simple tasks. The second reservation was that students would not understand what they were doing while using calculators and the third reservation was that their basic skills would suffer as a result of calculator use.

At the conclusion of the study, the parents did not feel that students would become dependent on calculators from the way they were being used in the sessions. The parents felt that calculators were tools that could help students become independent thinkers and learners if they are used in the right way. The parents did not all agree at the end of the study regarding students' understanding of concepts when calculators were being used. Four parents noticed that the students' understanding had improved through the use of calculators in most of the sessions, but two parents still felt that written methods would promote more understanding. At the conclusion of the study the parents all agreed that students must know their

tables and other mental basics well and that calculators should not be used for these tasks. They felt that using calculators all the time or for simple tasks would cause the students' basic skills to suffer. They did not have a problem with the way calculators were used in the sessions with regard to basic skills except that they felt students should be encouraged to estimate more before calculating.

Overall, the parents' attitudes were changed significantly in that they were able to see the value of calculator use and the many ways they can be used to promote mathematical understanding. Reservations about their use were still held by most parents, but these reservations were linked to the way in which they should be used, rather than whether they should be used, as was the case at the beginning of the study.

Recommendations for further research in this area would include more parental involvement in classroom activities that involve calculators in mathematical areas other than those shown in this study. Particularly the topic of number sense could be explored in the classroom further with parents and calculators. A whole school study into parental attitudes across the year levels would be beneficial, in order to see if a shift in attitudes towards calculators could spread around the school after starting with a few interested parents. Following up reactions of other parents to a post-study summary of the participating parents' comments could be another research topic to investigate.

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APPENDIX 1: Questionnaire



Better Implementation of Calculators
Through Parental Involvement

Questionnaire

Name: _____

Occupation: _____

Year levels of children attending the school: _____

Thankyou for participating in this research project!

Please indicate a response by marking the appropriate box or writing a response as indicated. All comments are greatly appreciated.

1. Is there a calculator in your home or workplace available for your use?

home workplace

2. For what purpose(s) do you use a calculator in your home?

3. For what purpose(s) do you use a calculator in your workplace?

4. Do you agree with the use of calculators in mathematics for year 5 and 6 students?

I strongly agree I agree I disagree I strongly disagree

other (please specify) _____

APPENDIX 1: Questionnaire

5. At what year level do you feel that students should begin using calculators for mathematics at school?

Pre-primary

Year 1

Year 2

Year 3

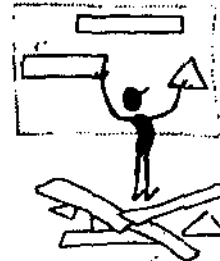
Year 4

Year 5

Year 6

Year 7

High school



Comments: _____

6. Which mathematical activities do you feel should involve the use of calculators? (you may indicate more than one)

mental computation (e.g. tables: 4×5 ; 12×11 , 7×2)

problem solving (e.g. Five children each spent \$6.75. How much change did they receive from \$50?)

place value (e.g. What is the value of "7" in the number 27 913?)

long multiplication (e.g. 27×139)

long division (e.g. $475 \div 19$)

measurement (e.g. Find the circumference of a circle that has a diameter of 12cm)

others (please specify)



APPENDIX 1: Questionnaire

7. What possible benefits do you see for calculator use in primary mathematics?

8. What reservations do you have about the use of calculators in mathematics?

9. Are there any further comments you would like to make about the use of calculators in primary school mathematics?

10. Are you interested in finding out more about how calculators are being used in your child's mathematics class?

Yes

No



*Thankyou for participating in
this questionnaire!*



Calculator Session 1

What can I do with a calculator?

AIMS:

- Students will revise known calculator functions
- Students will learn new calculator functions
- Students will use mathematical language to explain their findings

LESSON OUTLINE:

Introduction: Teacher explains to students that they will be investigating the things that their calculators can do. Teacher explains that groups should be ready to share their results afterwards.

Activities: Groups work through calculator functions, recording results on own activity page. Parents with a small group participate as a group member, listening to the language that the children generate. Teacher monitors groups, assisting as necessary.

Conclusion: Whole class discussion – teacher invites different groups to share a result they found with the class (whole class marking). Teacher comments on the way the children worked with their groups.

NOTES FOR PARENTS

- Avoid telling the students what to do unless they are really stuck – rather, give them a hint or make a suggestion. Don't allow the students to rely on you for answers – they are capable of working them out themselves.
- Don't worry if your group does not finish all the activities because they need more time. It's better for them to take the time they need to experiment and discuss their results than to rush through just to finish on time.
- Relax and enjoy spending time with the students – I want this to be an enjoyable time for both students and parents as you discover the potential of calculators together!

Calculator Session 2

Purposes of a calculator

AIMS:

- Students will investigate which mathematical problems are best suited for either mental computation or calculator use
- Students will explain why some problems are quicker with calculators and others are quicker using mental computation
- Students will suggest ways of using calculators sensibly in mathematics (ie for particular purposes)

LESSON OUTLINE:

Introduction: Teacher explains that the class is going to see which is faster – the brain or the calculator. Select volunteers for game – 2 students with calculators and 2 students without. Teacher gives problems verbally to students and the volunteers write the answer on board. Discuss why some problems were quicker for the brain and others were quicker with a calculator.

Activities: Students in groups conduct their own "Brain vs Technology" game with given maths problems. They complete a table showing which problems were quicker with either the calculator or the brain. They suggest ways that calculators can be used sensibly in the classroom.

Conclusion: Whole class discussion – complete table on B/B showing which problems were quicker with either the calculator or the brain. Students suggest ways that calculators can be used sensibly in the classroom.

NOTES FOR PARENTS:

- Relax and enjoy spending time with the students – I want this to be an enjoyable time for both students and parents as you discover the potential of calculators together!

Calculator Session 3

Place value 1

AIMS:

- Students will develop a further understanding of the place value and meaning of each digit in large numbers and small numbers to three decimal places

LESSON OUTLINE:

Introduction: Teacher asks children to enter a three digit number into their calculators (e.g. 254) and asks children how the 5 could be "destroyed". Repeat process with larger numbers and small numbers to three decimal places.

Activities: Students in small groups (two or three) play the game "Destructo" using the guide sheet provided.

Conclusion: Teacher allocates teams and gives students a quiz using the same place value concepts and their calculators.

NOTES FOR PARENTS:

- Relax and enjoy spending time with the students – I want this to be an enjoyable time for both students and parents as you discover the potential of calculators together!
- Here is a copy of the place values and their meanings:

1	2	3	4	5	6	7	.	8	9	2
million	hundred thousands	ten thousands	thousands	hundreds	tens	ones		tenths	hundredths	thousandths
1 000 000	100 000	10 000	1 000	100	10	1		.1	.01	.001

Calculator Session 4

Area investigation

AIMS:

- Students will consolidate their ability to calculate the area of a rectangle
- Students will begin to develop their understanding of the relationship between fractions, decimals and percentages

LESSON OUTLINE:

Introduction: Teacher revises how to calculate the area of a rectangle. Teacher explains the investigation and demonstrates how to cut up the newspaper page.

Activities: Students calculate and record the total area of their chosen newspaper page. Students cut out the news items and advertisements in rectangles in order to calculate the area of news items and the area of ads on that particular page of the newspaper.

Students record their measurements as fractions (ie news area / total area and ad area / total area). Students use their calculators to change the fractions to decimals.

Conclusion: Each group presents their results. Class discusses reasons for differing results (e.g. different parts of the newspaper have different ratios of ads and news). Teacher demonstrates how to change the decimal results to percentages. Students complete sheets with the percentages of ads and news for their newspaper page.

NOTES FOR PARENTS:

- Relax and enjoy spending time with the students – I want this to be an enjoyable time for both students and parents as you discover the potential of calculators together!
- Take note of whether students measure accurately – this can affect their results (ie – news area + ads area may not exactly equal the total area!)

Calculator Session 5

Fractions and decimals

AIMS:

- Students will investigate the relationship between fractions and decimals
- Students will identify the links between tenths as fractions and decimals
- Students will identify the links between hundredths as fractions and decimals

LESSON OUTLINE:

Introduction: Teacher explains that today the students will be finding fractions that are equivalent to decimals. Teacher explains that the children will be able to see a pattern for changing fractions to decimals. Teacher demonstrates how to change a fraction to a decimal using the calculator (revision from previous calculator session).

Activities: Students use a number line and a calculator to change fractions to decimals and vice versa.

Students investigate the relationship between tenths as fractions and decimals, and hundredths as fractions and decimals.

Students in groups discuss the links and patterns they found and apply what they know to thousandths.

Conclusion: Students revise what they have learned by playing "Zip Zap"

NOTES FOR PARENTS:

- Relax and enjoy spending time with the students – I want this to be an enjoyable time for both students and parents as you discover the potential of calculators together!
- You may notice that some children have misconceptions about the size of fractions e.g. a hundredth sounds really big compared with a tenth so the child may think that a hundredth is bigger than a tenth. I usually take the "pizza" approach to explaining their size
ie: a tenth = one piece from a pizza cut into 10 pieces;
a hundredth = one piece from a pizza cut into 100 pieces.

Calculator Session 6

Place value 2

AIMS:

- Students will develop a further understanding of the place value and meaning of each digit in large numbers and small numbers to three decimal places
- Students will begin to understand the relative size of numbers up to three decimal places

LESSON OUTLINE:

Introduction: Teacher revises how to use the constant function on a calculator. Teacher revises place value ideas using an abacus and MAB.

Activities: Students in small groups investigate patterns found when adding large and small numbers. Students discuss reasons for the results they find and refer to concrete aids (abacus and MAB) to help explain them.

Conclusion: Groups report back what they found and demonstrate using the abacus and MAB. Teacher consolidates knowledge using money examples.

NOTES FOR PARENTS:

- Relax and enjoy spending time with the students – I want this to be an enjoyable time for both students and parents as you discover the potential of calculators together!
- NB: The understanding of the relative size of decimal numbers is often a difficult concept for children to grasp. It may come as a surprise to some students that .2 is bigger than .02 etc.

Calculator Session 7

Estimation before calculation

AIMS:

- Students will estimate results of calculations before calculating
- Students will begin to understand the function of decimal places as midpoints between whole numbers

LESSON OUTLINE:

Introduction: Teacher demonstrates how to play "Target".

Activities: Students in small groups play "Target". Students compare results and discuss the importance of using numbers with decimal places in order to reach a target.

Conclusion: Groups report their closest results to the class.

NOTES FOR PARENTS:

- Relax and enjoy spending time with the students – I want this to be an enjoyable time for both students and parents as you discover the potential of calculators together!
- I am hoping that the children will begin to see the practicality of decimal numbers as being midpoints between whole numbers e.g. 4.2 is partway between 4 and 5. This activity is designed to encourage them to evaluate results in order to calculate more effectively the next time. They will begin to estimate results in order to calculate more effectively.

Calculator Session 8

Pattern finding

AIMS:

- Students will investigate patterns in their times tables
- Students will explore and describe patterns using mathematical language

LESSON OUTLINE:

Introduction: Teacher revises how to use the constant function on a calculator. Whole class investigates patterns in 2 x table.

Activities: Students in small groups investigate patterns in other times tables e.g. 4 and 9. Students describe the patterns they find using mathematical language such as odd, even, repeating, reverse.

Conclusion: Groups compare their results with the rest of the class.

NOTES FOR PARENTS:

- Relax and enjoy spending time with the students – I want this to be an enjoyable time for both students and parents as you discover the potential of calculators together!
- The focus of this activity is the various patterns that can be found in our times tables. As the students begin to recognise order in our number system, they will feel more confident with their maths skills. This activity is designed to also give them more confidence for learning their tables as they see regular patterns emerge.

Parent reservations about calculator use
TAKEN FROM SURVEY RESPONSES

FOCUS QUESTIONS

As we begin the calculator sessions that focus on particular mathematics concepts, I have prepared some focus questions to guide you in your comments for each activity.

You don't need to answer all the questions - just a few that seem relevant to the session you are writing about.

Don't feel restricted by these questions - you may write about any other aspect of the lesson also.

Happy writing!

- What skills or attitudes did the children display during this session?
- Were the children's skills or attitudes surprising in any way?
- How did the calculators appear to aid the children's learning in this session?
- How did the calculators appear to hinder the children's learning in this session?
- What potential benefits do you see in the use of calculators for teaching this concept?
- What reservations do you have about the use of calculators for teaching this concept?

If calculators are used in the primary classroom ...

1. Children will not understand the concepts

2. Children will become dependent on calculators

3. Children's basic skills will suffer

NAME: _____

CALCULATOR POWER!

What can you do with a calculator? Try these activities with your group and be ready to share your results with the class!

1. DIGITS

Most calculators can fit eight numbers in the display. How many digits can your calculator fit in the display? _____

2. SIMPLE PROCESSES

Complete these activities using your calculator:

- | | |
|---------------------------------|-----------------------------|
| a) $234 + 819 =$ _____ | b) $638 - 169 =$ _____ |
| c) $32 \times 18 =$ _____ | d) $882 \div 14 =$ _____ |
| e) $145 \times 3 + 419 =$ _____ | f) $392 \div 7 - 8 =$ _____ |



3. COMPLEX PROCESSES

Use the decimal point on your calculator to complete these activities:

- a) $45.3 \times 61.7 \div 35.6 =$ _____ b) $37.7 + 23.9 \times 34.9 =$ _____

4. PERCENTAGES

Use the percentage key on your calculator to complete these activities:

- | | |
|---------------------------|--------------------------|
| a) $35 \times 7 =$ _____ | $35 \times 7\% =$ _____ |
| b) $18 \times 32 =$ _____ | $18 \times 32\% =$ _____ |
| c) $24 \times 63 =$ _____ | $24 \times 63\% =$ _____ |

What did the percentage key do to these activities?

5. CONSTANT FUNCTION

Write the answer you get after each equals sign (=):

- a) $5 + 2 =$ _____ = _____ = _____ = _____ = _____ = _____
- b) $56 - 3 =$ _____ = _____ = _____ = _____ = _____ = _____

What do you notice? _____

- c) $5 \times 2 =$ _____ = _____ = _____ = _____ = _____

- d) $2997 + 3 =$ _____ = _____ = _____ = _____

What do you notice? _____

6. MEMORY

The memory can help you with complex calculations.

I want to find the answer to $20 - (5 \times 3)$

If I push $20 - 5 \times 3$, I will get 45 because the calculator thinks I am trying to calculate $(20 - 5) \times 3$

So instead I will use the memory to help:

$5 \times 3 =$ _____ M+ *this puts the answer to 5×3 in memory*

$20 - RM =$ _____ *20 - the number stored in memory*


Try these complex calculations using the memory function:

- a) $35 - (2 \times 8) =$ _____ b) $29 - (36 + 4) =$ _____


- c) $(45 \times 61) + (35 \times 29) =$ _____



NAME: _____



Brain vs Calculator




In your group, play your own game to find out which problems are quicker when using your brain and which are quicker when using a calculator.

One person in your group will need to get the questions from the teacher and the others can be the volunteers - you need at least one "brain" and one "calculator" person.

BRAIN	CALCULATOR

Be prepared to share your results with the class!



Brain vs Calculator

Questions

Round 1

1. $7 \times 2 =$ 14
2. $36 \div 4 =$ 9
3. $3 + 5 + 1 =$ 9
4. $40 \times 3 =$ 120
5. $28 + 32 =$ 60
6. $7 + 30 + 3 =$ 40
7. $6.1 - 3 =$ 3.1
8. $288 \div 8 =$ 36
9. $673 + 497 + 91 =$ 1261
10. $231 - 156 =$ 75

Round 2

1. $16 \times 9 =$ 144
2. $39 \times 13 =$ 507
3. $8 + 2 =$ 10
4. $30 - 10 =$ 20
5. $6.3 \times 0.4 =$ 2.52
6. $(5 \times 20) - 20 =$ 80
7. $2 + 0 =$ 2
8. $99 - 9 =$ 90
9. $600 \times 2 =$ 1200
10. $4 + 2 + 7 =$ 13

Name: _____

"Destructo"



HOW TO PLAY:

1. Take turns entering one of the numbers into your calculator.
2. Someone else in your group tells you which digit to destroy.
3. You receive a point for each time you try to destroy the digit until you succeed in destroying it.
4. The person with the LEAST points at the end of the game is the winner.

LEVEL 1 NUMBERS:

264	852	273	391	745
3285	2619	8471	5913	9372
1.73	8.36	4.62	5.29	6.18
37.42	92.51	18.45	23.19	64.83

LEVEL 2 NUMBERS:

14 928	25 617	52 946	91 523
739 813	142 587	263 775	595 341
692.45	195.82	341.76	427.34
8 152.69	2 746.58	9 373.24	1 584.81

LEVEL 3 NUMBERS:

8 291 526	2 357 148	6 934 217
48 125.63	73 295.19	25 826.47
18 429.729	45 291.648	63 182.297



NAME: _____

Pattern Detective

Be a pattern detective - find the patterns in these times tables and describe what you find:

4 x table _____

9 x table _____

3 x table _____

Name: _____

Area investigation

Choose one A3 page of the newspaper that contains ads and news.

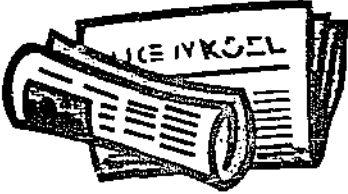
- What is the total area of the page?
 _____ cm x _____ cm = _____ cm
- Cut the page into rectangles to separate the news from the ads.
 Calculate the area of each small rectangle and record below.

NEWS	ADVERTISEMENTS

- What is the total news area? _____ cm
- What is the total ad area? _____ cm
- Represent the news area as a fraction: e.g. $\frac{\text{news area}}{\text{total page area}}$

- Change the fraction to a decimal: e.g. news area ÷ total page area

- Represent the ad area as a fraction and a decimal:



WHOLE CLASS

a) What percentage of your page was news? _____%

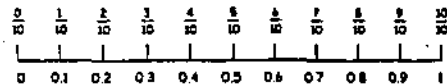
b) What percentage of your page was advertising?
 _____%

Name: _____

Tenths and other Tenths!

Activity 1. Comparing tenths and tenths!

◆ Use the number line to finish the number sentences.



$$0.1 = \frac{1}{10} \quad 0.2 = \frac{2}{10} \quad 0.3 = \frac{3}{10} \quad 0.4 = \frac{4}{10} \quad 0.5 = \frac{5}{10}$$

$$0.6 = \frac{\quad}{10} \quad 0.7 = \frac{\quad}{10} \quad 0.8 = \frac{\quad}{10} \quad 0.9 = \frac{\quad}{10}$$

Discuss: Can you see a rule for changing any tenth from a decimal to a fraction?



Activity 2. Using a calculator to explore the links between decimals and fractions

Materials: Calculator.

To find $\frac{2}{10}$ as a decimal:
Key 2 ÷ 10 =
Your display shows 0.2

◆ Use your calculator to change each fraction tenth to a decimal tenth

$$\frac{1}{10} = \boxed{\quad} \quad \frac{2}{10} = \boxed{\quad} \quad \frac{3}{10} = \boxed{\quad}$$

$$\frac{4}{10} = \boxed{\quad} \quad \frac{5}{10} = \boxed{\quad} \quad \frac{6}{10} = \boxed{\quad}$$

$$\frac{7}{10} = \boxed{\quad} \quad \frac{8}{10} = \boxed{\quad} \quad \frac{9}{10} = \boxed{\quad}$$

Extension Time!

Try the first few in each activity with a calculator then do the rest on your own!

Activity 3: Change these fractions to decimals:

$$\frac{3}{10} = \boxed{\quad} \quad \frac{6}{10} = \boxed{\quad} \quad \frac{7}{10} = \boxed{\quad} \quad \frac{9}{10} = \boxed{\quad}$$

$$\frac{2}{10} = \boxed{\quad} \quad \frac{4}{10} = \boxed{\quad} \quad \frac{6}{10} = \boxed{\quad} \quad \frac{8}{10} = \boxed{\quad}$$

Activity 4: Change these fractions to decimals:

$$\frac{3}{100} = \boxed{\quad} \quad \frac{6}{100} = \boxed{\quad} \quad \frac{1}{100} = \boxed{\quad} \quad \frac{9}{100} = \boxed{\quad}$$

$$\frac{5}{100} = \boxed{\quad} \quad \frac{8}{100} = \boxed{\quad} \quad \frac{7}{100} = \boxed{\quad} \quad \frac{2}{100} = \boxed{\quad}$$

DISCUSS: What do you notice about your results from Activity 3 and 4?

Activity 5: Change these fractions to decimals:

$$\frac{33}{100} = \boxed{\quad} \quad \frac{25}{100} = \boxed{\quad} \quad \frac{18}{100} = \boxed{\quad} \quad \frac{99}{100} = \boxed{\quad}$$

$$\frac{45}{100} = \boxed{\quad} \quad \frac{52}{100} = \boxed{\quad} \quad \frac{73}{100} = \boxed{\quad} \quad \frac{68}{100} = \boxed{\quad}$$

Activity 6: Change these fractions to decimals:

$$\frac{30}{100} = \boxed{\quad} \quad \frac{50}{100} = \boxed{\quad} \quad \frac{90}{100} = \boxed{\quad} \quad \frac{70}{100} = \boxed{\quad}$$

DISCUSS: What do you notice about your results from Activity 3 and 6?

NAME: _____

Predictomania

Use the constant function on your calculator to find these patterns.
Predict the next result then calculate it to find out the actual result.

1. $2 + 2 = \underline{\quad} = \underline{\quad} = \underline{\quad}$ Predict next result _____
Actual result _____

2. $20 + 20 = \underline{\quad} = \underline{\quad} = \underline{\quad}$ Predict next result _____
Actual result _____

3. $200 + 200 = \underline{\quad} = \underline{\quad} = \underline{\quad}$ Predict _____
Actual _____

4. $2000 + 2000 = \underline{\quad} = \underline{\quad} = \underline{\quad}$ Predict _____
Actual _____

5. $.2 + .2 = \underline{\quad} = \underline{\quad} = \underline{\quad}$ Predict _____
Actual _____



Stop and Think



Why was the previous result 1 and not .10?

6. $.02 + .02 = \underline{\quad} = \underline{\quad} = \underline{\quad}$ Predict _____
Actual _____

7. $.002 + .002 = \underline{\quad} = \underline{\quad} = \underline{\quad}$ Predict _____
Predict _____

What do you notice about the size of numbers in these examples?

8. Put these numbers in order from BIGGEST to SMALLEST.
.2 20 2000 .02 200 2 .002

EXTENSION TIME!

Can you do these WITHOUT a calculator?

Count by .2 up to 5:
2 .4 .6 _____

Count by .01 up to 2:
.01 .02 .03 _____

Count by .05 up to 10:
.05 .1 .15 _____

NAME: _____

Target

1. Enter the given number into your calculator.
2. Multiply it by another number to get as close to the target as possible.
3. Have five turns each: the person with the number closest to the target wins the round.

GIVEN NUMBER: 11

My tries: 11 x _____ = _____
 11 x _____ = _____
 11 x _____ = _____
 11 x _____ = _____
 11 x _____ = _____



GIVEN NUMBER: 23

My tries: 23 x _____ = _____
 23 x _____ = _____
 23 x _____ = _____
 23 x _____ = _____
 23 x _____ = _____



GIVEN NUMBER: 17

My tries: 17 x _____ = _____
 17 x _____ = _____
 17 x _____ = _____
 17 x _____ = _____
 17 x _____ = _____



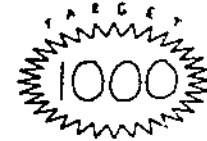
GIVEN NUMBER: 5

My tries: 5 x _____ = _____
 5 x _____ = _____
 5 x _____ = _____
 5 x _____ = _____
 5 x _____ = _____



GIVEN NUMBER: 122

My tries: 122 x _____ = _____
 122 x _____ = _____
 122 x _____ = _____
 122 x _____ = _____
 122 x _____ = _____



GIVEN NUMBER: 150

My tries: 150 x _____ = _____
 150 x _____ = _____
 150 x _____ = _____
 150 x _____ = _____
 150 x _____ = _____



PARENT A

Survey / interview	Session 1	Session 2	Session 3	Session 4
<p>For</p> <ul style="list-style-type: none"> *Calculators needed for high-school *Primary children should become familiar with a four-function calculator *Keep up with technology *Calculator used for high level maths e.g. engineering <p>Against</p> <ul style="list-style-type: none"> *Students won't estimate before calculating 	<p>For</p> <ul style="list-style-type: none"> *Children could see that they needed to understand before using a calculator effectively *Children learned not to trust a calculator blindly 	<p>For</p> <ul style="list-style-type: none"> *Children could see value of learning tables and mental maths 	<p>For</p> <ul style="list-style-type: none"> *This activity did lend itself to using the calculator effectively *Children focussed on what they were causing the calculator to do *A calculator can be very beneficial in teaching this concept 	N/A
Session 5	Session 6	Session 7	Session 8	Post interview
<p>For</p> <ul style="list-style-type: none"> *Student enjoyment, great attitude and willingness *Calculators useful in showing relationship between decimals and fractions *Calculators a good tool – students can see each step and its consequence <p>Against</p> <ul style="list-style-type: none"> *inaccuracy in pressing keys leads to incorrect answer 	<p>For</p> <ul style="list-style-type: none"> *Immediate feedback from calculators *Students had to think about what they were doing with the numbers *Calculators great for reinforcement and as part of teaching time <p>Against</p> <ul style="list-style-type: none"> *Some students need more concrete materials first 	<p>For</p> <ul style="list-style-type: none"> *Terrific tool for practice and reinforcement as well as teaching *Immediate feedback leads to modifying thinking <p>Other</p> <ul style="list-style-type: none"> *Mathematical knowledge needs to be in place first *Children must understand what they doing *Estimation is important and tables are essential 	N/A	<ul style="list-style-type: none"> *Calculators are one of many methods that must be taught *Calculators can be used creatively to help teach a concept *Children will not be dependent on calculators if the concepts are taught competently and the children have practice *Calculators should not be used unless the purpose of the activity is another concept e.g. area of a triangle

PARENT E

Survey / interview	Session 1	Session 2	Session 3	Session 4
N/A	For *Children keen, enthusiastic and confident	For *Children enthusiastic, not threatened, confident to challenge the calculator	For *Enjoyment of children in review game Against *Difficult to know if children really understood the concept of place value	For *Use of calculators improved accuracy and speed Against *Children used the calculator for all calculations – even simple ones *Estimating first then calculator to check
Session 5	Session 6	Session 7	Session 8	Post interview
For *Children were apprehensive at first, then found it easy and enjoyable *Calculator a good check for accuracy *Children not relying on calculator for simpler calculations – followed the patterns mentally Against *Patterns could be seen without any real understanding of the task – calculator unnecessary	N/A	N/A	N/A	*Tediousness of some work is simplified with a calculator *Children will not necessarily become dependent on calculators *Children must be well grounded in tables and written methods *Basic skills will suffer if calculators are used all the time *Children don't always understand what they are doing *Range of methods needed to consolidate

PARENT G

Survey / interview	Session 1	Session 2	Session 3	Session 4
<p>*No benefits for calculator use in primary school</p> <p>*Too much reliance on calculators</p> <p>*How do they know if they have the correct answer?</p> <p>*Calculators may be beneficial for students who are being held back because they don't grasp the concepts</p>	<p>Against</p> <p>*Calculators should not be encouraged at this stage of schooling</p>	<p>For</p> <p>*Fun and mentally stimulating for the "brains"</p> <p>Against</p> <p>*Calculators do not need to be introduced in primary schools</p>	<p>N/A</p>	<p>For</p> <p>*Calculators gave the children more time to work on their investigation —they were able to finish</p> <p>*No reservations about their use in this activity</p>
Session 5	Session 6	Session 7	Session 8	Post interview
<p>For</p> <p>*Positive attitudes</p> <p>*Children understood concept of changing fractions to decimals</p> <p>Against</p> <p>*Children relied on calculator to give answer for some activities</p> <p>*Calculators hindered their reasoning because of mistakes made when copying patterns</p>	<p>N/A</p>	<p>Against</p> <p>*Children relied on calculator supplying solution</p> <p>*Children didn't use calculator to its fullest benefit</p>	<p>For</p> <p>*Children able to perceive the patterns quicker with calculator use</p>	<p>N/A</p>

PARENT H

Survey / interview	Session 1	Session 2	Session 3	Session 4
<ul style="list-style-type: none"> *Children may rely on calculators *Learning to use them is an advantage; in some areas it is essential *Benefits are speed and ease of use *Children can become idle or lazy from using it instead of their brain *It may become too easy to use them without understanding what is happening or estimating first *Children should keep up with technology 				
Session 5	Session 6	Session 7	Session 8	Post interview
				<ul style="list-style-type: none"> *Children may understand what they are doing better by writing it out

PARENT J

Survey / interview	Session 1	Session 2	Session 3	Session 4
<p>*Primary students should be familiar with a basic calculator</p> <p>*Students may go to the calculator first before trying a problem in their heads</p> <p>*Don't like idea of calculators taking over brainpower</p> <p>*Children should be taught how to use technology appropriate for life in the "real" world</p>	<p>Against</p> <p>*Children are not estimating before calculating</p> <p>*Reliance on machines make our brains lazy</p>	<p>For</p> <p>*Enjoyment and challenge to prove brains better than calculators</p> <p>*Children proved their brains better than calculators for simple to medium level questions</p>	<p>For</p> <p>*Calculators were an aid for checking their answer</p> <p>*Calculators can be used in games which children respond to</p> <p>Against</p> <p>*Session would be as successful without calculators</p> <p>*Working by hand could bring better understanding</p>	<p>For</p> <p>*Children were able to use exact measures instead of rounding off</p> <p>*Children were able to calculate fractions and proportions</p> <p>Against</p> <p>*We all rely a little too much on machines – estimation is worth learning</p>
Session 5	Session 6	Session 7	Session 8	Post interview
<p>For</p> <p>*Calculators beneficial in checking answers and reinforcing the process to find decimals</p> <p>Against</p> <p>*Activity can be done without real understanding of the concept</p>	<p>For</p> <p>*Children's confidence is improving with calculators</p> <p>*Calculators helped show the correct answer and progression</p>	<p>For</p> <p>*Understanding of the decimal place values was increased</p> <p>*Calculators were an important and essential tool in this exercise</p> <p>*Children had to estimate before using calculator</p>	<p>For</p> <p>*Calculator useful for speed</p> <p>*Children were more confident to use numbers when using a calculator</p> <p>*Finding order in tables helped the children make links in maths – maths didn't seem so unpredictable or scary</p>	<p>*Calculators can be used in many and varied ways, not just checking or making life easy</p> <p>*Teaching concepts using the calculator as a tool and aid has been interesting and exciting</p> <p>*Calculators have been valuable tools</p> <p>*Some of the group may have understood better without them in only one of the sessions</p> <p>*We all become dependent on technology – fact of life</p> <p>*Calculators can be used for speed and understanding</p> <p>*Basic skills should be taught diligently</p>

PARENT 5

Survey / Interview	Session 1	Session 2	Session 3	Session 4
<p>*Children will need to use scientific calculators in high school – should learn to use a basic calculator first</p> <p>*Children may not know if they have the wrong answer when using a calculator</p> <p>*Lack of practice with basic facts would decrease ability to use them</p>	<p>For</p> <p>*Students' awareness of calculator functions was expanded</p> <p>*Students enjoyed conquering the challenging activities</p>	<p>*Lower ability group found this activity difficult and a little threatening</p> <p>*Writing problem may have helped</p>	<p>For</p> <p>*Calculators made the decimal places more obvious</p> <p>*Children were able to concentrate on the concept instead of the calculations</p> <p>Against</p> <p>*Students used the calculators for simple problems as well as difficult ones</p>	<p>For</p> <p>*Children confident to calculate area</p>
Session 5	Session 6	Session 7	Session 8	Post interview
<p>N/A</p>	<p>For</p> <p>*A useful exercise in practising decimals and becoming familiar with them</p>	<p>For</p> <p>*Calculators taught the concept of decimal places as parts of numbers</p> <p>*The onerous task of multiplying decimal numbers was removed</p> <p>*Without calculators, this task would be beyond Year 6 students</p> <p>Against</p> <p>*Students were not always thinking about what they were doing</p>	<p>Against</p> <p>*Calculators were superfluous in this activity</p>	<p>*Processes that may hinder understanding (e.g. long calculations) are removed from contention</p> <p>*Children were exposed to numbers not usually used</p> <p>*Children weren't bogged down by complex manual calculations – had the opportunity to understand concepts</p>

APPENDIX 5: Journals

5.1 J. Kemp Research Journal

7.2.99

The school year is underway and my students and I are settling into the classroom. I'm looking forward to getting started with the research in the classroom. During the first week we had two maths activities which involved informal use of the calculators [*tallying data: height, weight etc*]. Already I've noticed a positive attitude to using the calculators. C. F. was comfortable adding lots of numbers with her calculator but was unsure of how to shorten the process with x.

M.R. and R.H. had great enthusiasm with showing me a calculator "trick" – making a large number appear by pressing only one key (the memory button!). When I asked them what they thought the memory button could be used for in maths they weren't sure. After calming a disturbance with one group of boys it turned out they had been arguing over whose turn it was to calculate the total of measurements ie they were fighting over whose turn it was to use a calculator to obtain the result! All good signs I think!

I have met some of the parents already and they seem friendly enough. On Friday I sent the modified survey home with the students with a covering letter detailing its purpose etc and a request to have the survey returned by the following Friday. The Monday of Week 3 is our annual class meeting which I am going to use as an opportunity to talk about the project and test the interest levels of parents. I may even do a quick calculator activity then to start the ball rolling. Hopefully during that week I will be able to enlist volunteer parents ready to start the classroom activities in Week 4. Tuesdays are the days I don't teach (study days) so I can use those days to meet parents and get organised for each session.

The things I need to do now are plan the calculator sessions for the class meeting and classroom activities. I also need to format some questions for the volunteer parents to reflect on before, during and after the series of calculator sessions. I also need to check that each of my students actually has a calculator and obtain extras for the parents that come in.

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16.2.99

I received 14 surveys back by the due date and one more since. The results were varied in a similar way to the trial survey I administered last year. I have done a quick tally and analysis of the survey results so far and I'm hoping for a few more late responses to include later this week.

Last night we had the required class meeting with parents to discuss my expectations, class routines, my teaching philosophy etc. I included a 10-minute segment on calculators in maths education. I explained my own school experience with calculators and how I became aware of the potential for their use in primary classrooms while at university. I explained that calculators can be used in two major ways – as a computational tool and as a learning aid. The parents seem familiar with the general computational aspects of using calculators at school but I think I opened up a can of worms with my learning aid examples. I demonstrated how I would use a calculator to experiment with place value concepts (a hands-on experience for parents!). We did $.1 + .1 + .1$ etc to reach $.9$ then I asked them what would come next. I told them some responses I would expect to receive – the parents seemed quite focussed on what we were doing. I then put this number on the board – 57 496. I asked them if they could tell me the value of the 7 – someone said 70 000 then we arrived at 7000! I explained how I would ask the students to get rid of the 7 – some would try subtracting 7 – then I suggested subtracting 70 etc.

I got the impression that these kinds of calculator activities were a new entity for this set of parents. I gave a bit of a wind-up sell of the calculator activities coming up soon in class.

The parents who weren't able to attend the meeting will be seeing me early next week so as soon as that happens I'll send out the invitation letters for parent volunteers.

Hopefully by Week 5 we'll be underway with the class activities – we can continue next term if necessary.

2.3.99

I sent out the consent forms with the invitations to participate. Now I am waiting to see how much of a response

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I'll get. This is the nerve-wracking part – I don't know what I'll do if I don't get some help here.

Meanwhile it's time to begin preparing the activities and journal forms for parents. Since I have been working with place value this term, I think the earlier activities could be place value ones – particularly with decimals.

17.3.99

The parent info session is tomorrow morning. I've prepared lesson outlines and calculator activity sheets for the first two sessions and will explain these to the parents. First I'm going to get a feel for how they view calculators since some of them had spouses completing the questionnaires. Should be good!

Journal question – Wk 7 "What am I expecting from these activities?"

18.3.99

The parent information session was an informal, relaxed discussion. The parents who came were all involved in the discussion. I was most interested in their reservations about calculators but they also had some positive comments about the use of calculators. Three of the parents (J, A, & S) brought forward the idea of the high-school scientific calculators since they have children who attend high school. They felt that the complexity of these scientific calculators required that primary school students be familiar with a basic four-function calculator first. They were keen that their children should keep up with technology (this was particularly mentioned by A and H). A's husband's work involves high level mathematics and she sees the practical use of a calculator in this way.

The reservations of the five parents attending this session included the students going to the calculator first before trying a problem in their heads (H & J). A was concerned that the children wouldn't estimate first. S commented that the children may have the wrong answer and not know it. S also commented that a lack of practice with basic facts would decrease their ability to use them – she sited a personal example – working as a shopkeeper at one time.

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31.3.99

We have had two calculator sessions now and it seems to be going very well!

Session 1 – Parent S commented that her group said they *used* to like using calculators! Some children were very interested in the memory function – Parent A said her son was practicing at home that night. Two parents E and G were still trying the memory activity after the session finished.

Session 2 – The children and parents really seemed to enjoy this activity. The parents were surprised that the children were more keen to be the “brain” than the “calculator”! One of the comments in the parent information session was that children would tend to go for the calculators first before trying it out in your head.

The children were pleased that the “brains” won in most cases during the group activities. I want to look at the parents’ journals soon to see how they feel about everything.

Parents: A, S, H (sons), G, E, J (daughters)

3.5.99

The holidays and two Mondays with no school have made a bit of a gap between the sessions however its time now to get into the “meat” of the activities. I want the parents to see how calculators can be used to teach the children. Today’s session provided for the wide variety of ability levels in my class by having a range of numbers to choose from for children to “destroy” digits. I noticed a lack of awareness among the children of the role of decimal places – many children do not seem to have a concept of the size of numbers when they have a few decimal places. Later sessions will deal more with place value concepts and hopefully some of their misconceptions can be corrected.

The quiz at the end was popular, with many children demonstrating their ability to destroy decimal numbers which was encouraging. There are still a number of children who were not confident to attempt these in front of the class so I tried to call on them when they put their hands up in order to encourage them to have a go.

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10.5.99

This session was an opportunity to combine many aspects of maths and our theme. The children have not all grasped the concept of area and our newspaper theme this term makes this an ideal activity to include.

I noticed that some confusion started when the children had to combine areas from different parts of the page – some were unsure of whether to add or multiply to find the total area of news or ads. It stood out to me that calculators could only be effective if children understood what they were doing.

This session also introduced in a more practical way the concept of fraction, decimal and percentage equivalence. The children agreed that a percentage is an easier way to see the amount of ads or news on a page. During the conclusion some children suggested that you didn't really need to calculate the percentage of news and ads, just calculate one of them then subtract from 100%. You couldn't wipe the smile off my face then! Other children were concerned with the accuracy of the measure because some of the page is blank e.g. around the outside edge of the page. A thought-provoking session overall.

17.5.99

The concepts in this session have always been difficult for me to teach, and I believe the more they are reinforced in different ways, the more children will understand them. This was our class's first attempt at changing fractions to decimals and vice versa. I was amazed at the way the children seemed to catch on to the patterns and want to attempt them without the calculator.

[NB: That Friday after our quiz on the concepts covered in school that week I noticed that about 70% of children had retained a complete or almost complete ability to change fractions to decimals and vice versa – I'm hoping that with revision later in the term during a general class lesson, the concepts will be further reinforced]

23.5.99

While the parents worked with their small group I took the remainder of the children (13) in a larger group to go through the

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activities. Some children chose to forge ahead on their own while others were content to remain at the group's pace. The children found the first four exercises easy – dealing with ones through to ten thousands. After that some children gave some typical prediction e.g. $.8 + .2 = .10$ before discovering something quite different. I felt the success of one student in particular as he successfully predicted the outcome of $.008 + .002$ after he studied the patterns of the previous two exercises. The children picked up on the fact that the numbers got smaller as more zeros were placed after the decimal point before a digit (ie $.02$ is bigger than $.002$).

Extension time proved a little more challenging for those who had time to attend to it.

30.5.99

This session has perhaps been the most rewarding for myself as a teacher. I was walking on cloud nine for the entire afternoon after the session. It seemed that so many breakthroughs had been made and I sensed the enthusiasm of the children to discover and learn about the concepts. Many children for the first time were able to demonstrate to me that they understood that 4.35 comes between 4.3 and 4.4 . This is a fantastic activity to teach from because it is so non-threatening and there is usually not just one correct answer. One of my favourite experiences in this lesson was when a child was working on $11 \times ? = 100$ and came up with $11 \times 9.090909 = 99.999999$ after five attempts. When the groups reported their closest results I found it a non-threatening time of sharing possibilities and working out which results were closest to the target. After the lesson before I cleaned the board I just looked for a moment at the kinds of numbers my children had been exposed to: things like 100.00089 and 99.89 and 100.13 and 99.96 . Is my enthusiasm contagious?!

14.6.99

The calculators took a back seat to the other aspects of this activity, in fact, many children could have abandoned their use altogether although they provided an element of speed that helped the children progress further than would be otherwise

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possible. I was pleased with the general ability of the children to recognise and describe the patterns, however more time would have been beneficial for it as I felt we rushed a bit in order to finish on time.

The follow up interview was interesting with some great points being raised and discussed by the parents. These were the notes I wrote during the interview and immediately after:

Comments during discussion:

S & A: processes that may hinder understanding (e.g. long calculations) are removed from contention

S: exposure to numbers not usually used e.g. lots of decimals – chn were afraid of decimals earlier, but confident later

J: chn confident to use these numbers

E: concern if chn understand what they are doing; some just copy patterns without understanding it.

H: Chn would understand better by writing it out – e.g. writing in sand aids memory

J: important to estimate first in case of pushing the wrong button

E: need for other ways to consolidate

E & A: Did chn succeed because they already had the understanding of decimals or did this teach them something new?

J: finding order in table helped chn make links in maths; maths not so unpredictable and scary.

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General impressions following interview

1. Children will not understand the concepts

A: Destructo and Target were good for understanding because the chn had the answer to start with – they had to think to do the activity. Estimation in Target was helpful.

S: Calculators gave an opportunity for chn to understand concepts without being bogged down by complex manual calculations

2. Children will become dependent on calculators

J: Chn do rely on calculators to do the thinking for them

3. Children's basic skills will suffer

J & E: Chn need to know tables and other basic skills. They should know these without using a calc. The activities given would not let these suffer, but the more practice, the quicker the basic skills will be. Brain vs calc was important – the chn could see the purpose for learning tables

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5.2 JOURNAL – Parent A

Session 1

The children enjoyed their activity, not bored at all.

Most discussion and interest was generated by Nos 4,5 & 6. It was interesting to see them momentarily take an interest in why the decimal point was always 2 spaces back in “percentages”! (One or 2 may have known – I didn’t go into it.)

Quite a bit of discussion came about because of the 5 being constantly multiplied instead of the 2, as expected, using the constant function.

Began to wonder if one part of a sum is more important than another etc. or if that’s just how the calculator was made, is there differences between calculators etc.

The Memory keys were new to us all.

We learned by our mistakes (e.g. – not pressing = at end of calc.). Good little exercise.

In a way it was shown that we must know what we’re doing with the numbers before the cal. could serve us effectively. Although [sic] we “knew” we had operated it correctly – the answer of 15 was too large to be accurate, and made us think about trusting the calculator blindly.

Good fun!

Session 2

The children really enjoyed themselves.

Very useful activity for showing up the value of being competent in mental maths and tables.

Showed up mistakes made by those punching in numbers on calculators too quickly. – they then had to key in the sum all over again.

Session 3

“Destructo”

The children did enjoy this session.

All the boys seemed to understand the game and were very positive about their ability to solve the problem. However these 3 boys did take a few goes to get the result they needed.

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This didn't seem to worry them.

They found it easier with numbers above "0". When it came to decimals it was more difficult.

As they were a little bit noisy and silly, they weren't really focussing as much as they could have and therefore perhaps not showing their full ability and potential. I think that this was an activity which did lend itself to using the calculator effectively.

As the boys found themselves not obtaining the correct result, they did focus more on what they were actually causing the calc. to do.

The calc. made it possible to see immediately what the consequences of their calculation was. This depended on if they'd pressed the correct buttons, but this was less a factor in learning because they already knew the answer. The "question" was the goal and they could quickly see if they'd either miscalculated mentally or physically.

A calc. can be very beneficial in teaching this concept

Session 4 – N.A.

Session 5

All the boys very much enjoyed the activities and participated with a great attitude and willingness.

They all succeeded in their calculations and showed a good understanding.

If they hadn't known the rel. between dec. and fract. the calc. would have been a useful aid in helping them see that.

The only hindrance may be that the kids don't press the keys correctly and come up with the wrong answer. This may be less of a problem than other times as the calculation is relatively simple and straightforward.

The calc. is a good tool here, too, as the calc. proceeds through from beg. to end and the students can see each step and it's consequence.

e.g. $1/10$ is a part of the pie therefore 1 whole divided by 10 and then how this appears in decimal form.

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Session 6

The girls did enjoy this except for S. S. didn't try very hard and copied everything from K.

Although everything was explained to S. and we went along, she didn't seem to understand. (This may have just been "her" on that particular afternoon)

In a way this was a useful activity as they were able to have immediate feedback from the calculator, when they were predicting, and then perhaps be able to think through why their answers were different etc.

The "extension time" e.g. count by .2 to 5 etc. was very interesting. As there was a misprint, it made the girls really think and we really got involved in thinking about what we were actually doing with the numbers. However, this was only because the 2 girls knew all about decimals beforehand.

S. just gave up and didn't seem to have a clue what we were meaning. S. probably needed a much more concrete tool or tools to grasp what was happening with the numbers on the calculator.

Calculators would be great for reinforcement and as part of the teaching time.

Session 7

This was a very interesting time. Very good fun. Again, the calculator made a terrific tool to practise decimal place value but the necessary knowledge needed to be in place first.

It did give immediate feedback (assuming that the correct buttons were pushed properly). So it was easier to think through, perhaps, what you were doing with the numbers if you have an answer calculated quickly. Then you can modify your thinking and have immediate feedback on your sum. If the number you had calculated was a long way from what you needed, it made you think of where you may be going wrong.

This made me draw the conclusion that the calculator is a terrific tool for practise and reinforcement as well as a place in teaching if used in a certain way.

In general, the mathematical concepts must be taught in a concrete way in Primary School, so that the child understands what they are doing with the numbers in a certain calculation.

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They must know their tables and what they mean by $4 \times 4 = 16$ etc.

The children must be able to understand what the numbers are doing and be able to calculate on paper or mentally. I believe this is essential in Primary School Maths. They should also be able to check their calculation by estimation or even looking at the sum from a different angle.

e.g.
$$\begin{array}{r} 24 \\ \times 15 \\ \hline 360 \end{array}$$
 Est – $20 \times 20 = 400$

Tables are essential, addition, subtraction, mult. and div. must be able to be performed on paper or we are at the mercy of batteries, electricity and availability of calculators.

Some children, as the sums become more complicated or “bigger” may not really understand what they’re doing but are just applying the formula they’ve learned by heart. But they should, really, and in general, I think most children do (Understand, I mean!) (Am I making sense?) And even if they don’t fully understand how they’re getting the answer at least they can do it on paper without being dependent on a full charged calculator.

An activity where they already have the answer and have to work out the sum seemed more beneficial than the opposite.

Session 8- N.A.

Final response to parent reservations:

1. Children will not understand the concepts

The concepts must be taught using a variety of methods of which calculators could be one. Primary maths, I feel, needs to begin at a very concrete level and be as “concrete” as possible as long as possible, but calculators could be used very creatively to help teach a concept with various games and activities.

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2. Children will become dependent on calculators

This would only happen if a teacher let the students use the calculator almost all the time and didn't bother teaching maths properly. The child would only be dependent if the concepts are not taught competently and the child hasn't had enough practise in order to remember what he's learned. They must know their table off by heart and understand place value very well.

3. Children's basic skills will suffer

This would happen very easily if the calculator is being used more than the brain, especially children. Even "big" sums are dependent on knowledge of basic skills, so in Primary School the calculator shouldn't be used to do the actual calculation unless it was something such as your example, Jenny, of doing the calculation of the area of a triangle when the focus isn't mult. but area.

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5.3 JOURNAL – Parent E

Session 1

Teacher observations

1. Chn keen and enthusiastic
2. No observable reserve in using calculator
3. Both children worked independently of each other and the observer
4. Chn able to do functions but needed some assistance in phrasing observations.
5. Question 6 posed more of a challenge for observer and children. Question not completed.

Session 2

Brain vs Calculator

1. Children enthused by a challenge
2. Children didn't appear threatened by a calculator
3. Enough children confident to challenge the calculator.
4. Tables appeared to be well learnt.
5. On the simpler to medium difficulty calculations the brain groups were faster.
6. Calculations tended to slow children down
7. The harder and more complicated calculations were done more quickly on the calculator.

Session 3

Destructo

1. To begin with simple mistakes easily made.
2. Place value with decimal point posed problems for one of the girls.
3. By the end of the game an understanding of the decimal point reached – or rather correct answers given.
4. However teacher unsure whether child really understood the concept of place value. Did the child understand that .8 is $\frac{8}{10}$ of a whole number?
5. The children all enjoyed the game. The zip zap game a great success.
6. It would be interesting to see if the children could do the same exercise mentally!

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Session 4

Area

[skills and attitudes] Good measuring skills. No mental skills were required – I think the children should have had an idea of area.

[surprising] For simple calculations children were dependent on the calculator. No thought of doing it mentally.

[aid learning] For different calculations the use of calculator certainly accurate and fast.

[how did it hinder] The children didn't practise mental skills.

[benefits] Accuracy and speed.

[reservations] I think this exercise should have been done by estimating first and then by calculator. Calculator would then check accuracy of estimation.

Session 5

Fractions and decimals

[skills and attitudes] An ease with numbers and calculations

[surprising] 2 of the 3 children were not looking forward to the activity, but found it easy and enjoyable once tasks began

[aid learning] The calculator provides a good check for accuracy

[how did it hinder] For simple calculations children didn't need a calculator. Following the patterns were easier and quicker than the calculator

[benefits] Only as a check and to confirm mental calculations

[reservations] For all these calculations I think the calculator is unnecessary. Patterns could be seen without any real understanding of the task.

Session 6 – N.A.

Session 7 – N.A.

Session 8 – N.A.

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Final comments:

1. Children will not understand the concepts
They may not in all cases however the tediousness of some work is simplified by using the calculator
2. Children will become dependent on calculators
Not necessarily. If concepts are taught independently of calculator use and understanding assessed calculators are very helpful for more difficult calculations. However if children are not well grounded in table and methods they will become dependent on calculators.
3. Children's basic skills will suffer
Yes – if used all the time.

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5.4 JOURNAL – Parent G

Session 1

I have never used the calculator to its fullest extent, as in the memory. If I find it difficult to remember it myself then it is written down. A scientific calculator would lose me! I have looked at it as more as a convenience rather than a tool. Any new tool introduced should be learnt well. I still don't believe at this stage of schooling that calculators should be encouraged.

Session 2

Good fun for the children. Mentally stimulating for some "Brains". Frustratingly hard for others.

Some watches even have its own built in calculator!

Yes, I'm from the old school lots of mental maths, but my life does not require constant calculation involving maths. It would be interesting to know how much the pharmacist, builder, tiler, computer programmner etc would use it for their work.

I still don't think it needs introducing into Primary Schools.

Session 3 – N/A

Session 4

I only had two children with me and they were really willing to understand what to do, except one of them found the questions difficult and had to be guided through each step. The calculators gave them both more time to work on their investigation as I think without them, it would have caused them frustration by not having time allowed to them to finish.

I had no reservations about the use of calculators, and because of them, they were nearly able to finish their task.

Session 5

Positive attitudes. Understood the concept of changing fractions to decimals, but didn't understand how $30/100$ is the same as $3/10$, relied on the calculator to give them the answer. Copycatted the rest and made a few mistakes as a result. So I believe the calculators actually hindered their reasoning.

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Session 6 – N.A.

Session 7 – Target

The girls were a little bit laid back about it today. They were not excited about trying to find the exact amount or a closer number. They were not adventurous.

I also think that the calculator actually hindered their learning, as they relied on it supplying the solution, but also they didn't use it to its fullest benefit.

Session 8 – Pattern finding

Using the calculators helped the boys to perceive the patterns quicker.

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5.5 JOURNAL – Parent J

General thoughts:

I guess, like most parents, I don't like the idea of calculators taking over kids brainpower – replacing simple mathematical problem-solving. But in our age of rapidly-changing technology the kids need to be taught how to use technology appropriate to life in the "real" world. I however, am fearful that some kids are abusing the privilege of calculators and opting to use them instead of their brains for "simple" maths.

22.3.99 Following Session 1

I observed a feel of excitement amongst the kids – maybe that they were getting to use the calculators and not their brains!!? Of the three children I had in my group two seem fairly familiar with their machines but less confident when it came to the memory buttons. The other seems a little apprehensive, but was happy to just follow instructions. I doubt if these kids would readily experiment with the machines.

The kids entered the problems correctly into machines, with one or two slight errors in group (one being mine!). They didn't seem to grasp the concepts of percentages / decimal places, constant or memory very easily.

I admit that I don't usually use the memory button – I prefer to write down subtotals and then I have them there to doublecheck.

I found it quite surprising that the x constant didn't work as expected.

In chatting (de-briefing) with the other parents after the session it became clear that we are concerned that kids in general are not estimating a solution before processing in a machine, so mistakes are not picked up.

Becoming too reliant on machines makes our brains lazy (or in the case of washing machines – our biceps!)

21.3.99 Notes on Session 2

Well, did the kids enjoy the comp or what! The very "go get 'em" boys I had seemed ready to prove that their brains

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were as good as any calculator. I felt it was excellent that the kids themselves proved that their brains were better than calculators for the simple to medium level questions on the list. We had the calculator people having difficulty not using their brains for some questions, quite often working it out mentally before even pressing one button – which they found frustrating that they could not answer. I have to admit that the kids sometimes raced me with the mental answer – I must brush up on my tables!!

Session 3 – Destructo

I found that the kids didn't have much problem with the place value before the decimal point (whole numbers). One child just had to try a couple of times and then was OK with it. I noticed that they haven't quite grasped the big numbers name ie they knew it had 5 0's after it but not too sure if it was 20 thousand, 2 million or 200 thousand.

Most kids grasped the concept with the decimal point but some needed extra work to get it – an maybe still find it a challenge. I went through it later with K. as their group didn't get to the decimals. She had no idea to start with. I sense that she doesn't really understand what the decimal point is really for and that decimal numbers are parts of one whole number. This is same for one child in my group.

The calculators were an aid only for checking their answer. We could have done the session as successfully without them. Did the calculators hinder? Well, for the few kids having difficulty they may have. To do the working by hand could bring better understanding with the place values lined up on paper. The potential benefits of calculators to teach this concept would be only that they can be used for games such as this (The kids nowadays respond to games using technology!)

Thought – If 0's had been used as digits in the numbers – would that have brought a little more challenge?

NB: TO help those couple who had problems I told them to use 0's in place of all the numbers they wanted to keep ie $2534.189 = 0000.080$

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I didn't go into the fact that you don't need to use 0's before a decimal point. Hope it hasn't stuffed up your teaching of the concept!!

Session 4

Area investigation

The kids found this to be an interesting challenge, although wanted to choose a page that was straightforward in regard to dividing up the page.

I felt measuring was pretty accurate – we took it to the millimetre (didn't round off) – turns were taken in measuring and calculating. If we had rounded off to the centimetre we could have exercised the brain more and not used the calculator except for checking. At one point my mental addition answer came out different to the calculator and I met with slight objection when suggesting we calculate again.

Discussion was then held into what happens when checking out mental calculations with a calculator and getting differing results. The kids seemed to know the rule of checking 3 times.

But I think we all rely a little too much on machines! The practise of estimation is worthwhile learning.

The calculators aided as I have already mentioned in multiplying with decimal points, whole numbers should have been calculated using "Brain". Of course working out the fractions and proportions was aided with the machine. I'm not sure my Brain would have been up to working that out!

In the group setting I felt it would have been good to have a few "projects" going on at same time (as another Mum suggested) as only 2 people were really needed at once.

It may have been helpful to get the kids to estimate the proportion (fractions or %) of ad/news/other before starting measuring.

Session 5 – fractions and decimals

I think all the children found this concept fairly easy to pick up. After the initial use of calculator for first problems all could readily solve using brainpower.

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Although I found that most had no concept (or an incorrect) of what $1/10$'s and $1/100$ ths were.

I found the number line very helpful and had them show me on it where the fractions and decimals fitted in, then we divided it up into 100ths and marked fractions and decimals on it. The calculators were of benefit for checking of answers and the reinforcing of process to find decimals. This of course is needed to be learned and confirmed so can be confidently used in more difficult problems.

Session 6 – Place value 2

Well, this group's confidence on the calculator is improving, although I still sense caution or apprehension with the decimal point.

No problem with the whole numbers but the decimals caused a little confusion when going from .08 to .1 etc. Your explaining it using \$ and cents seemed to help the concept understanding. My group didn't get to the ordering from biggest to smallest activity. That would have been beneficial I think.

How did calculators aid? - Particularly with the decimals it aided to show the children the correct answer and progression. Although to explain why the digit changed columns I had to use old fashioned addition!

Session 7 - Estimation before calculation

This was a real eye opener for the kids. The understanding of the decimal place values was increased in most cases e.g. 4.35 is not greater than 4.4.

Calculators were an important and essential tool in this exercise and I feel were used in a excellent way as I've had to estimate therefore use brains, before using calculator to check estimation.

Session 8 – Pattern finding

It was good to reinforce the constant function in this session. The children have grasped that very well. Pattern finding is always quite interesting and sometimes the point at where the time tables concept fits into place for some.

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The calculator was useful in this session for speed only. The kids should have known the tables to twelve and without a calculator would have eventually been able to work out 'extras'.

Conclusions

Upon re-reading my initial thoughts, I realise now that the calculator can be used in many and varied ways – not just to check on manual calculations or to make life easy.

The way you have taught different concepts using the calculator as a tool and aid has been interesting and exciting.

It indeed has been a pleasure to work with the children, getting to know them as well as getting to know a little of the culture of the classroom and even how the kids function in these sessions!

Thankyou for the opportunity.

Final comments:

1. Children will not understand the concepts

I felt in only one session that some of my group may have understood better without calculators. As used in these sessions the calculators have been valuable tools.

2. Children will become dependent on calculators

As we all become more familiar and reliant on technology, we will inevitably become more dependent on them e.g. spellcheck on word processors, cash registers in retail stores.
FACT OF LIFE UNFORTUNATELY!!!

3. Children's basic skills will suffer

Let's hope that teachers will all be diligent in teaching the basic skills e.g. times tables, understanding of multiplication and division, so that the calculators can be used as an aid for speed and understanding will be underlying.

APPENDIX 5: Journals

5.6 JOURNAL – Parent S

Session 1

Expectations for session 1

(I'm really not quite sure what your expectations of this notebook are!)

- most/all students will be able to use basic $+$ $-$ \times \div functions of their calculator
- Very few will have used/ be able to use the memory function
- Some will have trouble understanding how to use it (memory) ie in which situations
- Some will have discovered the constant function before, but probably won't have a name for it
- The session should equip the students to get more out of their calculator
- The session should equip them with the correct names for calculator functions (ie memory constant etc)

Session 1

The group attacked the task very confidently and without any need for assistance, up to the "percentage" activities. They were able to complete them easily, but weren't as confident because of unfamiliarity with it. They could see what the % key did, I'm not sure that they understood why.

The memory key presented a bit of a challenge, and all three slowed down and went through step by step, with more conversation about the task, than with any other. Some calculations took more than one go to complete – they were able to see that the answer they got wasn't right in most cases, and so tried again.

I thought this was a very useful activity (I hadn't used memory function before myself) to expand the students awareness of calculator functions. For this particular group I think the more challenging problems were a really useful thing too. They said it was "boring" in the beginning, but I think they enjoyed conquering something that seemed hard in the last activity.

APPENDIX 5: Journals

Session 2

This was a much lower ability group who found this activity quite difficult, even a little threatening. Most of the problems were faster for the calculator person – the “brain” panicked a bit I think, knowing she should know, but not able to think with the pressure of timing.

Writing down the problem probably would have helped, but of course would have been slower. I don't think this group really thought that much about the calculator vs brain so much as “who was first”. We only got through the first half of the activities.

Session 3 “Destructo”

After the introductory activity, the students seemed quite confident and skilled at placing the values of given digits. Decimal points presented a challenge in larger numbers, although, with thought, they were able to rise to this.

On one occasion when I thought the wrong answer would be given (too many zeros), it turned out to be correct because the student had put in the decimal point at the correct place. It seemed that calculators may have made this more obvious.

One reservation I had re: calculators in teaching this concept was that students used them for every problem, even when it was very simple maths to subtract the number. However, this may have been because it was a “calculator” activity, and using them certainly made it more fun. Also, for weaker students, removing the burden of the calculation would have freed them to concentrate on the concept of place value. I see that as one of the chief values of calculators in maths.

Session 4 – Area investigation

The students seemed confident to calculate area of each section; most of the sections cut conveniently into rectangles, but on the one that didn't, the students involved set about measuring an extended area (ie L shape), without realising the difficulty involved until it was pointed out.

Another student had trouble organising the ‘information’ once she had it ie found it hard to work out how to calculate the total area. With some help however, this was easily overcome.

APPENDIX 5: Journals

Session 5 – N.A.

Session 6

This was a very capable group of students, who attacked this activity very confidently. They seemed to understand the concept of decimal places well. The only slight confusion (which I shared) occurred counting in .01's up to 2 (the misprint) and finding we would have to do it 200 times to get there! This seemed a very useful exercise in practising decimals and becoming familiar with them. The round up session was really helpful. Using money to explain decimals made it really clear and easy to understand.

Session 7 – “Target”

These two students were fairly different in terms of confidence. One was able to work quite independently, the other was clearly quite confused and unsure of herself. She needed quite a lot of help and prompting to get through it. However, she was very pleased when she got the exact answer for $5 \times ? = 49$. Both of the students were willing to try to 2 or 3 decimal places, but I don't think they would have thought of doing it themselves.

The calculators were useful for teaching the concept of decimal places as parts of numbers as they removed the onerous task of multiplying them. (Actually this would have been beyond most year six students!) However, I am not entirely confident that these two students came away with that concept, but rather tried more decimal places just to get the target, without really thinking about what they were doing.

Session 8 – Patterns

This was fairly quick and simple activity – I felt the calculators were a little superfluous as the addition was quite simple and a matter of knowing tables. One student was quicker to notice patterns than the other, but both did come up with them. With more time spent on it I think the students would see the patterns emerging strongly enough to make use of them in maths, but this would not have happened in the time we had.