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Calculator Use in Western Australian Primary Schools

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Table of Contents

CHAPTER 1 Description of the Survey.....	1
Introduction	1
Literature Review	1
Research Questions.....	4
Procedures.....	4
CHAPTER 2 Results of the Survey.....	7
Question 1.....	7
Question 2.....	11
Question 3.....	15
Question 4.....	17
Question 5.....	20
Question 6.....	23
Question 7.....	26
Question 8.....	28
Question 9.....	31
Question 10.....	32
Question 11.....	36
Question 12.....	40
Question 13.....	41
Question 14.....	42
Question 15.....	44
Question 16.....	45
CHAPTER 3 Discussion of Results.....	47
What is Needed?	49
Implications for Future Research.....	51
References.....	53
APPENDIX Calculator Survey.....	55

CHAPTER 1

Description of the Survey

Introduction

There are very few issues in mathematics teaching over the past twenty five years which have caused so much debate among teachers, parents and the community than the use of calculators in primary schools. Letters to newspapers, magazine articles and public comment often express the opinion that the apparent decline in the ability of young people to calculate, even simple computations, is a direct result of the use of calculators in schools. Anecdotal evidence in the form of reports from teaching practice students, personal observation in schools and comments from teachers suggests there is, in fact, very little calculator use in primary classrooms. Where a calculator is used it is for checking work – an electronic answer book – or for trivial activities, for example to make words appear on the display. No concerted, planned, integrated use as outlined by the *Statement on the Use of Calculators and Computers for Mathematics in Australian Schools* (AAMT, 1996) or the previous *National statement on the use of calculators for mathematics in Australian schools* (AAMT, 1987) has been observed at this anecdotal level. So if there is little or no calculator use in primary mathematics classes, what is the cause of this so-called decline in numeracy standards? Debate on this is left to another time.

One is left to wonder as to the actual use of calculators in primary classrooms. Blane and Willis (1986) reported on the use of calculators by 12 to 14 year old children in Australian schools. They noted “information on this topic (calculator use) is relatively sparse” (p.8). From a search of the relevant literature it seems that there is very little if any current information about calculator use in primary schools in Australia.

Literature Review

Very few surveys of calculator use in primary schools have been attempted. Our search of the literature which involved all current listed documents revealed the following major surveys:

- Reys, B. J., Reys, R. E., Barger, R., Hauck, J., Morton, L., Reehm, S., Sturdevant, R. & Wyatt, J. W. (1990). *Calculator use in mathematics teaching in Missouri schools: A 1990 status report*. A report of a survey conducted by the University of Missouri for the

Missouri Department of Elementary and Secondary Education. This report provides an indication of the situation in one state in the U.S.A.

- Reys, R. E., Bestgen, B. J., Rybolt, J. F. & Wyatt, J. W. (1980). Hand calculators: What's happening in schools today? *The Arithmetic Teacher*, 27(6), 38-43. This article outlines the results from a study carried out in Missouri a decade earlier.
- Groves and Stacey (1994) refer to two Australian Surveys – one carried out by Ferres in 1981 and another as part of the Calculators in Primary Mathematics Project in 1990.

Key elements of the above-mentioned surveys are presented below.

In 1986, Blane and Willis presented a *Report on the UNESCO Pilot Project on the Applications of Calculators to Mathematics Teaching in Australia* in which they considered the question of calculator use by 12 to 14 year olds. As part of that study, questionnaires were sent to a large number of schools across Australia. In summary, the authors stated that “despite clear statements from State and Territory Education Departments in Australia, there still appears to be a great deal of confusion about whether, when and how calculators should be used in Australian mathematics classrooms” (1986, p.6). They went on to say that “there have been some surveys on the use of calculators in school mathematics classes in Australia, but few have been published, and information on this topic is relatively sparse” (1986, p.8).

Groves and Stacey (1994) compared the results of two surveys carried out almost ten years apart. Their key findings are reported below:

Results indicated a remarkable shift in favour of the early introduction of calculators since an earlier survey was carried out ten years earlier (Ferres, 1981). In the 1990 survey, 75% of teachers supported calculator use in kindergarten to grade 3, compared with a mere 7% in 1980. These attitudes, however, did not necessarily translate into practice, as 58% of K-3 teachers admitted to rarely or never using calculators in their classrooms. (p. 2)

The apparent mismatch between attitudes and actions is highlighted by Groves and Stacey. This is a problem with most surveys, particularly those that canvas attitudes and opinions. It is proposed in a later phase of this project to observe actual classrooms to see *how* calculators are used in the reality of everyday life.

Reys and Reys et al (1990) also compared changes in the use of calculators over a decade. They surveyed both primary and secondary teachers within

the state of Missouri. They found that the changes which had occurred were most pronounced in the secondary school. Teachers still, however, primarily viewed the calculator as a tool for checking answers produced by written computation. Some teachers even expressed the belief that they had to do more written computation to make sure that proficiency with the written algorithm didn't decline as a result of the increased access to calculators in the home.

A discussion of the calculator debate would not be complete without a brief consideration of the meta-analyses carried out by Hembree and Dessart (1986, 1992) and the two large scale, longitudinal, Calculator Aware Number (CAN) and Calculators in Primary Mathematics projects. Research on children's achievements is best summarised by considering the meta analysis carried out by Hembree and Dessart (1986). In all, 79 studies were analysed in this way. Results again clearly indicated that mathematical achievement was at least as high, if not higher, for those children using calculators compared to non-calculator using children. No detrimental effects were noted for the high and low ability groups. Hembree and Dessart updated their work in 1992, locating nine further studies to add to their original 79 studies. The results from these further studies supported the previous findings. Hembree and Dessart (1992) reached the following conclusions. "The preponderance of research supports the fact that calculator use for instruction and testing enhances learning and the performance of arithmetical concepts and skills, problem solving and attitudes" (p. 31). A further advantage was that students using calculators fared better in tests involving problem solving and computation.

Research findings help to quell any fears teachers might have about using calculators in the primary classroom and provide insights into ways in which they might be used in the classroom setting.

- Students who use calculators and computers *within an appropriate instructional environment* can improve their basic skills by increasing their number sense and strengthening their understanding of arithmetic operations. It is NOT necessary for students to learn about numbers and number operations before they can effectively use calculators; rather, such understandings and skills follow naturally from appropriate access to technology.
- Children's attitudes and confidence improve as a result of using calculators.
- Students show greater persistence and effectiveness when allowed to use calculators to solve problems. They also appear more willing to take risks. (*Statement on the Use of Calculators and Computers for Mathematics in Australian Schools*, 1996, p. 6).

In order to examine the long-term effects of using calculators in the primary school one must turn to data collected from two curriculum projects – the Calculator Aware Number project in the United Kingdom and the Calculators in Primary Mathematics project in Australia. Ruthven (1995) summarised the findings of the Calculator in Primary Mathematics project:

The project children were better able to tackle real-world problems and computational tasks; in particular, that while they did not make more use of calculators, they made more appropriate choices of the calculating device and were better able to interpret their answers. (p. 239)

Similar findings were made in the CAN project. Duffin (1996) noted that teachers involved in the project changed their teaching styles to integrate the use of calculators into their mathematics program.

Research Questions

The following research questions were used as the basis for the development of the survey instrument.

1. To what extent are calculators being used in primary schools?
2. For what purposes are calculators used in the primary classroom?
3. What is the attitude of teachers toward the use of calculators in the primary school?
4. What impediments are there to the use of calculators in the primary school?

Procedures

In Term 3 of 1995 a survey of primary school teachers in Western Australia was conducted. Because of the size of the State and the scattered distribution of schools a questionnaire was used to gather initial data. The two researchers were aware of the typical low response rate often attributed to the use of questionnaires. The questionnaire was based on the earlier work of Reys and Reys et al (1990) and used many of the questions which were applied to the interviews conducted by Reys and Reys et al (see Appendix 1 for the survey questionnaire).

Questionnaires, with reply-paid envelopes, were sent to 787 primary schools across the state of Western Australia. These included all state and independent primary schools in Western Australia. Responses were requested from those teachers with classes at either Year 1, Year 3, Year 5, or Year 7 levels. Teachers with composite classes, e.g. Year 3-4, were asked to reply as well. If there was more than one class at each year level then

all teachers for that year were asked for their comments. The responses were to be anonymous on the part of the teacher. The only information requested of the school was to supply their post code so that later clustering by region could be attempted.

It is not possible to provide a specific response rate, as single and multiple responses were received from schools. There is no way of knowing whether schools had one or more classes at each of the targeted year groups. However, 1297 responses were received, quite a substantial response taking into account the industrial action being taken in state schools at the time.

Data from the surveys were transcribed to a computer data base for analysis and comparison with similar data from previous surveys.

CHAPTER 2

Results of the Survey

The survey questionnaire consisted of sixteen questions. The results for each of these questions are described in this chapter.

Question 1

Should all students use calculators in primary school?

No response*	No students	A few students	Some students	Most Students	All Students
12	4	8	107	238	928
1.0%	0.3%	0.6%	8.2%	18.4%	71.6 %

* It should be noted that while we received 1297 responses not all teachers responded to every question.

The overwhelming response to this question was 'yes' with almost three-quarters of the teachers concurring with *A National Statement on the use of Calculators for Mathematics in Australian Schools* (1987) recommendation that

ALL students use calculators at ALL year levels (K-12) (p. 1)

This data would suggest expressions of support for calculator use being consistent across the range of schools – country, large, small, metropolitan, and independent. Reys & Reys et al (1990) from their interview data gained a 94 percent positive response. It must be noted, however, that they did not include the word *all* in their question.

Looking beyond the statistics it was noted that when teachers responded that *all students* should use calculators in primary school they were not referring to free access to calculators but rather limited use as decreed by the teacher. The following quotes taken from the comments section on the survey revealed, in fact, a rather guarded response to this question. A cross section of teachers responding "all students" is given below;

Only in senior classes and only occasionally.

At some point in their primary schooling all students should use calculators.

At certain times eg checking multiplication sums. Not to be used everyday. Teacher directed.

But to varying degrees. More able children can use calculators to mark and correct work, puzzles, games and to do sums above their level.

Note the qualifying remarks in the last comment. Firstly the teacher refers to more able children and secondly outlines various uses for the calculator. The reluctance of teachers to allow students to determine when and how a calculator should be used is typified by the following comment.

Under the teachers' direction.

Other comments help to indicate the direction being given by teachers. For example some teachers report giving formal calculator lessons and refer to the need for *all students* to complete formal calculator lessons.

I don't allow children to use calculators during lessons. However, I take the children for an intensive course on the function and use of the calculators as part of my maths program.

The following comment indicates the types of activities specified by teachers as appropriate for calculator use.

At certain times eg checking work, marking work, occasional problem exercises specified by teacher, games.

Several themes became evident upon analysing the responses. These are summarised below along with responses that typify the nature of the theme.

Delayed Starting Points

Many teachers referred to various cut off points as to when students should start using calculators. These cut off points tended to cluster around the end of year one and after year four.

I don't think they are necessary below grade 3

Only senior grades – when tables are automatic.

Over-reliance

Some concern was raised that children might become reliant on the use of calculators.

Should be made available but not under all conditions.
Shouldn't learn to be totally reliant on them.

All students need the knowledge to use one but it shouldn't be used instead of their brain and pen and paper.

Basic tables, combinations and formulae should be known before widespread use of calculators is permitted.

Understanding Will Suffer

In particular teachers were worried that 'understanding' would suffer as a result of using calculators. Basic number facts in particular were mentioned as prerequisites to using a calculator to any great extent.

Until there is understanding of the process I don't believe calculators should be used.

All students should use calculators – but not all the time. Children need to be given the chance to explore algorithms and develop some automatic response to basic facts.

They need to learn the basic number facts before they can use a calculator.

I believe all children should be exposed to calculators but I don't believe they should use them consistently. I believe the constant use of calculators weakens an individual's mental maths ability.

Just like a pen license, I believe that when they can show they are confident with numbers and understand the processes they should be allowed to use a calculator.

Terms such as 'understanding' and 'process' were often used by teachers when responding to questions in the survey. It was clear from the variety of uses that teachers' interpretations of these terms vary widely.

Calculators as Checking Devices

Many teachers relegated the use of calculators to a checking device.

Can be useful for checking written calculations – AFTER solving without calculator first.

To be used at teachers' discretion – to verify estimates, check calculations etc.

Calculator use should not replace using the algorithms but should be primarily for checking work in the earlier years.

Formal Calculator Lessons

Formal calculator lessons were mentioned by several respondents. The responses seem to indicate that these lessons were seen as separate from what was going on in mathematics lessons at the time.

Need for structured lessons / times when these are used

I don't allow children to use calculators during lessons. However, I take the children for an intensive course on the function and use of the calculators as part of my maths program.

Real Life Use

Some teachers indicated that they felt calculators should be used because they had now become entrenched in 'real life'. Comments, such as the following, were typical of those in this category;

Every child will be exposed at one time or another to calculators out there in the 'real world'. Our job is to equip them with life skills.

Students will use a calculator in high school and 'real world' so need to be able to confidently manipulate one.

People do not use pen and paper maths when they leave school. They should be familiar with how to use a calculator.

Some respondents also referred to the need to be familiar with calculators because high school teachers assume primary students can use calculators.

Positive Comments

Some positive comments regarding the use of calculators were received. These are highlighted below;

Calculators should be used as a tool, the same as pens and computers. This does not mean that they should be used all the time.

All students should have their own calculator as part of their essential equipment.

From cavemen people have looked for easier ways to calculate number problems. Children should be able to use whatever technology is available to them to demystify mathematics and make it available to all.

Calculators are now the pen and paper of mathematics. The idea of students still doing long algorithms (or complex ones) on paper is dead and not relevant to the real world.

Reys and Reys et al (1990) also found that while many respondents thought children should use calculators in school they wanted to place conditions on that use. The main restriction was that children should know their basic number facts prior to using calculators. This issue is explored further in question four. They also found that calculators were often used as checking devices. This practice will be discussed later.

Summary

From the statistical data it seems that most teachers are in favour of all students in the primary school using a calculator. Looking beyond the data to the comments section offers a different picture. Use is much more guarded,

delayed or under the guidance of the teacher. Where they are used it is often for checking calculations rather than for fundamental approaches to learning mathematics.

Question 2

At what year level should students start using calculators?

NR	K	1	2	3	4	5	6	7	HS
2	369	411	168	200	152	61	31	6	4
0.1%	26.3%	29.3%	12.0%	14.2%	10.8%	4.3%	2.2%	0.4%	0.3%

It should be noted that 1404 responses were received even though there were only 1297 respondents. This occurred because some teachers gave responses such as K-1 or 2-3 and therefore were double counted, once in the first category and once in the second category. This mainly occurred in the K-1 area where many teachers grouped pre-primary and Year 1 children.

Almost 60 percent of the respondents suggested the use of calculators should start with the youngest children in the primary school. This is an interesting result as one of the often-heard arguments given in regard to calculator use is the need for children to master "the basics" first. Basics is often interpreted to mean the ability to compute using the four rules and standard methods, or the instant recall of basic number facts, in particular the multiplication facts. If this is a valid interpretation then the survey evidence is suggesting this is not the opinion held by many teachers. They are advocating the use of calculators before the basic algorithms are taught, usually in Year 3 or Year 4. Certainly from this data there is a feeling that calculators should be used before the upper primary level.

Reys and Reys et al (1990) in their data found 67 percent of primary teachers thought the children should "completely master the basic facts" before they were allowed to use a calculator. The main arguments were the fear that calculators might become a crutch and children would never be able to learn their facts. Another point raised was the concern that students should know why something works and somehow this understanding is hidden by the calculator. This argument assumes that being able to reproduce the procedure for a standard algorithm indicates understanding. Plunket (1977), however, suggests that standard algorithms are designed specifically to obviate the need for understanding.

General themes which emerge from the comments given for this question highlight interesting aspects of thinking behind the given answers. These responses could account for the balance of the statistics shown earlier by

giving meaning, clarification and detail. In many cases the themes and concerns raised in question one occur again.

Learning Potential of the Calculator

Comments in this section generally pointed to the use of a calculator as another tool in the teacher's armoury to help children learn aspects of mathematics. This is in line with *A National Statement on the use of Calculators for Mathematics in Australian Schools* (1987) recommendation that "the calculator be used both as an instructional aid and a computational tool" (p. 1). Generally the teachers who recommended early use highlighted activities and points made by Groves and Cheeseman (1995) in the Calculators in Primary Mathematics project. Sample comments are given below, with the teachers' class levels in parenthesis.

(1) Children can learn a lot about numbers by using calculators

(K) A calculator can represent a recognisable number for a student before s/he is proficient at writing it. That's power!

(K) They are a concrete learning tool that teaches lots of maths principles eg. patterns, tables etc.

(1) Learning to use the calculator from year one means children will learn to use it intelligently.

(1) I have found that some students in Year 1, having difficulty in learning to recognise numbers, were eager to learn using a combination of concrete materials and a calculator.

(1) Calculators should be seen as a natural resource – not something special – just as any other resource is seen. Early integration into maths learning can only promote effective maths development.

Technological Needs of Society

These comments were much more matter-of-fact and open. Teachers in this case, appeared to take a view that calculators are here and are being used extensively so children need familiarity with them in order for them to be used sensibly.

(K) No point in waiting—children use pencil, paper, books, computers, televisions etc. Calculators are part of daily life. Children need the skills.

(K) Experimentation and utilisation of technology is abundant in our society. Why ban children when their world outside school is becoming more technology based.

Use Them Only at a Later Stage

Teachers making comments about postponing the use of calculators seemed to hold the view that the calculator is simply a calculating tool, an easy way to do calculations. Generally it was not considered as a learning or teaching aid.

(5) Methods need to be understood in prior grades in case a calculator is not available.

(2/3) Children need to have basic understanding of the number system and the basic facts before using calculators. Calculators are only as good as their user so facts and estimation skills need to be developed so children can check the validity of the answer a calculator gives.

(5) Years 1-4 are formative years for concrete understanding of mathematical concepts. Once concepts have been mastered, calculators can then be introduced to short cut some steps or aid in checking answers.

(High School) The primary school syllabus is not demanding enough in maths to warrant widespread use of calculators.

(4) Prior to year four pupils should be able to perform their calculations in a written or mental form. Starting with year 4, pupils should be allowed to use calculators to save time in more complicated calculations PROVIDED they can perform these on paper.

Concept Skill or Procedure

There is a confusion between developing a concept and developing a skill or procedure. Many respondents used the word concept or process when it appeared they meant to use the word procedure. In most cases the context given by the statement suggested the person was in fact referring to a standard written procedure, for example decomposition in subtraction. The procedure in this case is the exact duplication of a method or series of steps that are applied to supply an answer to a calculation.

For many teachers it was important to be able to check that each step in the procedure had been correctly followed. The calculator is, in fact, a useful learning and teaching tool to help children develop a concept of subtraction, for example, where concept is referring to the growth and interconnections of ideas and understandings. If school mathematics is seen to be only the mastery of taught, standard procedures, then the calculator has no place in the system. Its only function may be to check answers to already performed calculations – an electronic answer book.

(5) I think by this stage children have the necessary skills to prove that they know the PROCESS of mathematics.

(4) When they understand the concepts of adding numbers then subtracting numbers.

Formal Calculator Instruction

There was a need identified by many respondents to have formal calculator lessons. These would be separate from mathematics lessons and follow on from initial play or familiarisation with younger children.

Checking algorithms for Year 3 progressing to explanation of all function keys by Year 5 (ie Use of Memory, Memory Recall buttons).

Incidental use by teacher or parents before then would occur however I believe formal instruction should occur in yr 2.

Younger children should be exposed to the use but instruction could start around Year 3 depending on abilities and availability.

No mention of integration with mathematics lessons was made. Calculator lessons were viewed as a separate appendage to the mathematics program.

Separate Calculator Use

While many suggested that calculators could be used with younger children they saw the calculator as an extra; something which did not interfere with the normal mathematics teaching. Calculators were used as a "fun" activity, as a reward or for early finishers of set mathematics work. They appeared not to be part of the planned, serious mathematics program or learning. There was no real mathematical purpose to their use.

Calculators could be introduced in a fun way early and students be taught to use them in specific ways as need arises.

Children could be introduced to calculators and allowed to use them for games etc. but they wouldn't use them in maths activities until an older age.

As 'fun' activities can be developed for very young students, there's no reason why calculators shouldn't be introduced at an early age.

Summary

Even though almost 60 percent of the respondents suggested the use of calculators should start in the junior primary years this figure is somewhat misleading. Clarifying comments revealed that 'calculator use' consisted

mainly of checking work, games and formal calculator lessons. Almost no mention was made of using a calculator in a problem solving context. The emphasis on standard written algorithms appears to impede the use of calculators in more realistic applications. The attitude that written algorithms provide rigour also appears to affect the way calculators are used in primary classrooms.

Question 3

Should all students use COMPUTERS in primary school.

No response	No students	A few students	Some students	Most Students	All Students
19	6	1	27	76	1168
1.5%	0.5%	0.1%	2.0%	5.9%	90.0%

The response was an overwhelming 'yes' with 90 percent of respondents reacting positively by nominating *All Students*. If one includes the response to *Most Students* then almost 96 percent of teachers were in favour of primary school children of all ages using computers.

The major reason for advocating use for everyone was the fact that computers were everywhere and children had access to them at home.

Computers are part of today's society.

As computers are very much a part of the growing technological world, all children should at least be exposed to computers as a learning tool.

Computers are obviously the way to go for all students – whether they go onto further studies or not. Computers are everywhere and everyone needs to know how to use them.

Computers provide children with access to information across the curriculum. Children need to feel empowered in the use of computers – earlier the age the better.

Relevance to the Basic Education and the Speed of Change in the Technology

Some teachers were against the use of computers and offered the following reasons.

Computers are not the main or only or even necessarily an important method of learning.

Not necessary. Children will all experience the use at home / friend's home / school at some stage. If we don't have 1 per child the benefits are minimal.

But this shouldn't be stressed in the early years as by the time these children are in the workforce today's technology will be totally superseded.

I can't see the value and don't have time to do an intensive computer program.

I think Years 1-3 need to learn to write sentences first. The computer can be a toy in too many classes.

I am opposed to the idea of using computers. The basic skills should first of all be learned, not a machine used to avoid the basics of handwriting, book research, drawing, diagrams etc.

The Application of the Technology in the Classroom

The following comments indicate the variation in philosophies espoused by the teachers who participated in the study.

Computers are a 'tool' for learning and have enormous potential thought their schooling – word processing, databases, spreadsheets, graphing as well as drill & practice games.

Beginning with basic games and activities to develop skills, keyboarding and programming activities (e.g. using Logo to develop logical thinking processes) can be incorporated into a whole school program.

Computers are an excellent resource for practising skills – improve work presentation – develop problem solving – great for motivation / reward.

As with any subject correct methods and skills need to be taught. Unfortunately there are not enough trained teachers to teach the subject accurately, therefore poor habits and skills develop.

All children in our school have access to computers each week, both for word processing and to work their way through educational packages.

Maybe taught in year seven. In middle and lower primary not for whole class use. Some use in certain teaching areas for students needing remediation or reinforcement.

If there is access to a class set of computers and a lesson can be taken with all children participating.

Difficulties of Implementing Computers in the Classroom

It would be nicer though if we had a skilled computer instructor for them.

Impossible to implement with 1 computer to 30 children.

I find a computer in the classroom more trouble than its worth. I feel there should be a fully stocked computer room with a specialist teacher. The tendency is for mindless games to occupy the children.

Summary

Teachers viewed the use of computers in the classroom in a more positive light than the use of calculators. The question that really needs to be answered is: How are the computers being used? It is possible that while computers may be used in the classroom, this use may be restricted to low-level applications such as typing stories and drill and practice programs. This would mirror the situation with calculators where they are used to check answers and to spell words.

Question 4

Students should completely master the basic number facts (e.g. tables) before they use calculators.

No response	Strongly Agree	Agree	Maybe	Disagree	Strongly Disagree
43	215	163	134	510	232
3.3%	16.6%	12.6%	10.3%	39.3%	17.9%

This question asked specifically for information inferred by Question 2 with regard to the connection of calculator use with basic facts knowledge. From the survey it appears that 30 percent of teachers feel that the basic number facts should be learned before calculators are used by the children. From a comparison with Question 2 there seems to be some discrepancy. If 60 percent say children should use calculators early in their school life but 30 percent suggest that this use should be delayed until the basic number facts are mastered then for what tasks should children be using calculators?

Almost 60 percent of the respondents actually disagree with this statement and see the calculator being used at least in parallel with the learning of facts or as an instrument to help with the gaining of knowledge. The written responses to the question highlight several themes.

Calculators Used for Checking

Typical responses in this category are given below.

A calculator should not be used as a tool to do mental algorithms! It should be a separate tool and it can be used to check answers.

Children should use calculators in upper grades mainly to check work. If they use them all the time they may forget basic facts and how to work out problems and become lazy.

Children Need to Know these Facts

There was strong support for the learning of basic number facts as evidenced by the following comments:

Tables and other facts can be learned separately to calculator skills.

Tables need to be known before calculators are used as children may rely on them too much and not learn tables etc.

I believe that is essential for children to know how to master the basic number facts and study them because it's not all the time that they will have calculators to help them.

Basic facts and calculator use are two separate issues. Calculators are used to perform calculations requiring large numbers, or to check answers – NOT to provide answers to simple '5 x 3' type everyday problems.

It is important they master basic number facts but calculators can be used intermittently at times as a fun activity as the child wants.

There is still a need for the knowledge of basic facts (for mental arithmetic). It is quicker to work these out mentally. Calculators could be used to assist in this learning process.

Otherwise they'll never learn their basic facts – they'll rely solely on the calculators and won't want to learn the skills which they need to check accuracy.

The calculator should NEVER be seen as a substitute for basic facts.

Children should have an understanding of algorithms at their level and recall of basic facts continues to be taught – revised at all levels.

Basic Facts Later

For those teachers who disagreed with the statement that "students should completely master the basic number facts before they use calculators", the issues seemed to be based around the following reasons.

The Children Can do Other Things with the Calculator

Yr 3 may not know their tables; however, they are able to make good use of calculators.

The calculator can be used simultaneously with other methods. The calculator is a great motivational tool and helps children overcome hurdles they previously considered 'too hard' thus increasing their confidence to 'have a go'.

Basic Facts in Conjunction with Calculator Use

Calculators help children to see patterns and to understand numbers; help them think mathematically without being burdened by lack of knowledge of number facts.

Basic facts learning can prevent some children progressing in maths. Calculators can free up this progress. They must learn basic facts but not to the exclusion of other concepts.

Children should be encouraged to master basic number facts but calculators can be used as an aid to learning these facts, for more complex calculations etc whilst consolidating these facts.

They should be used where appropriate – but number facts should also have attention. I focus on both number fact learning and calculators. Senior students who have mastered the number facts won't bother with a calculator – it is too slow!!

Calculators may assist children in the learning of basic facts therefore this would be a valuable aid to them to aid understanding.

A number of basic facts can be investigated and discovered using calculators. Number patterns and sequences discovered on calculators can enhance children's understanding and knowledge of basic number facts.

The following comment recognises the need to use calculators for more than just simply checking work, trivial exercises or learning basic facts.

Calculators need not be used just for +, ×, x, -, basic facts but for use in probability, problem solving etc.

The Children will be Deprived without its Use

Some children will always have difficulty mastering basic number facts but we can't deprive them from using calculators for their entire primary school career.

It is more important that they understand the processes. Some will never memorise the tables etc and they are the ones who will need the calculators.

Basic facts are only a small part of maths and to give the impression one can't do maths without mastering the basic facts is one of the causes of maths phobia.

Summary

Many of the responses to Question 4 indicate that the teachers place a high value on the memorisation of the basic number facts. Similar results were found in the Reys and Reys et al (1990) study. Sixty five percent of respondents felt that students should master the basic facts prior to using calculators. Similar arguments to those given by teachers in the current study were given. These revolve principally around the belief that calculators will become a crutch and will weaken traditional mental and written computation skills.

Question 5

Has the issue of calculators been discussed with parents?

Informally Yes	Informally No	Parents' nights Yes	Parents' nights No	Newsletter Yes	Newsletter No
559	506	327	651	130	705

No percentages are given as respondents may have chosen more than one option.

A similar question was posed in the Reys and Reys et al (1990) study. In that case the question focused on whether parents had initiated contact about calculator use in the classroom. Fifteen percent of teachers in that survey reported parent contact on the issue.

In the current survey the issue of calculator use does not seem to have a high priority for many schools. Approximately half the teachers had some form of informal discussion with parents' whereas about a third of the schools had undertaken a parents evening to consider the subject.

It is possible that parental interest in the use of calculators may be heightened if calculators are to be used in a more controversial manner. Parents may find the use of calculators to check work to be acceptable but

may be much more inclined to voice concerns if their children were given free access to calculators.

The general themes arising from the respondents' comments fall into the following categories.

The Use of Calculators had been Explained

Discussions, newsletter items etc were used to address issues a few years ago. This is no longer necessary.

When I have demonstrated to the sceptical parent, what is REALLY involved with the use of the calculator and they have watched their own children's approach, they have changed their attitude.

It was explained that calculators could be used to check column algorithms, not to work initial answers. Also importance of children being familiar and confident with using calculators.

Special Parent Nights had been Arranged

1991 – calculator workshop for parents. The newsletter was given at information session. Not more than 15-18 parents attended but those that did were positive and enthusiastic about how useful they can be.

A calculator evening was held when introducing calculators in the school. Very little attendance.

Many teachers reported that little or no contact with parents had been initiated on the use of calculators in primary school mathematics although some mentioned that the use of calculators came up in the context of general discussion about mathematics.

Parents were Positive About Calculator Use

Reports that parents were positive about the use of calculators in the classroom need to be considered in context. It appears that teachers believe parents are happy for children to use calculators, provided their use is carefully monitored. In many classrooms the use of calculators is limited to checking the results of written calculations. If calculators were used more often for a wider range of purposes then parents may not be quite as positive about their use. The following comment is typical of those made about parent attitudes toward the use of calculators in the primary classroom.

Keen to use these in classrooms – however parents wanted their usage monitored (i.e. learning centre / problem solving activities only).

Parents (some) felt they were detracting from learning process – “In my day...” etc. We were able to dispel this with arguments for calculators use.

It was explained to the parents that they were used for working out larger number patterns – games and problems. They could also be used for checking answers in some situations.

It may be seen from the last comment that restricted calculator use doesn't cause too many concerns. It is quite possible that more use of calculators might concern many parents.

Issues Raised by the Parents

Teachers reported that parents with concerns about the use of calculators tended to raise the following points:

If the students don't know their number facts they shouldn't be allowed to use a calculator. Many parents see rote table knowledge as the key to understanding maths.

Cost, necessity, children not learning basic methodology, children 'cheating', vandalism and safety of property

The child who won't learn their tables. “The Golden Age” when everyone knew their basics. The painful shop assistant who can't add 2 simple numbers without the calculator.

Some parents wonder whether they should ALLOW calculators. Won't the child cheat? Won't the child take the easy way out?

Whether the children were allowed to use them all the time in class, and for homework.

How to use them to the best advantage at home.

Horrified to think children would use a calculator instead of being taught first how to do a computation.

Wanted to be sure children knew how to do written maths and tables.

That's not how I learnt – and I'm OK. How will they learn? They don't have to think! It's cheating and all the usual bunkum.

Summary

While parents on the whole appear comfortable with the level of calculator use in their children's classes, few of these classes appear to come near the level of calculator usage exemplified by the CAN project and the Calculators in Primary Mathematics project. Reports from the CAN project (Duffin, 1996) indicate that there was considerable concern on the part of both teachers and parents when it was suggested that the teaching of traditional written algorithms be abandoned in favour of children's own informal methods of calculation and the use of calculators. One can only speculate whether the same might be true if calculators were being used for more than simply the checking of written computations.

Question 6

How much has your opinion about calculator use in the primary classroom changed over the last 5 years?

No response	Not at all	A little	A moderate amount	Considerably	A great deal
44	366	335	252	224	76
3.4%	28.2%	25.8%	19.4%	17.3%	5.8%

In any interpretation of this question one needs to consider the information not given or not obvious in the answer. For example, from where was the person starting when they changed? Was it from an anti-calculator stance to a pro-calculator stance or somewhere in between? If they have not changed was it because they already had a good opinion of calculators or a poor one?

From the data presented it can be seen that almost a quarter of the teachers had changed either considerably or a great deal. Almost 60 percent, however, had not moved very much at all. Reys and Reys et al (1990) reported 45 percent of primary teachers' opinions regarding calculator use had changed. They noted a greater change among experienced teachers as compared to newly trained teachers. From their survey data there was less change among primary teachers than secondary teachers. With the advent of scientific and graphing calculators and their acceptance into examinations and assessment procedures there seems to be a greater change in the teaching and thinking in secondary schools.

The reasons for a change of opinion tend to fall into the following groups:

Working with Children

Probably the most powerful change agent for teachers is seeing how well an idea translates into classroom practice. Research findings on calculator use

have little influence on classroom practice unless the benefits to teachers in ordinary classrooms can be demonstrated. Teachers are often sceptical about new ideas or approaches until they are proven to work in the classroom context. The following comments tend to bear that out.

Using them in different ways (for different purposes) and watching students' ability to handle them and the effects that different use had on their ability to work mentally.

With experience in the classroom situation I am finding more ways to use calculators in the classroom, and have gathered more resources over the years.

The Influence of Other Teachers

Colleagues may also influence classroom practice. The need to conform is a very powerful influence on beginning teachers. They tend to fit in with the status quo and follow the lead of more experienced colleagues. These colleagues may stifle educational reform or help promote it. Often simple comments made over a cup of coffee in the staff room can be the trigger to try something new. The response of the children in the class will often determine whether or not new ideas are taken up.

Other teachers have shown me a variety of activities and I have used some publications also. Children's interest and enthusiasm is a contributing factor.

Initial Training

Many teachers referred to their initial teacher training as having a bearing on their use of calculators in the classroom.

Great ideas / strategies were taught during maths lectures at Edith Cowan University / teachers college.

I went to Uni to become a teacher where I was privy to accurate information on the value and uses of calculators and could see how they assisted students more accurately than pen/paper computations.

My teacher training provided me with an insight into how calculators can be used to aid learning rather than as a substitute for it.

At uni we were shown a range of activities that can be done in the junior grades to introduce calculators. Before this I felt they had no use in a junior primary class.

Study at university – we were taught how to use them to foster learning, not to replace learning. I also tried using calculators to promote a positive attitude towards them – with successful results!

The Influence of Textbooks

Many teachers referred to various texts as having a bearing on the use of calculators. Often text materials will direct whether calculators should be used and how they should be used.

Inservice and Professional Development

Several teachers commented on the need for constant inservicing to help them keep up with technology and to improve classroom practice. The power of good inservice to change practice may be noted in the following comment.

Because I did a coordinators' maths course at Edith Cowan (Churchlands) and my assignment choice was 'Calculators in primary school'. At first I was rather opposed to their use – but subsequently was converted!

Negative Views

Negative classroom experience had caused some teachers to change their opinion of using calculators in the classroom. As previously mentioned, classroom experience can be a powerful change agent. The following comments help to bear this out:

When I first started teaching I though they were essential. Now I would prefer the children to work even complex operations out in their heads.

Initially we introduced calculators to all grades – younger children wasted much time 'miskeying' required digits. Children experiencing difficulty with concepts of maths were not aided but more frustrated as their comprehension of numbers was not helped – they needed concrete evidence before them to assist their learning.

I decided that my students should now be disadvantaged because I was fundamentally opposed to calculators as encouraging laziness. However, I believe they still should be used only as a tool for enhancement and not a prop for 'tired' students.

The Needs of Society

The notion that school should prepare students for the 'real world' was mentioned by teachers as a reason for a change in belief about the use of calculators. The following comment is typical of those made by teachers responding in this manner:

Realising that they're used extensively in the real world. It is necessary to acquaint children with them. They are a reality of life. Not many people operate without a calculator.

Documents

The Student Outcome Statements and the *Learning Mathematics K-7 Syllabus* were mentioned as having an influence on the use of calculators in the classroom. No mention of *A National Statement on Mathematics for Australian Schools* (1991) or the *National Statement on Calculator Use* (1987) was made. It is possible that inservicing associated with the introduction of Student Outcome Statements may have influenced teachers' thinking.

I used to think calculators weren't necessary for juniors until I did a "Maths in the Early Years" inservice and read the new syllabus and Outcome Statements.

The student outcome statements – have drawn my attention to the use of calculators throughout the primary school – inservicing has been particularly helpful in supplying activity ideas.

Summary

There does appear to be some change in attitudes toward the use of calculators in primary classrooms. Not all of this change has been positive. Several reasons were given for a change in attitude. Chief among these was successful classroom experience. The survey found that the main reasons for a change in attitude by teachers were:

- a better understanding of student learning problems;
- more use of calculators in their own personal life;
- experience watching students working with calculators; and
- society's accepting view of technology.

Similar findings were noted by Reys and Reys et al (1990) in their 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%

There is an almost equal weighting of 11-12 percent between the "free access" teachers and the "never" teachers. The proportion of "some use" is about two-thirds of the teachers whereas approximately a quarter were identified as never or rarely using them. One then has to ask the question: For what reasons and tasks are they used?

Reys and Reys et al (1990) in their primary school sample noted a little over 40 percent of teachers using calculators either daily or weekly. Though again their data are clouded because of the number of teachers who responded with "it depends." They cited the differing uses due to topics taught throughout the school year as one of the reasons for this comment.

The main themes emerging from the data in the responses to the survey question are as follows:

Little or No Calculator Use

The lack of or availability of calculators was cited as the main reason for not making use of them. The following clarifying comments indicate the situation in some primary schools:

No class set for the juniors available.

Hardly any have them – but I allow their use!

Unavailable at the school.

We don't have many.

Free Access

It became apparent when examining comments made by the 11 percent of teachers reporting 'free access' that definitions of 'free access' varied. For example, some teachers classified access to calculators to check answers at any time as being 'free access'. No one described a situation similar to that encountered in the CAN or Calculators in Primary Mathematics projects where students were given the opportunity to choose when and how to use the calculator. The influence of standard written algorithms appears to work against the notion of free access. There is also concern that if given free access students will choose to complete simple calculations with the aid of a calculator.

Later Use

Many teachers mentioned postponing the use of calculators to later in the year, implying that calculators would be used once the bulk of the 'real mathematics' had been covered.

I begin calculator activities in term 4 & end of term 3.

I haven't started using calculators yet. It is programmed for term 3.

Summary

While it is clear that calculators are being used in many classrooms it is difficult to gauge the level of use due to the different interpretations of phrases such as 'often' and 'sometimes'. Interpretations of 'often' could vary

from weekly to daily. Sometimes could also be interpreted to mean weekly or monthly. Twenty five percent of teachers reported little or no calculator use and the remaining seventy five percent of calculator use may simply mean that children regularly use calculators to check answers.

Question 8

In what ways are calculators used in your classroom?

Checking Work	Complex Calculations	Teaching Learning Aid	Specific Lessons	Calculator Games	Problem Solving	Other Subject Areas
870	671	735	805	736	723	346

No percentages are given as respondents were at liberty to choose more than one category.

The greatest number of replies noted the checking of work as the major use of the calculator in the classroom. Comments on this practice by Reys and Reys et al (1987), and Swan (1996) suggest it as an undesirable way to use the calculator in the primary classroom. Koop (1979) also commented on poor calculator use as instances where the calculator is not used as a natural part of the lesson but in the form of a separate calculator lesson. The second most favoured way of using the calculator is in this separate form. One could also group with the "checking work" category the responses to "complex calculations" and bring this into the "calculator as a calculating aid" format as identified by the *National Statement on Calculator Use* (1987). Specific lessons and calculator games could form another group where the calculator was separated from the main mathematics teaching. An integrated model could be formed from the "Teaching and learning aid", "Problem solving" and "Other subject areas" categories which highlights the other recommendation of *A National Statement on Mathematics for Australian Schools* (1991).

Blane and Willis (1986) found the calculator was usually used as a calculating device rather than an instructional tool. There was a low level of actual calculator use in problem solving and investigation work but a high level of agreement they should be used in this way. This illustrates the mismatch between beliefs that calculators should be used and actual calculator use.

Reys and Reys et al (1990) identified the most frequent preferred use by elementary (primary) teachers to be for problem solving activities. Other activities mentioned were computation, checking answers and basic skills (i.e. when children could not do the calculation without one).

The associated comments add considerable, interesting information and clarification as to how the calculator is actually used in the classroom. Classroom observation should lead to a more accurate picture of when and how calculators are used in primary classrooms. The major classifications are as follows:

The Checking and Marking of Work

Much has already been said about the use of calculators to check work. Calculators tend to be used as a type of electronic marking key. The use of calculators in this fashion is non-controversial as students are still expected to complete computations on paper or in their heads. Thus rigour is still maintained.

For Play or for Fun

Several teachers referred to activities such as creating words by turning the calculator upside down as a type of 'fun activity' involving calculators. Calculator crosswords also fit into this category. Students often have calculator races where they use the constant button on the calculator to set the calculator counting. Students then rapidly depress the equals key for a short period of time (perhaps a minute) and then compare the totals to determine a winner. The following comment indicates the trivial nature of some of these practices.

Non mathematical purposes – children hold upside down and write words!

The teacher acknowledges that these word games are non-mathematical – akin to mathematical busy work.

During Free Time or as a Reward

Many teachers are obviously keen to use calculators as teachers report they use them to motivate children to finish their work. Children are allowed access to calculators as a reward for completing set work or during free time. Often this means that only more able students are given the opportunity to use calculators. Comments made by teachers indicate how calculators are used in this role.

For the better students' use only.

By gifted children in extension activities.

Yes – they have free access to use them during busy work / free time.

Sometimes children are allowed to experiment when they have completed set work.

Don't Use Them

Teachers who choose not to use calculators cite several reasons for this.

No time.

No, but they see me use one for working out averages.

Don't use them as we use Rigby maths. Don't include calculator in syllabus at Level 2/3.

We don't have a school set and the booklist did not ask parents to provide. Economic considerations for parents.

Despite all my comments prior saying using them in the younger years is fine, I don't have access to class calculators therefore don't use them at this stage. If I did I would use them for calculator games as a means of familiarity.

In Other Subject Areas

Several teachers mentioned using calculators in other subject areas; in particular science and social studies.

As a Teaching Aid

Several teachers mentioned using the calculator as a teaching aid. In particular using the calculator to teach 'the tables' often featured in the comments on this section.

To learn tables (using the constant function).

An Integral Part of the Classroom

Some teachers listed calculators as an essential piece of mathematics equipment.

They are part of their desk equipment along with a dictionary.

Every child in the class has a calculator and when a need arises they automatically take them out.

Summary

The data clearly suggests that calculators are being used in many primary classrooms but this use is often restricted to checking work, games and other activities which often trivialise the role of the calculator. Few classrooms appear to make use of the calculator as a tool in problem solving situations. The calculator is sometimes used as a teaching aid, but often this use is limited to the development of table patterns with the aid of the constant feature. Little other mention was made of using the calculator as a teaching aid. The potential of the calculator to encourage perseverance in problem

solving situations, as a powerful tool in the mathematics toolbox and as a teaching aid appears not to have been achieved.

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%

Clearly, most decisions about whether to use a calculator are made by the teacher. Similarly, 85 percent of teachers surveyed by Reys and Reys et al (1990) said they made the decision when and how calculators were used in their classroom. Teachers reported placing limits on technology use and then allowing children to choose whether to use calculators. As year level increased the limits tended to be reduced and students were able to use calculators at their own discretion.

Very few clarifying comments were made in relation to this question. The issue of availability was raised by several respondents. If a class set of calculators is provided then teachers tend to decide when the calculators should be distributed and used. If teachers have to borrow the school set of calculators then they must make a conscious decision to reserve the calculators for that particular lesson. This problem is exemplified by the following comment:

We don't have a class set of calculators at our disposal so any usage has to be orchestrated.

One teacher mentioned that students can't be offered choice as to when to use calculators because they aren't always available.

... but if they were ALWAYS in our room, students would (select when to use them).

It appears that the books and materials used also influence when and if calculators are used. Comments indicate that the Distance Education materials become the defacto decision maker as to whether calculators are used. Likewise, textbook series, for example *Eureka Mathematics*, have a similar influence on the decision to use calculators in the classroom.

Only one teacher made reference to the age of the students and their ability to make informed decisions as to when and how to make use of calculators. This teacher suggested that the decision to make use of calculators was a shared responsibility.

Students in upper primary can make informed decisions.

It appears that even when students are given the opportunity to decide when and how to use calculators, the decision in reality is a shared one between the teacher and the student. The following comments bear this out:

Although they (the students) check first to see if it's OK (I don't know why!) it does depend somewhat on the activity.

Sometimes I stop use, when I feel children would benefit from performing process as written activity.

Teacher usually (makes decision) but students do request and are allowed.

I provide; children choose whether they want to use it.

I only decide when not to be used.

Student (decides) unless specifically stated by teacher not to use them.

Summary

Teachers are the ones who decide what goes on in the classroom including the use of calculators. In many cases limits are set as to the use of calculators and students are free to make use of calculators within the guidelines set by teachers. In some cases children appear to negotiate calculator use with teachers but ultimately the decision to allow or deny access is made by the teacher. Where calculators are held as a class set, teachers consciously or perhaps unconsciously restrict access simply by deciding whether or not to hand out calculators at the beginning of the lesson. Where calculators are stored in inaccessible locations, perhaps a central mathematics store, the choice to use calculators is taken out of the students' hands and in many cases a teacher's choice is limited because other teachers in the school may wish to use the calculators at the same time.

Question 10

Do you allow children to use calculators in assessment situations other than when testing for basic facts or mental computation?

Yes	No	Depends	No response
240	461	399	197
18.5%	35.5%	30.8%	15.2%

A disparity between primary and secondary teachers was found in the study carried out in the Reys and Reys et al (1990) study. While almost all secondary teachers allowed calculators to be used in tests very few primary teachers allowed children to use calculators in testing situations. A similar pattern would likely be found in Western Australia.

This question provoked a number of interesting comments. In particular the "depends" response was clarified by comments such as:

I don't allow them for testing basic facts – mental computation! They may use them to check work which is difficult or where they've already done the hard work.

At junior primary stage I am often also assessing ability to use an algorithm. If actual calculation is not important or if calculator skills *are* important.

If I want to know what they are able to do unaided – then no calculator. If I want to know how much they understand I allow the use of calculators.

Many teachers restricted access to calculators if they wished to test a particular memorised skill such as the basic number facts, other basic facts or written algorithms. Many respondents clarified their comments suggesting that calculators be restricted to complex calculations and for tests involving problem solving.

Several themes became apparent from the comments made by teachers. These are outlined below along with sample comments that typify the response in each category.

Effect of External Testing

Comments noted the power of external tests to influence what goes on in primary classrooms. Secondary curricula have been strongly influenced by external examinations for many years but it was felt that primary classrooms had been spared from the influence of external testing. There are very few formal external tests but it appears that tests such as the *Westpac* tests have become by default a measure of student ability and school ranking.

Some respondents referred to large scale tests such as *Westpac* and noted they did not employ the use of calculators and therefore teachers felt calculators should not be used in school-based tests. The following comment is typical of those made in this category.

MSE (Monitoring Standards in Education) & Westpac and Math Olympiad assessors ban their use.

Equity Issues

A large number of teachers referred to equity issues as the reason for not using calculators in testing situations. The equity issue was often mentioned throughout the survey and is obviously a cause of concern for teachers. One can only speculate whether responses would be different if all children had calculators.

Not enough children have calculators. A class set bought by the school would be helpful.

As it is difficult to get hold of a class set, I rarely allow children to use calculators in an assessment situation.

Insufficient resources. If we had calculators for each child I am sure I would then program lessons and activities to make use of them.

The Textbook

Of concern were the number of teachers who cited textbook series as the reason for using or not using calculators. Pedagogy seemed to be driven by the use of particular textbook series. Text series also appear to encourage the use of calculators as a checking device. Note the following comments made by teachers:

When I had Year 2/3 we had calculators in the class and the "Rigby Maths Program" really encouraged it. The schools new program "WA Mathematics" doesn't.

When the Rigby books have indicated that calculators are to be used then this work is checked using calculators.

School Policies

Still others mentioned school policies which actively discouraged the use of calculators in testing situations.

Our policy (school testing) does not allow calculators to be used in testing situations; however, children can use calculators to check answers after tests have been graded. An unfortunate compromise.

Emphasis on Written Algorithms

Many teachers still place a strong emphasis on algorithms and written computation as evidenced by comments such as:

Not at this level because I need to ensure the children understand the algorithms.

What can we Mark – Evidence

Some concern was raised that if children used calculators in tests there would be nothing to mark.

I want children to write out what/how they think through a problem.

Calculators Used to Mark Tests

Some teachers described how children were allowed to use calculators to add up test results and work out percentages:

Children may add up group points or check assessment points given to them.

Specific Calculator Tests

Several teachers made reference to calculator tests where the children are tested on particular features of the calculator and their ability to make use of them. Reference was made to tests that contained specific calculator questions. This trend is of specific concern as it makes the calculator a specific element of mathematics rather than an integral part of it.

Never Thought About It

Comments like those below suggest that the question caused teachers to reflect on their approach to testing.

I've never thought of it. But – you've given me a new angle that I'll think about. It could be quite practical.

I like children to complete written assessments without aids – maybe I need to re-think.

Positive Comments

Assessment in year one consists of: observation, workbooks, using materials to demonstrate concepts... – not just 'paper and pencil' testing. Therefore calculators can not be used in every assessment situation.

I would if the situation arose. If you let kids use them in everyday learning then you should also allow them during assessments.

After a recent First Steps maths inservice I would be inclined to do so.

I used to ban them in tests but now I allow them if the children can show me some written evidence of their workings as well.

Other Comments

The following comments provide a cross section of other thoughts expressed by some teachers who took part in our survey.

In real life calculators won't be readily available.

Standardisation of 3 Year 7 groups – none of us use calculators during end of term tests.

I want the children to gain confidence in their own ability rather than taking the 'easy way out'.

If I want children to emphasise careful work – i.e. no careless errors of calculation I ask them to work manually (most of time). Will get back to using them for rest of year.

I use calculators as a teaching aid to enforce and introduce concepts, but I expect students will eventually learn these / commit to memory – this is what I test.

Summary

When discussing testing, teachers tended to focus on the need to assess procedures and therefore they wanted to see the working. Many felt that if students were allowed to use calculators there would be little to mark. Secondary teachers, who, for the most part allow the use of calculators in testing situations, do not seem to encounter similar problems. It is possible that because so much emphasis in primary mathematics classes is placed on learning the basic number facts and standard written algorithms for all four operations teachers feel it would be inappropriate to use calculators in testing situations. The focus of testing in primary classes appears to be to see whether children can repeat the procedures learned in class, whereas secondary testing, in many cases, tends to focus on problem solving where the calculator is only useful if the student knows how to use it.

Practical issues such as the need to provide calculators for every student in order to ensure fairness also dominate the thinking of primary teachers. In secondary school all students are expected to provide their own calculators and are in fact disadvantaged if they don't.

Question 11

What hinders calculator use in your classroom?

Reys and Reys et al (1990) noted several factors inhibiting the widespread use of calculators. Chief among these was "teachers' beliefs about what mathematics is and what their role as a mathematics teacher includes" (p. 29). These beliefs include the emphasis placed on written computation. Equity issues such as a lack of calculators were also raised.

Western Australian teachers appeared to enjoy answering this question. Many of their responses indicated anger at not having enough resources and time to make use of calculators in their lessons. The majority cited a lack of calculators as the main reason for not using calculators. They referred to not having enough 'working' calculators in the 'class sets' provided by the school for everyone in the class to use them. Problems of finding the school set of calculators also deterred teachers from using them.

Some schools had placed the onus on students and their parents to provide calculators for the children to use. Several problems were associated with this practice. Some parents had refused to provide calculators because they felt their children shouldn't become over-reliant on them. Teachers also reported problems with this approach as they had to cope with the variety of calculators that were supplied by students. Not all calculators work in the same way, keys are in different places and many teachers felt this put undue pressure on them to explain how individual calculators work rather than 'get on with the lesson.'

Classroom discipline and management problems were a cause of concern for many teachers. Reference was made to broken calculators, sabotaged calculators, the removal of batteries and general misbehaviour when using calculators. Some teachers were upset that class sets of calculators were left to dwindle in number until there were barely enough calculators to 'share one between two'. It also appears that many calculators used in primary classrooms are starting to show their age. One teacher mentioned that the school set of calculators was at least ten years old and subject to breakdown at the most inopportune time. Batteries were often mentioned as a source of irritation. This was a surprise, considering that most modern calculators are solar powered or run on long-life batteries that do not require regular replacement. It appears that many of the calculators used in primary schools are of the older type which required regular replacement of batteries.

Clearly the attitude of teachers toward the use of calculators in primary schools plays a major role as to whether or not they are used. Several teachers felt that there was no need for primary children to be using calculators. Many teachers were forthright in admitting that a major hindrance to using calculator was their own lack of understanding of how to use them and how to incorporate them into the mathematics program.

Of concern were the number of teachers that cited 'time' as a major constraint on whether they would use calculators. This comment seems to indicate that they viewed the use of calculators as an added extra or adjunct to the curriculum rather than a part of it. Some indicated that they didn't have time to give specific calculator lessons. Others blamed the syllabus and other curriculum documents or the text they were using as not providing enough direction and support as to how calculators could be incorporated into the mathematics program.

Surprisingly only a few teachers referred to a lack of parental support for the use of calculators. The major themes, along with typical comments, are listed in order from the most common.

Not Enough Calculators

We don't have a class set.

No access to overhead calculator screen so children can see exactly what buttons I am pressing.

No uniformity of calculators.

No calculators in the school.

Insufficient number of 'working' calculators for number of students.

Whether or not the children have them and how well they're maintained.

Attitude Towards Calculators

Some children think that it's 'cheating'.

Children need to use their natural calculators more (their brain). It's often a lot quicker.

Over-reliance on them / drop in number facts knowledge.

The fact that I'm afraid the children may become too dependent on calculators for basic calculations, rather than working it out with pencil and paper.

Children use them to work questions out rather than for checking.

Children tend to cheat. They like to finish quickly.

When I think about it – I don't rely on them to complete activities – I hope most children can work out the 'problem' by themselves – checking work is fine – you also hope children aren't 'cheating'.

Peer pressure!! You're dumb if you need a calculator for that.

Get children to check and verify their answers. Not to rely on calculator but on 'brain' to get the solutions.

Lack of Direction on How to Use

My lack of knowledge on how to better implement calculators.

My lack of knowledge on how to effectively use calculators in the classroom other than for checking.

I am not confident with the maths syllabus as yet. Hopefully as I become more proficient I will explore more possibilities and involve calculators to a greater extent. I would also feel more confident with using calculators after some type of PD or reading relevant materials.

Unfamiliarity of variations of use of calculator and relation to the syllabus.

Classroom Management

Basically, having to get them from other teachers – one set per class would be ideal.

Children's behaviour and ability to work with a calculator without fiddling.

Storage. Different brands. Too smaller size due to developing fine motor skills still developing.

Irritating things, like flat batteries, a couple of children may not have one, they are too big to keep in trays, so have to be given out, etc.

Children can get off task and 'play' with calculators instead of using them as a tool.

The 'excitedness' of children.

Handing out (takes time). Collecting.

Discipline problems.

Time / Crowded Syllabus

The syllabus – there is much more to do than just use calculators.

Too much curriculum and things to cover, thus calculators are not a priority.

An overloaded syllabus – there are so many other aspects of Maths that need to be covered.

Time constraints – Maths is a problem area and kids have not mastered even the basics.

Not having it listed in the Maths Syllabus.

Texts

Rigby Maths Program is used in class and does not include calculator use.

Time!! The feeling that there are more 'important' things to cover. Lack of teacher resource e.g. suitable activity book. Current ones aren't suitable.

Maths program is written by DEC and does not include calculator activities.

Textbooks – some do not include calculators in the exercises and therefore sometimes forgotten about.

Parental Expectation

The children whose parents will not buy them a calculator – the school has to have a supply which 'dwindles' each year – have to be replaced.

Parents who disagree with children using them.

Summary

There were many and varied reasons for not making use of calculators in primary mathematics. These ranged from concerns about assessment practices, lack of clear direction on how to use calculators, including no clear school policy for the use of calculators to everyday issues such as not having enough calculators to go around. Teacher attitudes also make a difference to the level of calculator usage. Many teachers cited discipline problems or resource management problems as excuses for not using calculators whereas other teachers appear to have solved these problems. Similar issues exist for any piece of equipment used in the classroom. Teachers are well known for their resourcefulness and ability to manage time and resources. It appears that many lack the will to apply these skills to the use of calculators.

Question 12

How are calculator purchases handled in the school?

Class sets	Booklist	Individual supply own
597	422	123

The most common approach was for a school to buy a class set of calculators. This was in contrast to the findings of the Reys and Reys et al (1990) study where less than 15 percent of teachers reported that schools provided calculators for student use.

Clarifying comments seem to indicate, however, that there are not enough class sets to 'go around'. Often schools only had one class set of calculators to service the needs of the entire school. These sets, in many cases, were old and therefore teachers reported experiencing problems with calculators breaking down and batteries running flat – all of which lead to there not being enough calculators in the set to give access to all students.

Some schools reported placing calculators on the booklist. Teachers in schools adopting this approach reported problems such as having to cope with the idiosyncrasies of various models. Some parents refused to buy calculators or simply passed down a calculator that belonged to an older sibling. Often these calculators are too sophisticated for a primary student to use effectively.

In an attempt to overcome the problems mentioned above some schools have opted for an eclectic approach where they expect each child to have their own calculator but they also have a few class sets available for loan.

Question 13

Do you teach students in your class how to use a calculator?

Yes	No
782	397
66.3%	33.7%

Even though there was a two-third, one-third split in favour of teaching students how to use calculators it was clear from the comments made that opinions within the 'yes' group varied considerably. Similar results were noted by Reys and Reys et al (1990). They report that more than 75 percent of teachers provided some instruction on how to use a calculator. Whether this involved formal lessons or incidental teaching is not stated.

Many teachers appear unsure as to how to go about teaching children to make efficient and effective use of their calculators. Opinion varied from the need for formal 'how to' lessons to incidental teaching as the need arose.

Incidental teaching was mentioned by many of the respondents.

Incidentally, rather than a lesson devoted to it.

Not formally, incidental.

As the need arises.

Teachers who mentioned the teaching of specific operations made distinctions between teaching the basic functions and more advanced functions. Many teachers chose not to teach children how to use the memory features of the calculator. The use of the percentage key was specifically mentioned. This point is interesting because the way percentages are calculated may vary from calculator to calculator and is different to paper and pencil methods. Typical responses in this category are shown below:

Do not tackle memory at this stage.

Basic four functions only.

Not how to use the memory.

Teachers expressed concern about their own lack of knowledge of how to use calculators. Comments such as those given below:

Someone needs to teach me first.

Wouldn't know how!

The above comments indicate that teachers need support in trying to integrate the calculator into the classroom mathematics program.

Summary

It is clear that students need to be taught how to make the best use of available technology such as calculators, but whether formal 'how to' lessons are useful is debateable. Parallels might be drawn between reading computer manuals and simply experimenting with software. Similarly most students appear happy to experiment with various functions on their calculator and seek help when necessary. Teachers may also make use of incidental teaching opportunities to explore various functions on the calculator. Obviously as children progress through their schooling calculators become more sophisticated and secondary teachers in particular, need to teach their students how to make efficient use of their calculators. Most primary students use simple four-function calculators and therefore require far less instruction.

Question 14

What opportunities have you had for becoming proficient at using calculators as a teaching aid?

Initial teacher training	Inservice	Informal discussion	None	Other
365	425	367	349	126

Western Australian teachers appear to have had more opportunities than their Missouri counterparts when it comes to opportunities to become proficient in the use of calculators. Eight-eight percent of the participants in the Reys and Reys et al (1990) study indicated that they had not received any preservice training on using the calculator in the classroom. It should be noted that this study was carried out in 1990 and the period when teachers participated in the study may have been a factor affecting the result. The teachers surveyed may have completed their training prior to calculators having made much impact in society and education. Even those teachers with less than ten years' experience, however, made similar comments indicating the issue of calculators was not covered in their initial teacher training courses.

The need for inservice education becomes an important consideration if teachers are to keep up with the use of technology in mathematics classes. Inservice education becomes even more important if teachers have not received adequate preservice education. Reys and Reys et al (1990) found that well over half the sample surveyed reported not having received any inservice education on the use of calculators. Over half the sample of teachers in the current study also reported that they had not attended any inservice courses on the use of calculators.

Teachers were at liberty to choose more than one option when answering this question. Of most concern is the indication that 349 respondents had not had any formal opportunity to learn about using calculators. Several respondents mentioned that they were self taught or had read the manual. Obviously, reading a calculator manual would not provide information on how to use a calculator in the classroom or how to integrate calculator use into the normal mathematics program.

Several teachers referred to professional reading they had done in the area or inservice courses they had attended. A cross section of comments made by teachers is given below. In some cases teachers mentioned specific courses that they have attended.

At maths conferences, workshops and reading (FAMPA).

Journal articles, magazines, maths books.

Reading teacher resource books. Reading First Steps Maths
– Student Outcome Statements.

Other teachers relied on colleagues for suggestions, or as one respondent claimed – "Trial and Error".

Have never done anything regards calculator use. Asked others how to do things.

The power of text materials was highlighted by the following comment.

Some text books suggest appropriate times to use calculators. Curriculum material also outlines useful learning activities using calculators.

Summary

It would be opportunistic to suggest that more inservice is required but the demands on primary teachers to keep up with curriculum changes are already great. Collegial support and in-school help is often discounted as a means of professional development. Results of this study, however, indicate that many teachers rely on this support to keep up to date with current trends. Of concern is the large number of teachers who had not been given or perhaps have not taken the opportunity to learn about calculators.

Question 15

Are you well prepared, professionally, to use calculators in your teaching?

Very Poorly	Poorly	Quite well	Well	Very Well
63	336	511	222	57
5.3%	28.3%	43.0%	18.7%	4.8%

Almost two-thirds of teachers felt they were quite well prepared or better, to use calculators. Several respondents made reference to their initial teacher training and inservice courses. It is of concern, however, that one third of teachers felt they were poorly prepared to use calculators in their teaching.

Reys and Reys et al (1990) found that while less than half of the teachers they surveyed had received training in using calculators, more than three-quarters of them felt adequately prepared to use calculators in their teaching. Comments made by teachers indicate that there were a variety of interpretations placed on the notion of adequate preparation. Some teachers referred to knowledge about how to use calculators whereas others mentioned knowledge of how best to use them in the classroom. With the introduction of graphics calculators into the secondary school there is certainly a need for inservice courses on how to use the new technology and then for a sharing of how best to use them in the classroom.

A significant finding made in the Reys and Reys et al (1990) study was "that there was an inverse relationship between attendance at workshops or presentations and positive feelings of adequacy to use calculators" (p. 23). This highlights the problem of blissful ignorance. As teachers gain more knowledge of calculators they become aware of the need to learn even more about them. Teachers attending workshops and inservice courses tend to want to know more.

Summary

Considering the data above produces a dilemma. Encouraging those teachers who have not attended professional development courses to participate in calculator workshops may increase the numbers of teachers reporting feelings of unease about calculator use. Informed teachers should be in a better position to determine their needs in terms of calculator inservice courses. Encouraging teachers to discuss issues within their schools should also lead to better informed teachers.

Question 16

What support would be most useful in helping you to prepare to use calculators in your teaching?

Teachers responding to this question were asked to rank various options from one to five indicating the most useful type of support, with the number one for and the least useful, and five for the most useful. The various options are listed below.

book on how to develop personal skills with the calculator

book on how to teach with calculators

inservice on the use of the calculator

book of calculator activities for students

video on the use of calculators in the classroom

The spread of results indicated that any support would be welcomed but many teachers referred to the lack of time to keep up with all the demands placed on them. Calculators are seen to be only a small part of the mathematics curriculum, which in turn forms only a small part of the overall teaching load for teachers, and therefore they are not given an very high priority in many teachers' minds. As a result teachers tended to favour books containing classroom-ready activities. There are several publications of this nature on the market so teachers appear well catered for in this area.

6/1/2014

CHAPTER 3

Discussion of Results

Each chapter with its statistics and commentary have highlighted the evidence from the survey and have commented on specific themes arising. The purpose of this section is to consider overall themes and issues which have appeared.

The survey has produced a range of data to highlight a number of questions related to calculator use in primary schools of Western Australia and insights and opinions of teachers. As noted in the commentaries on many questions the data need to be treated carefully. Some of the questions could be interpreted in more than one way, for example Question 6 on the changing of opinions. There is, however, now some data related specifically to calculator use in Western Australia, to primary schools, and to the mid-1990s.

From a pedagogical point of view the main issue was one of availability of calculators. The class set which offered the teacher control over their use was a major focus and requirement of teachers. Teaching style and classroom organisation appear to be based on whole-class lessons with every child doing the same thing at the same time. For many the issue of group work, or of matching work to the needs of the child were not options. Group work would offer the chance to use a smaller number of calculators and to relate their use to the learning needs of particular children.

Textbook materials were a great influence on many teachers. If the text did not – and most do not – require the use of a calculator then there was no need to consider calculator inclusion in the teaching program. There also appeared to be a lack of specific school policies on the use of calculators. The syllabus document which many teachers use as a basis for their planning, has little or no references to calculator use. Other external sources, for example the *Monitoring Standards in Education* and the *Westpac* tests, also appear to ignore the calculator. Many teachers consider these as indicators of appropriate practice.

Many teachers see the calculator in a very restricted way; viewing it only as a machine to do computations. The notion that it might be used as a teaching and learning machine was rarely mentioned. The calculator is considered as an extra – an add-on to the normal day-to-day mathematics teaching. Thus, it is used to check answers, to play with, to do fun things and in some cases for specific calculator lessons. It makes no impact on the

algorithmic, procedural teaching of the four operations, or to learning and testing of basic number facts. This is possibly due to a lack of awareness as to how the calculator can be used to help children learn mathematics or a philosophical stand-point which equates mathematics with precise replication of taught procedures for calculations.

Time is a factor for many teachers. They consider the amount they have to teach is already too much and there is no space for any more. The emphasis is on coverage of content and the speed needed to achieve this coverage. There is little or no realisation that the calculator may in fact replace or ease the learning of some of the material. The philosophical underpinning is on the amount of teaching rather than the need for quality of learning.

There seems to be no planned use of calculators in the programs of many teachers. If calculators are used it is for trivial, incidental or "fun" activities. The impression given is that the calculator is not important and that using it is tantamount to cheating. Mathematics seems often considered to be serious, mystical, hard and boring. Some teachers, however, are incorporating the calculator into their planning and finding worthwhile and interesting ways to use it to help children understand the mathematics they are doing. Teachers who use calculators to help their children learn and understand mathematics appear to have been exposed either to research-based ideas or have undertaken planned activities with their children and have seen the benefits of calculator use.

It appears from the result of the survey that the teaching of standard algorithms and the rote learning of basic number facts is the main emphasis in Western Australian primary schools. Calculators, where they are used, apart from minor exceptions, are for checking and trivia. The rumours and media hype regarding the alleged inability of children to do simple calculations in their head cannot be attributed to the widespread use of calculators in primary schools. The stereotyped shop assistant who reaches for the calculator to solve a simple calculation, cannot be attributed to calculator use in the primary school, but rather to the fact that she or he has no other calculation strategies to use. The emphasis on paper and pencil procedures has left many students with limited skills for calculating.

Development work in schools with the CAN project (Duffin, 1996) and the Victorian calculator project (Groves and Cheeseman, 1995) has shown that calculators provide a rich source of teaching and learning and that children benefit from their integrated and sensible use. Major reviews of research studies (Hembree & Dessart, 1986, 1992; Suydam, 1982) have reported the fact that calculator use has no detrimental effects on the mathematics achievement of children. In fact the reviews point to the opposite conclusion – that is they improve children's ability with calculations and problem solving.

What is Needed?

Results of the survey may be used to highlight what teachers feel they need if they are to incorporate calculators into their mathematics teaching. This may, in fact, only be a minor thing, and often resource based. For example, having a class set of similar working calculators.

The major need, however, one could argue is for a development and change of emphasis in the underlying philosophy of mathematics teaching held by classroom teachers. As long as the stress in teaching mathematics is placed upon the learning and reproducing of standard computational procedures and the instant recall of facts then little or no change in calculator use will occur. A philosophy of mathematics teaching which sees the development of a variety of computational strategies and an emphasis on understanding, problem solving, and working in mathematical ways will lead to the calculator being considered as a valuable learning tool, rather than as a scapegoat for all that is wrong in the world of mathematics.

Support for this philosophical stand-point needs to come from various agencies – from curriculum documents and commercial textbooks; from professional development providers, and from school policy documents. Only then will the calculator be seen as a help to children learning mathematics. Detailed, planned, sensible use of the calculator in integrated programs is needed, rather than trivial or isolated usage.

The 1996 *Statement on the Use of Calculators and Computers for Mathematics in Australian Schools* recommends that:

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; and
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.

While the release of this statement would not have had any bearing on the current survey results, it builds on the previous *National Statement on Calculator Use* released in 1987. Unfortunately the 1987 statement appears to have had little impact on calculator use in primary classrooms. It is hoped that the 1996 statement will have more impact.

Several other aspects of the 1996 document include the statement that "access to a basic calculator is required for ALL students as a most significant means for introducing and developing number sense" as is the view that calculators should be personal tools "available at all times" (p. 4). The results of the current survey indicate that few teachers had embraced the above philosophy.

A National Statement on Mathematics for Australian Schools (1991) states:

All students should leave school knowing how to use a calculator effectively. It should be taken for granted that a calculator is available whenever it can be used, from Years 1-12. A number of skills, both conceptual and technical, underlie the correct use of a calculator and these should be taught explicitly. (p. 109).

This rather short statement implies that calculators should be readily available in all classrooms. This *Statement* was first released in 1990. Seven years later it is doubtful whether it can be taken for granted that calculators are readily available to students in primary school. One purpose of carrying out a survey of this nature at this time was to help establish a baseline to determine the current usage of calculators in West Australian primary schools and teacher views on their use.

The National Statement on Mathematics for Australian Schools states the following for Bands A and B – those pertinent to primary school:

A9 use a basic four-function calculator efficiently

Possible activities:

- Enter and read measures and amounts of money and operate on them.
- Add and subtract any numbers arising in practical situations.
- Multiply and divide by whole numbers consistent with extent of concept development.
- Use constant multiplication and division techniques. (p. 115).

B9 use a four-function calculator with memory facility efficiently

Possible activities:

- Use a calculator to perform the four basic operations on any numbers arising in practical situations.
- Practise the skills needed to enter fractions, and use the memory and constant addition and subtraction functions.
- Recognise and adapt to different orders of operation.
- Interpret remainders in the division process and decide whether to round up or down.
- Use simple order of magnitude arguments to check for calculator error.
- Interpret calculator answers which refer to money and measures (e.g. interpret 0.5 as 50 cents). (p. 120).

Teachers wishing to make use of calculators in their classrooms certainly have solid backing. After considering all the foregoing, however, a conscious decision must be made by teachers to start using calculators. It is one thing to say calculators should be used and another to actually use them.

Implications for Future Research

Discussion in the body of the report has drawn attention to the limitations of some of the wording in the questions and how variation in interpretation of some questions led to different data being provided.

Case studies of teachers using calculators with children in an integrated and planned way in the classroom would provide a rich source of data on their application.

An evaluation of professional development and support models of calculator use in schools would generate useful information on effective ways to help teachers take the first steps in implementing calculator use in their mathematics programs.

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APPENDIX

Calculator Survey

SCHOOL:

ADDRESS:

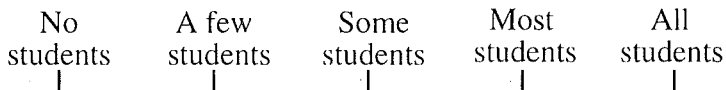
POSTCODE

YEAR LEVEL(S) TAUGHT (in 1995): _____

NUMBER OF YEARS TEACHING: _____

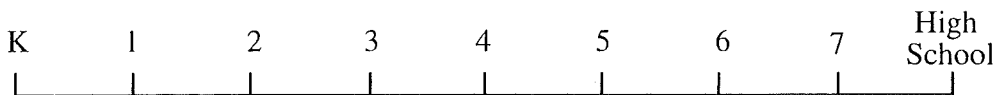
QUESTIONS:

1. Should all students use calculators in primary school?



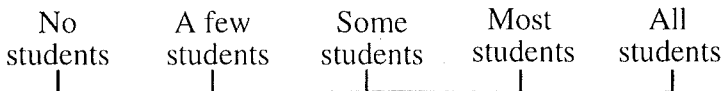
Clarifying comments _____

2. At what year level should students start using calculators?



Clarifying comments _____

3. Should all students use COMPUTERS in primary school.



Clarifying comments _____

4. Students should completely master the basic number facts (e.g. tables) before they use calculators.

S/Agree Agree Maybe Disagree S/Disagree

Clarifying comments _____

5. Has the issue of calculators been discussed with parents?

Informally YES NO

Parents' nights YES NO

Newsletter YES NO

Other, please specify? _____

What issues were raised by parents? _____

6. How much has your opinion about calculator use in the primary classroom changed over the last 5 years?

Not at all A little A moderate amount Considerably A great deal

What caused your opinion to change and in what ways? (e.g. inservice course, activity book etc.).

7. How frequently do students use calculators in your classroom?

Never Rarely Sometimes Often Free Access

8. In what ways are calculators used in your classroom?

Tick any relevant sections

- checking work
- for complex calculations
- as a teaching/learning aid
- in specific lessons about calculator use
- calculator games
- in problem solving contexts
- in other subject areas

Do your students use calculators for any other purpose? Please elaborate.

9. Who decides when students in your class use calculators?

Teacher Student

10. Do you allow children to use calculators in assessment situations other than when testing for basic facts or mental computation?

yes no depends

Please elaborate:

11. What hinders calculator use in your classroom? Please list.

12. How are calculator purchases handled in the school?

- Class sets owned by the school
- On booklist for parents to buy
- Individual students purchase calculators

13. Do you teach students in your class how to use a calculator? (e.g. how to use the memory facility).

YES NO

14. What opportunities have you had for becoming proficient at using calculators as a teaching aid?

- initial teacher training
- inservice
- informal discussion with colleagues
- none
- others. Please specify.

15. Are you well prepared, professionally, to use calculators in your teaching?

Very poorly prepared	Poorly prepared	Quite well prepared	Well prepared	Very well prepared

16. What support would be most useful in helping you to prepare to use calculators in your teaching? (Please rank these from 1 to 5 where 1 indicates the most useful and 5 the least useful. Do not use equal ranks.)

- book on how to develop personal skills with the calculator
- book on how to teach with calculators
- inservice on the use of the calculator

- book of calculator activities for students
- video on the use of calculators in the classroom

Please detail here any specific help that you feel you need to integrate the calculator into your teaching

Thank you for completing this survey. Please feel free to add any further comments and attach them to this survey.

