Should all children use calculators? A Western Australian Survey.

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To what extent are calculators used in primary school classrooms? Data sources are scarce and somewhat dated for judgements to be made. This paper outlines some of the findings of a recent survey undertaken in Western Australian primary schools. Data related to the issue of young children using calculators will be discussed. Initial findings suggest that integrated calculator use is rare with most use being extra to mathematics learning and trivial in nature

Introduction

There are very few issues in mathematics teaching over the past twenty five years which have caused as much debate among teachers, parents and the community as 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 sums 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 apparent decline in numeracy standards? Debate on this is left to another time.

One is left to wonder about 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. A search of the literature covering all current listed documents revealed the following 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, 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.

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)

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 primarily viewed the calculator as a tool for checking answers produced by written computation. Some teachers even expressed the belief that they had to spend more time teaching 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.

Research Questions

The survey was designed to provide data to answer the following questions.

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 as well as the apparent mismatch between attitudes and actions which is highlighted by Groves and Stacey (1994). This is a problem with most surveys, particularly those that canvas attitudes and opinions. The questionnaire was based on the earlier work of Reys & Reys et al (1990) and used many of the questions which were used in their interviews.

Questionnaires, with reply paid envelopes, were sent to 787 primary schools across Western Australia. These included all state primary 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 eg. 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; however, schools were requested to supply their post code so later clustering by region could be attempted.

It is not possible to provide a 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 unrest in state schools at the time.

Data from the surveys were transcribed to a computer data base ready for analysis and comparison with similar data from previous surveys. Responses were tabulated and where appropriate a simple percentage calculated. Comments to the particular question were clustered under thematic headings.

Findings

For the purpose of this paper only aspects of data related to a single survey question will be discussed. A more complete account may be found in *Calculator Use in Western Australian Primary Schools: A survey* (Sparrow & Swan, 1997).

The first question on the survey and the one for discussion in this paper is shown in Table 1.

Table 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%	0.3%	0.6%	8.25%	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 with its high level of positive response would suggest expressions of support for calculator use being consistent across the range of schools - country, large, small, metropolitan, and independent. One must, however, temper this statement with the realisation that the responses may have come from a minority of teachers within the total school staff. Reys & Reys et al (1990) from their interview data gained a 94% 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 comments from teachers responding "all students" is given below;

> Only in senior classes and only occasionally.

> 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 above comment. The teacher refers to more able children and also outlines various uses for the calculator. There is a reluctance on the part of teachers to allow students to determine when and how a calculator should be used.

Several themes became evident when reading the more detailed evidence from the responses given by participants. These are summarised below along with responses that typify the nature of the theme.

Delayed Starting Points: Many teachers referred to various stages below which children should not use calculators. These 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.

Overeliance: 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.

Understanding Will Suffer: In particular teachers were worried that 'understanding' would suffer as a result of using calculators. Basic number facts and particularly the tables were mentioned as prerequisites to using a calculator at any great length:

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

> 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.

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 of these words 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.

> 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 separate from what was going on in mathematics lessons at the time:

> 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.

> 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:

> 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 facts or table facts prior to using calculators.

Conclusions

From the statistical data it seems that most teachers are in favour of all students in the primary school using a calculator. When one looks beyond the data to the comments section a different picture emerges. Use is much more guarded, delayed or under the guidance of the teacher, highlighting the mismatch of actions and beliefs noted earlier. Where they are used it is often for checking calculations rather than for fundamental approaches to learning mathematics.

Many teachers see the calculator in a very restricted way, viewing it only as a machine to do sums. 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 rules and rote learning and testing of tables. 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.

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 and far too easy. Mathematics should 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 completing.

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 survey that the teaching of standard algorithms and the rote learning of tables 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.

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.

Data from the first of sixteen questions in the survey offers insights into the research questions, particularly numbers 1 to 3. Question 4 relating to the impediments to calculator use is more difficult to answer from the evidence presented here. One impediment that does appear strongly is the attitude and belief of the teacher. Until this generally reserved and negative attitude is changed there will be no concerted, integrated use of calculators in primary classrooms in Western Australia.

Returning to the original question in the title of this paper -Should all children use calculators?- the answer appears from the evidence presented in response to question one of our survey to be a resounding yes BUT...

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