The Role of Professional Development in Using Calculators in a Sample of Queensland Primary Schools

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A survey ascertained teachers' knowledge about and use of hand-held calculators in primary mathematics classes. This paper focuses on 341 teachers' experiences of Professional Development(PD) on the use of calculators in teaching mathematics. Only nine had experienced such a workshop in the past two years while 10% had during their career. Approximately 40% regarded themselves as poorly prepared for calculator use in their teaching. A face-to-face hands-on PD session conducted by an 'expert' was the teachers' choice to develop their calculator pedagogy.

This study was motivated by a concern of the authors with the attitudes and ideas held by their pre-service teacher education students who were preparing to become early childhood and primary teachers. Many of the students were quite negative towards the incorporation of calculators into the mathematics curriculum and voiced the standard reasons about cheating and making students lazy thinkers (Biddulph, 1996). Furthermore these students had very little knowledge of how standard four-function calculators could be used for other than simple calculations. The authors wondered whether these negative attitudes and concerns were widely held amongst practicing teachers into whose classrooms many of these students go for professional experience rounds, and whether these supervising teachers had limited knowledge and experience with using calculators in their mathematics lessons. Hence it was decided to survey teachers in a sample of state primary schools in Queensland to seek answers to these questions.

Background to the Study

Sparrow and Swan (1997, p. 1) report that "very few surveys of calculator use in primary schools have been attempted" and nothing much has changed since their 1997 report on calculator use in Western Australian primary schools. In their survey it was reported that "almost three-quarters" of those surveyed agreed with the recommendations of *A National Statement on the use of Calculators for Mathematics in Australian Schools* (Australian Association of Mathematics Teachers, 1989, p. 7). Reys, Reys, and Wyatt (1993) found similarly that between 1979 and 1990 the use of calculators in one state in the USA remained largely unchanged. A study of high school principals and mathematics teachers in New York State (Ostapczuk, 1995) found that less than 50% of mathematics teachers routinely used calculators in classroom instruction and that more than 70% had no in-service available to them on calculator use. The great majority of the teachers were aware of the position statement of the National Council of Teachers of Mathematics on the use of calculators in schools.

The main documents that influence teachers in their lesson preparation in Queensland are the *Year Level Sourcebooks* (Department of Education, Queensland, 1989) and the *Years 1-7 Syllabus Support Document* (Anderson, 1995). These documents both support the views expressed in the *National Statement* that "all students use calculators at all year

B. Barton, K. C. Irwin, M. Pfannkuch, & M. O. J. Thomas (Eds.) *Mathematics Education in the South Pacific* (Proceedings of the 25th annual conference of the Mathematics Education Research Group of Australasia, Auckland, pp. 600-607). Sydney: MERGA. ©2002 MERGA Inc.

levels". The *Year Level Sourcebooks* go on to explain the role of calculators in problem solving and the development of positive attitudes to mathematics. It was regarded as opportune to conduct the survey to determine the current situation in Queensland state schools.

Methodology

Subjects

A stratified random sample of 159 state primary schools was taken from the 11 Education Districts in Queensland north of the Tropic of Capricorn. Within each district the schools were grouped into bands to give a range of school sizes and then the sample chosen randomly from each band. Details of the distribution across bands are shown in Table 1.

Table 1
Distribution of Schools Across Districts and Band Size

	Band[a]						
Education District	5	6	7	8	9	10	11
Emerald	5	2	3	3			
Longreach	7	1	2	3			
Mackay Hinterland	6	2	2	3	1		
Mackay North	3	3	1	3	2		
Mount Isa	2	2	1	2	2		
Townsville Burdekin	4	2	3	3	3	1	
Townsville North	6	3	3	1	2		
Tablelands	7	4	3	2	1		
Cairns & Cape York	7	5	3	3	6	1	1
Thursday Island	2	4	1	1			
Rockhampton	8	3	3	2	2	1	
Total	57	31	25	26	19	3	1

[a] as a general rule, increasing band size indicates larger school size but there can be other factors involved.

It is worth noting here that most of these districts contain small to medium sized schools many of which are in rural areas and some in quite isolated areas. Furthermore, only four of the districts are centred on the major Queensland cities of Townsville, Cairns and Rockhampton. There are very few band 10 and 11 schools across these Districts and only one band 11 school and three band 10 schools were chosen in the sample.

Instruments

A survey questionnaire consisting of 23 questions was developed and field tested with a group of local teachers. This survey was based on instruments used in previous studies in New South Wales (Howard, 1992) and Western Australia (Spanner & Swan, 1997) and adapted to suit the Queensland context. School administrators were asked to distribute the survey to all teachers within their schools and each teacher was given a return envelope to send the questionnaire individually to the researchers. Information was sought on the following areas: (a) grade currently taught; (b) years of teaching experience; (c) calculator professional development opportunities; (d) school policy on calculator usage; (e) when calculators should be introduced into the mathematics curriculum; (f) planning for calculator use in mathematics classes; and (g) areas in the mathematics program where calculators are included.

In this paper the data related to the teacher characteristics and aspects and issues associated with professional development are reported. (see Appendix for the questions related to this paper)

Data Analysis

Data from the surveys were entered into a database and analysed with the assistance of the Statistical Package for the Social Sciences (SPSS) Release 9.0.1 (1999).

Results

Approximately 1 500 surveys were distributed to the 159 schools in order to allow every teacher in the smaller schools and around 75% of the teachers in most of the larger schools to respond if they so desired. Of the 1 500 distributed a total of 341 surveys were returned by teachers who chose to respond. This represents a return rate of 22.7% which is not high and that may have been caused by the timing of the survey that occurred in the latter half of term four of the school year.

Table 2
Return Rate for Different School Districts

Education District	Number of primary schools Bands 5 - 11	Number of teachers responding to the survey
Emerald	13	13
Longreach	11	16
Mackay Hinterland	14	39
Mackay North	13	30
Mount Isa	9	16
Townsville Burdekin	14	41
Townsville North	15	40
Tablelands	17	25
Cairns & Cape York	26	64
Thursday Island	8	9
Rockhampton	19	48
Total	159	341

Table 2 indicates the number of schools in each district and the number of teachers in each district who responded to the survey. It reveals a good spread of teachers across the 11 districts that vary considerably in area and population. The 341 teachers who returned surveys were from 93 different schools and this represents a return rate of 58.5% of schools.

Grade Currently Taught

Table 3 is the distribution of the grades currently taught by the teachers answering the questionnaire. The category of composite was included as teachers were asked to indicate specifically if they taught a composite grade.

Table 3
Distribution of Teachers by Grade Level

Grade	Frequency	Frequency %
Preschool	6	1.8
1	35	10.3
2	22	6.5
3	35	10.3
4	25	7.3
5	26	7.6
6	23	6.7
7	30	8.8
Composite	130	38.1
Non-teaching staff	2	.6
Special Education	2	.6
Learning Support	4	1.2
Music	1	.3
Total	341	100.1

The distribution across the seven grades of the primary school was fairly consistent. What is somewhat surprising is the large number of teachers with composite grades – over one third (38.1%) of the teachers surveyed. It is also interesting to see six preschool teachers completing the survey as well as non-teaching and learning support and special education staff.

Years of Teaching Experience

Respondents were asked to indicate the length of their teaching experience. The distribution showing the numbers in the age brackets provided on the questionnaire is shown in Table 4.

Table 4
Distribution of Teachers by Length of Teaching Experience

Number of Years	Frequency	Frequency %
0 – 5	67	19.6
6 – 10	64	18.8
11 – 15	70	20.5
> 15	138	40.5
Total	339	99.4

The high percentage of people who have been teaching for more than 15 years represents many of the teachers who would have been in the education system when the current Queensland Mathematics syllabus was introduced in 1987. This syllabus was the first to give specific suggestions on the inclusion of calculators for topics such as long division and multiplication by two digit numbers.

In-service Sessions on Calculator Use

Of particular interest to the authors was the recency and number of any in-service sessions dealing with calculator use that the teachers had undertaken. They were asked whether they had participated in any such sessions in the last two years and only nine people (2.6%) indicated that they had. The number of sessions attended ranged from one to four with the median being two. Of the remainder of teachers who indicated that they had not been to an in-service workshop on calculators, the principal reasons given fell into the following main categories shown in Table 5.

Table 5
Main Reasons for Non-attendance at Calculator In-service Workshops

Reason	Frequency
No sessions were offered or no opportunities arose to attend such a session	229
Calculator in-service was not seen as a priority by the teacher or the school	17
No particular reason for a 'NO' answer	19
No response at all for a 'NO' answer	38
Isolation and distance were a major factor	9
Teachers did not have a need to attend a calculator in-service workshop	6
Teaching less than two years	5

Clearly the lack of availability of workshops on calculators in teaching was the principal reason that about two thirds of these teachers did not or could not participate in a calculator in-service. While only nine mentioned 'distance' as a reason, it is likely to be a major contributing factor to the lack of offering of in-service workshops by some districts that are large in area and lightly populated.

Opportunities for Becoming Proficient at Using Calculators as a Teaching Aid

Teachers were given a range of options to respond to when asked about opportunities that had been available to become proficient at using calculators as a teaching aid. As indicated in the distribution of responses shown in Table 6, approximately 69% of the teachers had some opportunities to develop proficiency in using a calculator as a teaching aid with about half of these referring to their initial teacher education as the time when this occurred. Clearly for people who have been teaching more than 10 years (~62%) this is a long time ago. Only 10% of the respondents indicated that they had been involved in professional development workshop that were specifically devoted to calculator use in teaching mathematics.

Table 6
Frequency of Opportunities at Becoming Proficient at Using Calculators in Teaching

Event/opportunity	Frequency	Frequency %
Initial Teacher Training	120	35.2
Professional Development Workshop	35	10.3
Informal Discussion with Colleagues	65	19.1
None	104	30.5
Other	14	4.1
Total	338	99.1

As a follow up to this question the teachers were asked to indicate how well prepared professionally they felt they were to use calculators in their teaching. Their judgements are shown in Table 7.

Table 7
Judgment of Professional Preparation to Use Calculators in Teaching

Level	Frequency	Frequency %
Very well prepared	10	2.9
Quite well prepared	128	37.5
Well prepared	51	15.0
Poorly prepared	115	33.7
Very poorly prepared	24	7.0
No response	10	2.9
Total	338	99.0

Fifty-five percent of these teachers judged that they were well to very well prepared to use calculators in their teaching. While this is an encouraging figure it still a major concern that about 40% of these teachers view themselves as poorly prepared to use calculators in their teaching.

Table 8
Preferred Method of Preparing Teachers to Use Calculators in the Classroom

Method	A book on how to develop personal skills with the calculator	A book on how to teach with calculators	PD on the use of the calculator conducted by an expert	A book on calculator activities for students	A video on the use of calculators in the classroom
Usefulness	29	106	250	159	95
Ranking [a]	5	3	1	2	4

[a] 1 = most useful, 5 = least useful.

When asked to rank five possible methods for assisting teachers to prepare for the use of calculators in their teaching, there was a diversity of rankings. Table 8 shows that the teachers strongly favoured Professional Development as the way to help them prepare to teach with calculators. The least useful way from the teachers' perspectives was the availability of a book that would develop their personal skills with a calculator.

A further examination of Table 8 reveals the order of decreasing usefulness as: PD on the use of a calculator, a book on calculator activities for students, a book on how to teach with calculators, a video on the use of calculators in the classroom, and a book on how to develop personal skills with the calculator.

Discussion

Findings in this survey have some clear implications for the school system in Queensland both on a local level and a district level. When asked for reasons for not participating in Professional Development workshops on calculators a number of the teachers indicated that distance was a problem. Furthermore, they indicated that their isolation made it difficult if not impossible for Districts to set up a workshop that was accessible to them. The lack of availability of substitute teachers required to release these regular teachers for the day is an added complication if such a workshop is set up during school time. There is a need to investigate ways of overcoming the problems of distance when it comes to delivering professional development.

The teachers made it quite clear that they preferred face to face interaction with an 'expert' for Professional Development. Given that this may not be feasible as suggested above, and given that approximately 20% indicated that their proficiency was helped by informal discussions with their colleagues, it would appear that modern technology could play a valuable role in overcoming the problems of distance in delivery of professional development. The use of video-conferencing that approximates face-to-face interaction has potential is presently used extensively by rural doctors for in-service activities and has potential. Trialling and evaluation of the internet, DVD and CD ROM in the delivery of such workshops is of high priority and not just for mathematics education.

University mathematics educators have a challenge with the large number of composite classes identified in this study. It is imperative that time is taken in developing pre-service teachers' skills in planning for and implementing mathematics programs in multi-age classrooms.

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Appendix

Ques. 1. What Grade(s) are you currently teaching?
If you teach a composite class please indicate what grades.

Ques. 2. How long have you been teaching? (please circle)

- 0 - 5 years
- 6 - 10 years
- 11 - 15 years
- more than 15 years

Ques. 3. Have you participated in an in-service session on calculator usage in mathematics in the last two years? (Circle your response)

YES (go to Ques. 4) NO (go to Ques. 5)

Ques. 4. If YES, how many sessions?

Ques. 5. If NO, any reason?

Ques. 6. What opportunities have you had for becoming proficient at using calculators as a teaching aid? (Tick all those that apply)

- Initial teacher training
- In-service/ professional development workshop
- Informal discussion with colleagues
- None
- Other. Please specify.

Ques. 7. How well are you prepared professionally to use calculators in your teaching? (Circle one)

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

Ques. 8. Listed below are five possible methods to prepare teachers for the use of calculators in their teaching. (Please rank these from 1 to 5 where 1 is the most useful and 5 is the least useful. Do not use equal ranks)

- A book on how to develop personal skills with the calculator
- A book on how to teach with calculators
- In-service/professional development on the use of the calculator provided by an expert
- A book on calculator activities for students
- A video on the use of calculators in the classroom