SURVEY OF THE USE OF HAND-HELD CALCULATORS IN MATHEMATICS CLASSES IN THE SECONDARY SCHOOLS OF BRITISH COLUMBIA

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INTRODUCTION

A questionnaire concerning different aspects of the use of hand-held calculators was mailed with the 1975/76 school year's last issue of *Vector*, the journal of the British Columbia Association of Mathematics Teachers (BCAMT).

The survey was initiated due to the rapidly increasing interest in the use of hand-held calculators. Since the price of hand-held calculators fell below $20 per unit, many schools have been buying laboratory and/or class sets of hand-held calculators. The use of hand-held calculators by public school students has spread so fast that the National Council of Teachers of Mathematics (NCTM), the world's largest association of mathematics teachers, has created a special subcommittee to look into the matter. Also the NCTM has dedicated the November, 1976 issue of *The Arithmetic Teacher* to articles concerning the use of hand-held calculators. Before the special issue on calculators, the NCTM had already published 15 articles in the last five years concerning hand-held calculators. The NCTM recently published a brochure, *Minicalculator Information Resources*, which lists over 50 publications and articles that have been produced since 1972 concerning hand-held calculators.

Given such increased interest concerning hand-held calculators it was felt that some baseline data were needed for British Columbia.

METHOD

The questionnaire was created and piloted. Based on the results of the pilot, the questionnaire was revised and shortened. The final form of the questionnaire was then turned over to the BCAMT. The questionnaire was included in the next mailing of *Vector*. The returned questionnaires (N = 75 for secondary mathematics teachers) were turned over to the keypunching service at UBC.

The data cards were used in a computer program to gain a frequency count for each item on the questionnaire. Since this is an exploratory study to gather initial data, no tests of significant differences were used to analyze the data. A weighted score was computed for each item by assigning a value of 2 to Strongly Agree, 1 to Agree, 0 to Undecided, -1 to Disagree, and -2 to Strongly Disagree. The values were then multiplied by the frequency in each choice category, and the five products were added; to obtain the weighted score one then divided by 75, the number of respondents.

RESULTS

The survey is not an attempt to gather information from every teacher in the province. The survey report will not be judging the data, only presenting and interpreting the data. The survey gathered data from about one out of every five members of the BCAMT. The sample is biased in the sense that the characteristics of teachers that belong to the BCAMT may differ from those of mathematics teachers who do not belong to the BCAMT, and teachers who returned the questionnaire may have different characteristics than the teachers who did not return the questionnaire.

The teachers who did return the questionnaire took the task very seriously. Of the 3,264 possible responses only 33 were left blank. Of the 62 percent of the teachers who marked that they have used hand-held calculators in their classes, 100 percent took the time to write comments concerning the ways they use the hand-held calculators in their classes.

Even though the questionnaire had been pilot-tested, the data from one item (item 16) was lost due to a typographical error.

Since the survey instrument was distributed by the BCAMT, teachers from Grade I through university returned the questionnaire. The data from all 136 questionnaires are presented in this section, but for the purposes of this report only the data for the secondary mathematics teachers are analyzed.

AVAILABILITY OF HAND-HELD CALCULATORS

Items 1, 2, 9, 24 and 25 were concerned with the availability of hand-held calculators. The data for these items are presented in Tables 1 to 5. The title for each table presenting raw data is the statement of the item as it appeared on the questionnaire.

Table 1

Item 1: More Than Half of the Students I Teach Have a Calculator at Home

	SA[1]	A	U	D	SD
Primary	0	1	0	2	8
Intermediate	1	1	5	8	5
Secondary	3	13	7	40	9
College/University	2	3	0	2	0
Total[2],*	7	21	19	56	26

[1]SA - Strongly Agree, A - Agree, U - Undecided, D - Disagree, SD - Strongly Disagree

[2]The numbers appearing as the total may not be the sum of the four categories since 19 subjects did not mark their teaching level.

*5% of the subjects left this item blank.

Table 2

Item 2: I Personally Have a Calculator and Use It Often

	SA	A	U	D	SD
Primary	2	3	0	3	3
Intermediate	1	10	1	4	5
Secondary	27	32	2	9	5
College/University	4	3	0	0	0
Total*	40	57	4	18	0

*3% of the subjects left this item blank.

Table 3

Item 9: The School Should Buy the Calculators for Each Class, Just as They Do Books

	SA	A	U	D	SD
Primary	0	2	2	6	1
Intermediate	4	5	2	4	9
Secondary	8	18	13	21	13
College/University	2	2	0	0	3
Total*	16	31	19	36	32

*1% of the subjects left this item blank.

Table 4

Item 24: The Sooner We Get the Calculator into the Classroom the Better

	SA	A	U	D	SD
Primary	0	3	6	1	1
Intermediate	4	3	10	4	1
Secondary	15	26	17	12	4
College/University	3	3	1	0	0
Total*	27	40	36	20	9

*3% of the subjects left this item blank.

Table 5

Item 25: I Have Used Calculators in My Classes

	Yes	No
Primary	3	8
Intermediate	7	17
Secondary	57	17
College/University	7	0
Total*	84	51

*1% of the subjects left this item blank.

As mentioned before, in presenting an interpretation of data in an exploratory study no tests of significance will be given. A weighted score will be given to indicate trends in the data. The formula for the weighted scores (see Methods section) does not allow the group marking "Undecided" or leaving the item blank to have any effect in the numerator, but does allow them to have an effect in the denominator. Those two groups will have a "dampening" effect upon the results.

Table 6 contains the weighted scores for the secondary mathematics teachers for the data presented in Tables 1 to 4. The weighted scores reflect the trends in the data concerning the availability of hand-held calculators.

Table 6

Weighted Scores for Items 1, 2, 9, 24

Number of Table in Which the Data Appear	Weighted Score
1	-0.52
2	0.77
3	-0.17
4	0.48

While the teachers tend to own a calculator, they do not feel their students have a calculator at home. The data also show that the secondary mathematics teachers (responding to the survey) feel that hand-held calculators should be placed in the classrooms as soon as possible, but the teachers are undecided as to whether the school should buy the calculators for the classes (though the tendency is that the school should not buy the class calculators).

WHO SHOULD USE HAND-HELD CALCULATORS?

Items 3 to 7 dealt with the type of student who should be allowed to use hand-held calculators in the classroom. The data for items 3 to 7 are presented in Tables 7 to 11.

Table 7

Item 3: Calculators Have No Place in the Elementary Classroom (K - 7)

	SA	A	U	D	SD
Primary	0	2	2	2	5
Intermediate	4	1	5	5	9
Secondary	14	13	15	21	12
College/University	0	0	0	3	4
Total	22	18	24	36	36

Table 8

Item 4: Calculators Have No Place in the Junior Secondary Classroom (8 - 10)

	SA	A	U	D	SD
Primary	0	0	1	5	5
Intermediate	0	1	3	10	10
Secondary	3	6	3	38	25
College/University	0	0	0	2	5
Total	4	11	7	61	53

Table 9

Item 5: Calculators Have No Place in the Senior Secondary School (11 - 12)

	SA	A	U	D	SD
Primary	0	0	0	3	8
Intermediate	0	0	1	9	14
Secondary	0	2	1	23	49
College/University	0	0	0	2	5
Total	0	3	3	42	88

Table 10

Item 6: Calculators Should Only Be Used by "Good" Students

	SA	A	U	D	SD
Primary	0	1	0	3	7
Intermediate	0	2	3	7	12
Secondary	0	1	2	40	32
College/Universtiy	0	0	0	3	4
Total	1	4	5	59	67

Table 11

Item 7: Calculators Should Be Used by Students Who Cannot Remember Their Basic Facts or Skills

	SA	A	U	D	SD
Primary	2	2	1	1	4
Intermediate	3	7	5	3	5
Secondary	1	14	12	23	25
College/University	1	3	0	2	1
Total*	9	31	20	32	42

*1% of the subjects left this item blank.

The weighted scores for the data presented in Tables 7 to 11 are in Table 12. This group of data is concerned with what grade level and type of student should use the hand-held calculator in mathematics classes.

Table 12
Weighted Scores for Items 3 - 7

Number of Table in Which the Data Appear	Weighted Score
7	-0.05
8	-1.01
9	-1.59
10	-1.37
11	-0.76

The trend of the data is obviously that calculators should be used in the secondary mathematics classroom, but the secondary mathematics teachers were undecided about the use of hand-held calculators in the elementary classroom.

The subjects felt very strongly that students other than the "good" students should use hand-held calculators. The subjects also felt that students who cannot remember their basic facts or skills should not use calculators. Later it will be shown that this result does not mean that the "slower" students should not use hand-held calculators to drill on basic facts or skills.

HOW SHOULD HAND-HELD CALCULATORS BE USED?

Items 10, 11, 13, 14, 15, 22 and 23 were concerned with "how" the hand-held calculators should be used. The data for the items in this section are presented in Tables 13 to 19.

Table 13

Item 10: Special Courses Should Be Designed That Would Use Calculators for Most of the Computation

	SA	A	U	D	SD
Primary	0	2	6	3	0
Intermediate	2	10	4	4	3
Secondary	7	21	17	22	8
College/University	0	3	0	2	2
Total*	12	42	30	34	17

*1% of the subjects left this item blank.

Table 14

Item 11: Most Parents I Know are Against the Use of Calculators in the Schools

	SA	A	U	D	SD
Primary	0	0	9	2	0
Intermediate	0	1	16	5	2
Secondary	0	10	44	18	2
College/University	0	0	1	5	1
Total*	0	13	83	34	5

*1% of the subjects left this item blank.

Table 15

Item 13: Students Should Be Allowed to Use the Calculator on Tests Designed to Evaluate Problem-Solving Ability

	SA	A	U	D	SD
Primary	3	6	1	1	0
Intermediate	4	13	4	1	1
Secondary	13	43	12	3	3
College/University	2	5	0	0	0
Total*	27	74	19	7	6

*2% of the subjects left this item blank.

Table 16

Item 14: Calculators Should Be Used to Extend a Student's Problem-Solving Ability

	SA	A	U	D	SD
Primary	4	6	0	1	0
Intermediate	6	17	1	0	0
Secondary	21	46	5	3	0
College/University	4	3	0	0	0
Total	44	78	9	5	0

Table 17

Item 15: Students Should Be Allowed to Use Calculators Only to Check Their Work

	SA	A	U	D	SD
Primary	0	2	2	7	0
Intermediate	1	1	6	14	0
Secondary	1	4	8	53	9
College/University	0	0	0	5	2
Total	2	7	17	93	17

Table 18

Item 22: I Am Convinced That "How To" Use the Calculator Should Be Taught to Every Student Before Leaving Secondary School

	SA	A	U	D	SD
Primary	2	4	3	1	0
Intermediate	8	9	5	2	0
Secondary	19	35	13	8	0
College/University	3	4	0	0	0
Total*	41	55	22	17	0

*1% of the subjects left this item blank.

Table 19

Item 23: The Calculator Will Be a Big Help to Other Classes Besides Mathematics

	SA	A	U	D	SD
Primary	0	9	2	0	0
Intermediate	6	10	5	3	0
Secondary	22	45	6	2	0
College/University	3	4	0	0	0
Total	39	76	13	8	0

The weighted scores for the data presented in Tables 13 to 19 appear in Table 20. This group of data is concerned with ways the hand-held calculator should be used in secondary school mathematics classrooms.

Table 20

Weighted Scores for Items 10, 11, 13, 14, 15, 22, 23

Number of Table in Which the Data Appear	Weighted Score
13	-0.04
14	-0.16
15	0.80
16	1.13
17	-0.87
18	0.87
19	1.16

The subjects felt rather strongly that the hand-held calculators would be beneficial in non-mathematics classes and that hand-held calculators should be used to extend a student's problem-solving ability. The students should be allowed to use a hand-held calculator on tests, if the test is designed to evaluate problem-solving ability. The subjects also felt that before leaving secondary school every student should have been taught how to use a hand-held calculator and the use of hand-held calculators should go beyond simply checking one's work.

The subjects were undecided as to whether special courses should be designed which would use hand-held calculators for most of the computation. The subjects were also split as to whether parents are for or against the use of hand-held calculators in the schools.

THE HYPOTHESIZED EFFECT OF USING HAND-HELD CALCULATORS

Items 8, 17, 20 and 23 are concerned with the possible effects of using hand-held calculators. The data for item 23 are presented in Table 19. The data for items 8, 17, and 20 are presented in Tables 21 to 23.

Table 21

Item 8: Calculators Will Keep Students from Learning Their Skills If Used Before Junior Secondary School

	SA	A	U	D	SD
Primary	0	3	2	4	2
Intermediate	2	2	2	8	9
Secondary	7	17	15	26	8
College/University	0	1	1	3	2
Total*	12	28	25	43	25

*2% of the subjects left this item blank.

Table 22

Item 17: Calculators Could Lead to a Complete Breakdown in Students Learning Basic Skills

	SA	A	U	D	SD
Primary	0	2	1	7	1
Intermediate	1	3	4	9	7
Secondary	3	15	13	32	11
College/University	1	2	1	2	1
Total*	9	24	20	58	24

*1% of the subjects left this item blank.

Table 23

Item 20: Calculators Will Inspire Students to Continue in Mathematics Since They Take Away the Drudgery of Computation

	SA	A	U	D	SD
Primary	1	3	4	2	0
Intermediate	3	9	7	3	1
Secondary	11	31	17	15	1
College/University	2	4	1	0	0
Total*	18	56	34	23	3

*1% of the subjects left this item blank.

The weighted scores for the data presented in Tables 21 to 23 and Table 19 are presented in Table 24. This group of data is concerned with the hypothesized effect of the use of hand-held calculators.

Table 24

Weighted Scores for Items 8, 17, 20, 23

Number of Table in Which the Data Appear	Weighted Score
21	-0.15
22	-0.44
23	0.48
19	1.16

As mentioned before, the respondents felt very strongly that the hand-held calculators would benefit other classes besides mathematics classes.

The data in Tables 7 and 21 may be closely related. Just as the subjects were undecided (weighted score of -0.05) as to whether hand-held calculators should be used in the elementary grades, they were undecided as to whether using hand-held calculators in the elementary grades would keep the students from learning their skills. The data, however, do show that the subjects tend not to agree that calculators could lead to a complete breakdown in students learning basic skills.

The respondents also tended to feel that using hand-held calculators would inspire students to continue in mathematics since the hand-held calculators take away the drudgery of computation.

PREPARATION FOR USING HAND-HELD CALCULATORS

Items 9, 12, 18 and 19 are concerned with the preparations that are needed to make use of hand-held calculators in secondary school mathematics classrooms. As with item 23 in the last section, item 9 in this section is being repeated. The data for item 9 appear in Table 3. The data for items 12, 18, and 19 appear in Tables 25 to 27 below.

Table 25

Item 12: Special Materials Should Be Written to Be Used with the Hand-Held Calculators

	SA	A	U	D	SD
Primary	2	2	7	0	0
Intermediate	7	11	2	4	0
Secondary	14	38	5	15	3
College/University	1	3	0	1	1
Total*	29	62	16	23	5

*1% of the subjects left this item blank.

Table 26

Item 18: Textbooks Should Have Special Sections Devoted to the Use of Hand-Held Calculators

	SA	A	U	D	SD
Primary	1	3	5	2	0
Intermediate	6	10	3	5	0
Secondary	7	39	15	12	2
College/University	2	2	2	0	1
Total	20	65	27	20	4

Table 27

Item 19: Special Inservice Courses Should Be Given to Teachers Who Wish to Use Hand-Held Calculators in the Classroom

	SA	A	U	D	SD
Primary	2	7	2	0	0
Intermediate	7	12	2	2	1
Secondary	14	42	8	9	2
College/University	2	4	1	0	0
Total	30	75	16	12	3

The weighted scores for the data presented in Tables 25 to 27 are in Table 28. Also in Table 28 is the weighted score for item 9 (see Table 3). This group of data is concerned with preparations that could be made for the use of hand-held calculators in secondary school mathematics classes.

Table 28

Weighted Scores for Items 9, 12, 18, 19

Number of Table in Which the Data Appear	Weighted Score
3	-0.17
25	0.60
26	0.49
27	0.76

The trends shown by the data are that materials and training are desired. Special materials should be written to be used with the calculator, and textbooks should have special sections devoted to the use of the calculator. Besides the materials, there should be inservice courses for teachers who wish to use the calculator in the classroom.

COMMENTS

As mentioned earlier, every subject who marked "Yes" in item 25 took the time to make comments concerning "how" they made use of hand-held calculators in their classes. It is always difficult to organize written comments in such a manner that one can see if there are any trends indicated by the comments. Many of the subjects used hand-held calculators in several different ways. In Table 29 are listed the categories and the number and percent of the subjects stating that they use hand-held calculators in the specified manner.

Table 29

The Uses of the Hand-Held Calculators

Category	Number of Subjects	Percent of Subjects
To reduce manual computation	47	82
To check work	24	42
To do computation when the computation is of minor concern for the concept being taught	20	35
To motivate the learning of basic skills	14	25
To teach a unit on calculators	11	19
To drill students	8	14
To demonstrate a concept	2	4

By far the main use of the hand-held calculator in secondary school mathematics classes in British Columbia is to reduce computational time and effort. The reasons for wanting to reduce computational time and effort seem to be to spend more time and attention on the primary concept of concern, to motivate students to work on their skills, and to be able to cover more examples of a concept or more concepts.

SUMMARY

With the rapidly increasing interest in and use of hand-held calculators, it became necessary to gain some indication of the use of hand-held calculators in the secondary school mathematics classes of British Columbia.

The survey instrument was distributed by the BCAMT via its journal, *Vector*. Of the 136 replies, 75 were from secondary school mathematics teachers and are the object of concern of this report.

The strongest responses from the subjects were that hand-held calculators have uses throughout the secondary school grades in mathematics and non-mathematics classes by all ability groups. Equally strong was the response that hand-held calculators should be used to extend a student's problem-solving ability.

Other fairly strong responses were that while the subjects have calculators and use them often, the subjects feel that the students probably do not have calculators available to them at home. Special materials and special inservice courses concerning the use of hand-held calculators probably should be developed. Everyone should learn how to use hand-held calculators before leaving secondary school. A student should be able to use a hand-held calculator for more than just checking his work; in fact, a student should be able to use a hand-held calculator on a test, if the test is designed to evaluate the student's problem-solving ability.

Given the size of the sample and the fact that this was an exploratory study to gather initial data in an area of increasing concern to secondary mathematics teachers, it is preferred to classify the remainder of the results as too equivocal to include in a summary section.

APPENDIX — The Survey Instrument

In order to determine how some mathematics teachers feel about using the hand-held calculator and/or use of the hand-held calculator in mathematics classes, the members of the British Columbia Association of Mathematics Teachers are requested to please fill in this questionnaire.

This form has been designed to take a minimum of time to complete. The information you provide will be kept confidential and only summary data will be made public.

Please take the time to complete the form and return it to Jim Sherrill, Faculty of Education, U.B.C., Vancouver, B.C. V6T 1W5.

Please circle the grade(s) in which you teach a mathematics class:

K 1 2 3 4 5 6 7 8 9 10 11 12 College University

For all but the final two items you are asked to mark how you feel about each statement using the categories Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), or Strongly Disagree (SD).

1. More than half of the students I teach have a calculator at home.	SA	A	U	D	SD
2. I personally have a calculator and use it often.	SA	A	U	D	SD
3. Calculators have no place in the elementary classroom (K - 7).	SA	A	U	D	SD
4. Calculators have no place in the junior secondary classroom (8 - 10).	SA	A	U	D	SD
5. Calculators have no place in the senior secondary classroom (11 - 12).	SA	A	U	D	SD
6. Calculators should only be used by "good" students.	SA	A	U	D	SD
7. Calculators should be used by students who cannot remember their basic facts or skills.	SA	A	U	D	SD
8. Calculators will keep students from learning their skills if used before junior secondary school.	SA	A	U	D	SD

9.	The school should buy the calculators for each class, just as they do books.	SA	A	U	D	SD
10.	Special courses should be designed that would use calculators for most of the computation.	SA	A	U	D	SD
11.	Most parents I know are against the use of calculators in the schools.	SA	A	U	D	SD
12.	Special materials should be written to be used with the calculator.	SA	A	U	D	SD
13.	Students should be allowed to use the calculator on tests designed to evaluate problem-solving ability.	SA	A	U	D	SD
14.	Calculators should be used to extend a student's problem-solving ability.	SA	A	U	D	SD
15.	Students should be allowed to use calculators only to check their work.	SA	A	U	D	SD
16.	When my students finish their formal education mathematics will (sic) computation only.	SA	A	U	D	SD
17.	Calculators could lead to a complete breakdown in students learning basic skills.	SA	A	U	D	SD
18.	Textbooks should have special sections devoted to the use of the calculator.	SA	A	U	D	SD
19.	Special in-service courses should be given to teachers who wish to use the calculator in the classroom.	SA	A	U	D	SD
20.	Calculators will inspire students to continue in mathematics since they take away the drudgery of computation.	SA	A	U	D	SD
21.	Most people in the future will not have to do very much computation because machines will do it for them.	SA	A	U	D	SD
22.	I am convinced that "how to" use the calculator should be taught to every student before leaving secondary school.	SA	A	U	D	SD
23.	The calculator will be a big help to					

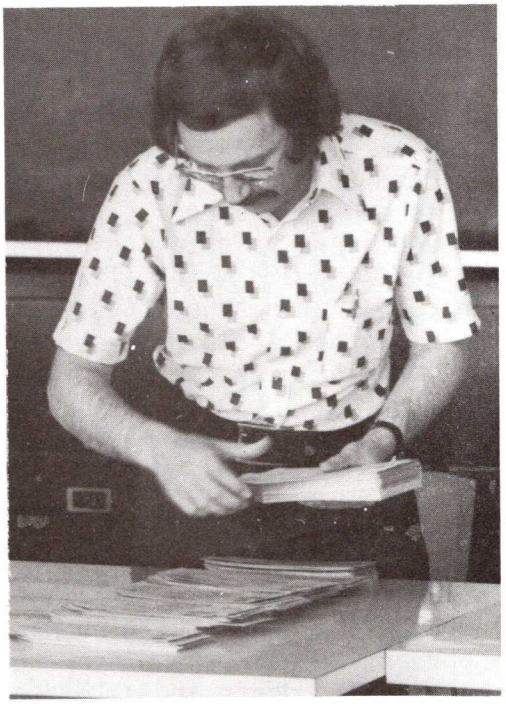
other classes besides mathematics. SA A U D SD

24. The sooner we can get the calculator into the classroom the better. SA A U D SD

25. I have used calculators in my classes. YES NO

26. If you marked "YES" for number 25, would you please describe how you make use of the hand-held calculator in your class(es).

Thank you very much for taking the time to complete the form! We hope that you will return your completed form to the address on the other side of this form.



Tabulating the data.