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MATHEMATICS, TECHNOLOGY AND TEACHER EDUCATION[1]

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At the onset of the XXI century, many societies stress what they see as the inevitable importance of science and technology. Science and technology are viewed as key factors in the development of society and as strategic factors in tomorrow's global economy. The implementation and development of a scientific and technological culture rely, among other things, on different institutions such as schools. Actually, tomorrow's adults are now starting or about to start their schooling process at elementary schools. This is why, whether in America or in Europe, technology is now part of educational programmes with varying degrees of inclusion. With this frame of reference in mind, I started investigating a specific aspect of technology in elementary schools - the use of calculators in mathematics education. Its inclusion in educational programmes is becoming more and more explicit. For example, in the US, more and more states are reviewing the training of teachers to include the use of calculators (Hembree & Dessart, 1992) whereas in Great Britain, the use of calculators is already part of the curriculum in elementary schools. In Ontario, there are four proposed areas of study from grade 1 to grade 9, one of which is Mathematics, Science and Technology.

THE CONTEXT

Calculators have been available on the market for more than twenty years. When they first appeared, they prompted a debate on their usefulness in mathematics education. Most teachers wanted to ban them from the school. The debate then was overshadowed by the outspring of computers which tooh the lead in

1. I would like to acknowledge the financial support of Texas Instruments in this research.

educational technology for the next decade, leaving calculators in the darkness of teachers' drawers.

Now that computers are available in classrooms and schools, and that their use and potential have been demystified, and now that calculators are very inexpensive, accessible to all and conveniently transportable, and that some are quite specialized and sophisticated, the attention towards calculators is re-emerging. There are few reasons for that besides their availability and accessibility. Calculators provide direct access 1) to big numbers - the only limit imposed is the number of spaces displayed by the screen; 2) to decimals which cannot be bypassed the minute the division is used; and 3) to the four operations (Lozi, 1992; Walsh, 1992).

Because of these characteristics, calculators challenge the classical structure of mathematics education in the first years of schools where the study of big numbers is built upon small numbers, integers are studied before work with decimals and fractions, positive numbers before negative numbers, and addition before sustraction, multiplication or division. This allows calculators to be technological tools which facilitate working with real life situations. First, they give access to a wide spectrum of the number structure. Secondly, they free mathematics education from the burden of teaching computational algorithms which seem to be using some 80% of teaching time in the mathematics classes[2]. Finally, they allow the provision of time for other mathematical learning such as problem solving, decision making, reasonning, mathematical communication, as well as the links between mathematics and other disciplines (Lichtenberg, 1992; Olson, 1992; Romberg, 1993; Sugarman, 1992).

Given these characteristics, one would expect a wide use of calculators in elementary schools. However, this is not the case. Research shows that calculators are still rarely used at lower grade levels. They are not part of the teaching and the learning of mathematics in elementary schools (Wheatley & Shumway, 1992; Burrill, 1992). The lower the grade, the less the calculators are used (Hembree &

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[2]. In the United States, 71% of the questions of the six most used standardized tests are devoted to computation (Romberg & Wilson, 1992, mentionned by Chambers, 1992).

Dessart, 1992). Moreover, there is relatively little research being done on the use of calculators for all pre-collegial levels (Hembree & Dessart, 1992).

In the fall of 1993, case studies conducted by students on 23 elementary Francophone schools in the South-East part of Ontario revealed that only two grade 3 classes used calculators at the end of the year, one grade 2 teacher used the calculators once a year for an experiment on mass, one school provides calculators in grades 1, 2 and 3 to be used in mathematics centres, and maybe another one or two teachers used calculators when the book's exercices require them. As for grades 4, 5 and 6, only few teachers seemed to use them; they did so in particular when the book required their use or to check computations. Moreover, one School Board has adopted a recommandation *not* to use calculators before grade 4. This quick overview of elementary schools indicates that calculators do not seem to be part of the school curriculum. A future investigation will gather more detailed information.

This situation reveals a misappreciation of calculators' potential which teachers convey through a widely shared attitude of not using them as long as children do not master the basic mathematics concepts. As a consequence, calculators play a role of checking answers (Pagni, 1992) rather than one of support in the learning of mathematics and the construction of mathematical understanding. Further, changes are difficult given the little amount of material available (Romberg, 1993) and the existence of standardized tests (Chambers, 1993) which prevents innovation from taking place in elementary schools as advocated by some non-govermental agencies such as the National Council of Teachers in Mathematics in the United States (Fey & Hirsch, 1992).

THE RESEARCH

In 1992, I started reviewing the literature on the use of calculators in elementary mathematics education, gathering information on different projects involving calculators, and visiting some sites where innovative approaches are used in the integration of calculators within the mathematical curriculum, such as the CAN project[3] in England. I then designed a research plan which will provide knowledge on the future teachers I am training in mathematics education, as well as some guidelines on the activities I should set up in order to facilitate the integration of calculators in the teaching of mathematics.

The aim of the research is to study the orientations of pre-service teachers towards mathematics and the use of calculators. A questionnaire was developed with that perspective in mind. It covers the following aspects: the students' orientations towards mathematics; their knowledge, use and spontaneous perspective on calculators; and their socio-demographic characteristics. On campus, the questionnaire was completed in September 1993, at the beginning of the course in mathematics education, before I even started describing the course and my own perspective in mathematics education. Off campus, where I do not teach, it was administered after classes had already started.

PRELIMINARY RESULTS

The research is in process. Questionnaires were analysed and the open questions treated for categorization. First statistical analyses are available and provide the following portrait.

Characteristics of the students

One hundred and ten students registered in the francophone elementary school training programme completed the questionnaire. Three groups of students were on campus in Ottawa (N = 77), and two groups were off campus in Oakville and Windsor (N = 33). Twelve students are men (11%) and 98 students are women (89%) which is representative of the elementary school teacher sex ratio. On campus, 75% of the women were born between 1968 and 1972 (between 21 and 24 years old). Off campus, 24% of the students were born between 1968 and 1972 while more than half of them (55%) were born before 1960 and are 35 years old or more. The average age is 30 with a significant difference between on campus, where the average is 27 years, and off campus, where it is 35 years.

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[3]. Calculator Aware Number project, in Cambridge (Shuard *et al.*, 1991).

Not only do students off campus tend to be older but they also come from larger families. Forty two per cent of them came from a family of 5 to 12 children. This is the case for only 18% of the women on campus. The data also show that future teachers tend to be the elders. In the family of origin, 27% of the students' mothers and 27% of the students' fathers have a primary school diploma; 31% and 26% have a secondary school diploma; and 18% and 14% have a university degree. Four per cent and 7% of students' mothers and fathers respectively hold a university graduate degree, and 1% and 6% of students' mothers and fathers respectively have no diploma or degree.

Origin of the students

On campus, most students are franco-ontarians (69% vs 36%) while off campus there are more immigrants (30% vs 5%). The rest of the population comes from Québec; none of the students comes from another province of Canada. On campus, a quarter of the women live with their parents while, off campus, this is the case for 18% of the students. On campus, another 25% of the students have a partner and no kids (21% off campus). On campus, 13% of the students have chidren and a partner (33% off campus). The age of the children varies between 1 and 19.

Choice of the profession

Between 22 and 28 percent of all students chose to become a teacher when they were in secondary school, attending university, or following a work experience[4]. They chose elementary schools for different reasons, the most important ones being[5] the love for children (34%) followed by the social value of the work (22%).

Perspectives on teaching

One of the questions asked related to their perception of a good teacher. The student could select only one answer out of four which categorized teaching styles

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4. Forty-one percent (41%) of the students off campus mention choosing the teaching profession after a work experience.

5. The question here is an open ended question and the categorisation was done according to the answers provided.

according to the typology developped by Sieber and Wilder (1967). Out of the four possibilities given by the cross sections of content and teacher-student relation, 77% of the students chose the one stating that a good teacher "tends to make her class interesting and encourages her students to be creative and to work by themselves". Another 17% of the students chose the one concerned with content and children's progress. The categories related to discipline or to care and love were chosen by very few students (4% and 2%).

Work experience

Three types of work were recurrently found in the work experience of the students[6]: secretarial work, camp work, and teaching assistantship. Most students have between 5 and 8 years of work experience but for 36% of them this experience is not in teaching, although 15% and 21% of all students have respectively one or two years teaching experience.

Forty one percent of the students don't work while they study. As for voluntary work, 26% of all students conduct such activities mainly in schools, with the church, within the community, or with friends and the family.

Religion and religious practice

Ninety one per cent of the students are Catholic. A quarter of them attend religious celebration once a week or more (19% on campus vs 35% off campus). Another 35% attend occasionnally during the year (39% on campus vs 23% off campus). In summary, 91% of the students practice their religion at least once or twice per year. This makes the student population a group for whom religion is important.

Language

Eighty percent of the students have French as a mother tongue while 15% have grown up with both French and English. The language they use the most frequently at home is French for 64% of all students (70% on campus; 49% off

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6. The categories of Blishen (1973) were used for the classification of work experience.

campus), English for 15% (8% vs 27%) and both languages for 18% (19% vs 15%). Hence, more students off campus use English at home.

Studies and studies in mathematics

A baccalaureate degree is a requirement for admission into teacher education and 90% of the students have it. The other 10% are admitted as mature students with experience. Only 6% of the students do not have a diploma in humanities or social sciences; among these latter fields, langage and literature was selected by 31% of the students, and psychology by another 19%. No student has a specific background in mathematics.

Students off campus have interrupted their studies for a longer time than the students on campus (59% vs 24%). The interruption ranges from 1 to 20 years. In mathematics, only 13% of all students took their last course in mathematics a year ago; 50% within the last four years; 25% between 5 and 10 years ago; and 10%, 20 years ago and more. The last course in mathematics was taken at a secondary level for about half of the students.

Opinions with respect to mathematics

Eighteen different questions were asked with respect to three aspects of mathematics and mathematics learning: 1) the difficulty of learning mathematics, 2) the value attributed to mathematics, and 3) the pleasure of doing mathematics.

Difficulty of learning mathematics

The total mean average of the six questions dealing with the perceived difficulty of learning mathematics is 1,76[7]. Results indicate that, for the majority of students, learning mathematics or acquiring what they miss does not appear to them as an impossible venture. However when asked whether mathematics is a more difficult subject to succeed in than other subjects, the students spread among the four

[7]. A Likert scale of four points was used for questions dealing with attitudes and beliefs, 1 referring to complete disagreement and 4 to complete agreement.

possible answers with 45%/55% split on disagreement/agreement with the statement.

Value attributed to mathematics

The social status of mathematics is well represented: it is essential for the development of the country; it is important in everyday life; most want to learn mathematics and it is not viewed as a specialised subject for mathematicians only. Half of the students believe people need a good training in mathematics but 38% of all students mention having little interest in subjects dealing with or related to mathematics. The mean attached to the value of mathematics is 3,26.

Pleasure of doing mathematics

Although 25% of the students admit partially or totally hating mathematics, the reverse is not true. That is, only 56% admit partially or totally liking mathematics. Forty-five percent (45%) of the students admit not being attracted to this subject; 63% reject the idea of doing some mathematics even if it is not an obligation and 28% will dream of not doing any mathematics anymore. The six questions provide an average of 2,71 for the pleasure of doing mathematics.

Calculators

Only five of the 110 students mention not possessing a calculator and 56% own at least one. One student out of four has two calculators[8]. Even if they own calculators, students do not know the differences between one calculator and another. Most students will describe their calculator as an ordinary one, through the type of energy it works with, or by its use. Thirty-five percent say they own a calculator of an unknown brand name; 45% own a Texas Instruments calculator and 16% a Casio calculator[9]. Although 54% of the students know that there are calculators that respect the priorities of the operations, they are not acquainted with the fact that there are calculators which allow computation on fractions as

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8. Forty-five percent of the students mention owning a computer.

9. Let us remember here that students might own more than one calculator; hence percentages do not add up.

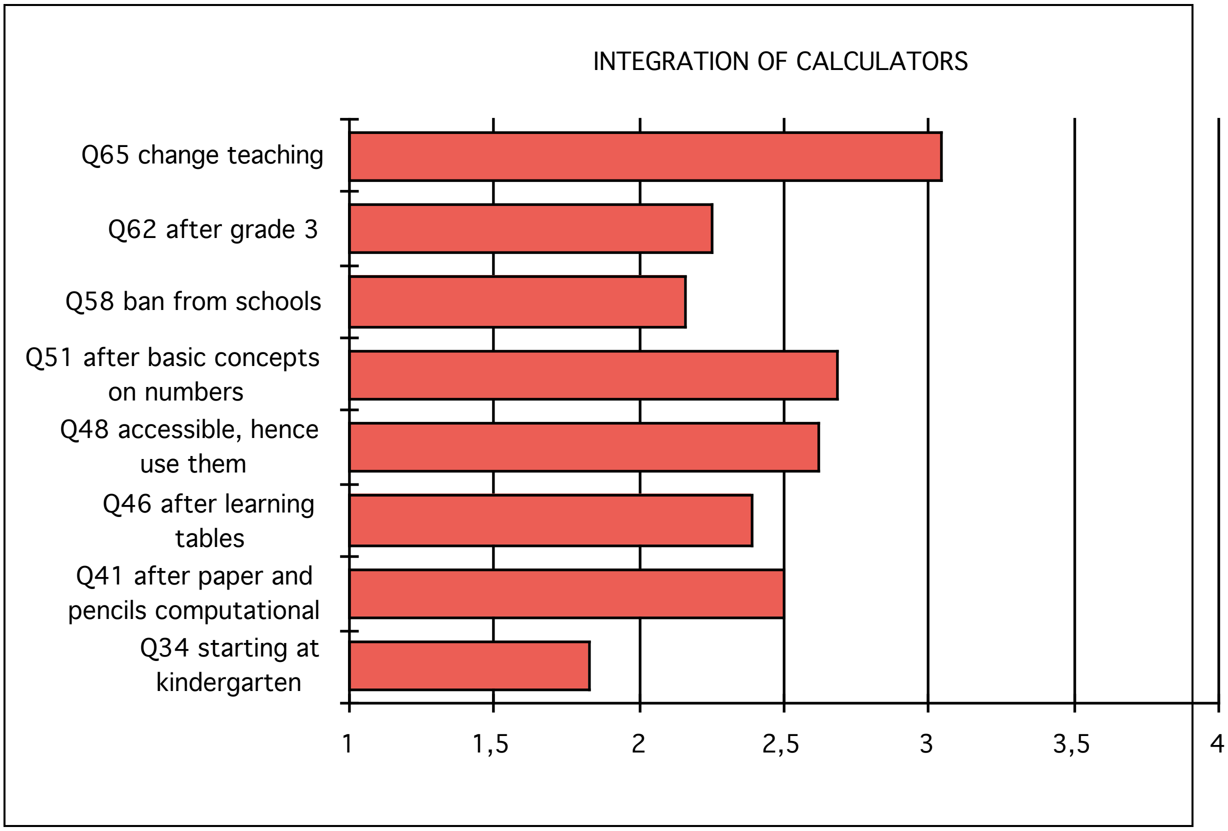
fractions, nor that there are calculators specifically designed for teaching mathematics.

As for the use of calculators, one person out of five uses a calculator few times within a week, 44% use one few times per month, and 35% use one rarely. Only one person uses it every day and nobody never uses them. Hence, altogether, 79% of the students use calculators rarely to a few times per month. When used, a calculator is mainly for budget or income tax computations. It is almost never used to do the market, to cook, or to compute quantities needed in a project.

Calculators and Teaching mathematics

Forty questions were designed in order to gain information on the attitudes and beliefs of the students towards calculators and their use in elementary schools. These questions were grouped into five different aspects: the integration of calculators into teaching, the negative effects of the integration, the positive effects of the integration, the availability and use of calculators, and personal attitudes and aptitudes.

Integration of calculators into teaching

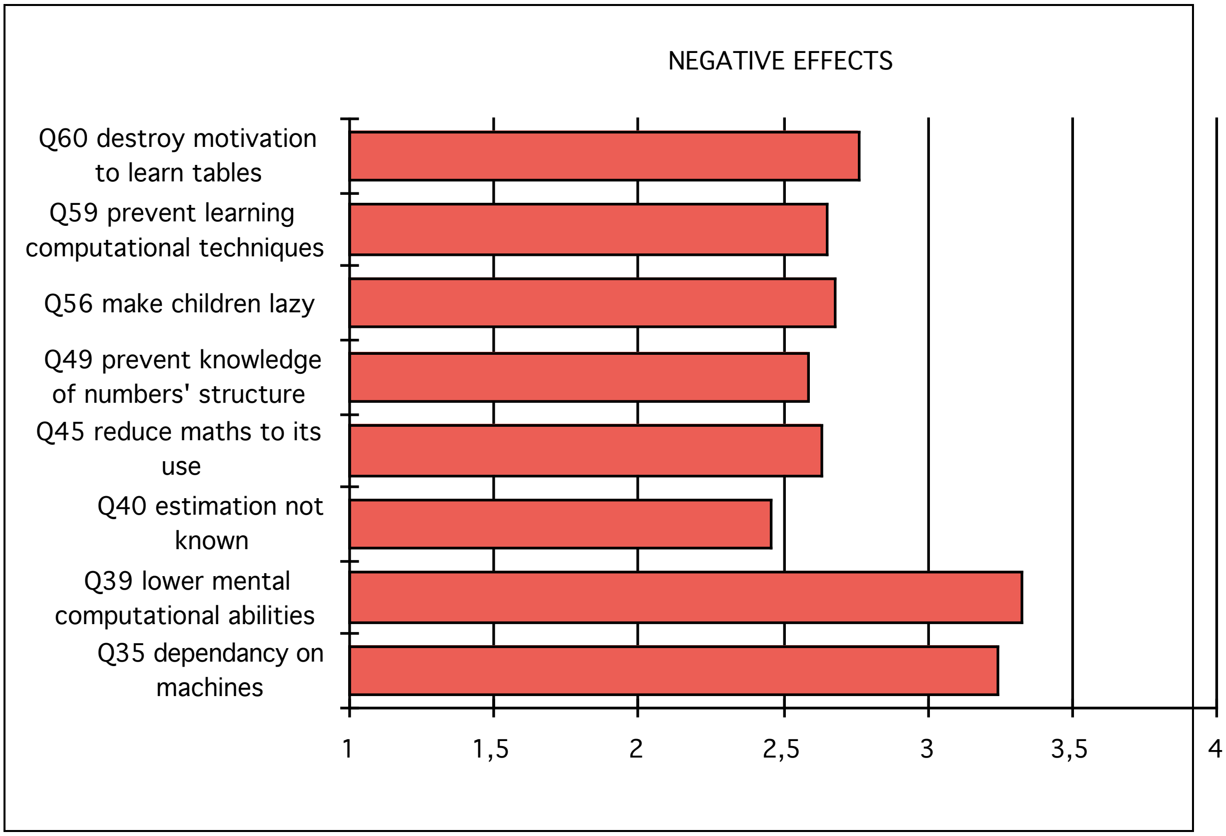


All the questions use a Likert scale of four points as a choice for answer. The students had to chose between total and partial disagreement (1 and 2) or partial and total agreement (3 and 4). Besides a general agreement that the integration of calculators will modify teaching (3,04; 22/78)[10] and a general disagreement about introducing calculators starting at kindergarten (1,83; 78/22), the results reveal that the students are split into two groups fluctuating between partial disagreement to partial agreement. They induce a movement whereas calculators can be integrated into classes starting at grade 3 (2,25; 60/40), after children have gained knowledge

10. Numbers in parenthesis are first the mean and then the percentage of disagreement (points 1 and 2 combined) vs the percentage of agreement (points 3 and 4 combined). In the present case, 3,04 is the mean to question 65 for which 22% of the students disagreed and 78% of them agreed.

of the addition and multiplication tables (2,39; 57/47)[11], or after basic concepts on numbers are acquired (2,68; 37/63). The students tend to disagree with the banishment of calculators from schools (2,16; 66/34) and share to some extent a pragmatic attitude, that is, calculators are accessible so let us use them (2,62; 44/55)[12].

Negative effects of the integration



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11. The responses to this question correlate with the age of the students (r=,1967; p<,05)

12. The results to question 48 correlate with age (r=,1953; p<,05) and there is a significant difference between campuses (0,22), the students off campus being more pragmatic then the ones on campus.

By order of importance, the expected negative effects of the integration of calculators are as follows:

1) children develop less their mental computational skills (3,33; 14/85)[13];

2) children become dependent on the machines to do their computations (3,24; 18/82)[14];

3) calculators destroy all motivation to learn the tables of addition and multiplication (2,76; 36/64)[15];

4) they make children lazy (2,68; 36/64)[16];

5) they prevent the learning of computational techniques (2,65; 43/57)[17];

6) their use reduces mathematics to its use (2,63; 47/53);

7) their use prevents the development of an understanding of the numbers' structure (2,59; 50/50);

8) children using calculators do not know how to estimate (2,46; 53/47).

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13. There is a significant difference between the students on campus (3,47) and the students off campus (3,00) (T-test: 2,23, $p<0.05$)

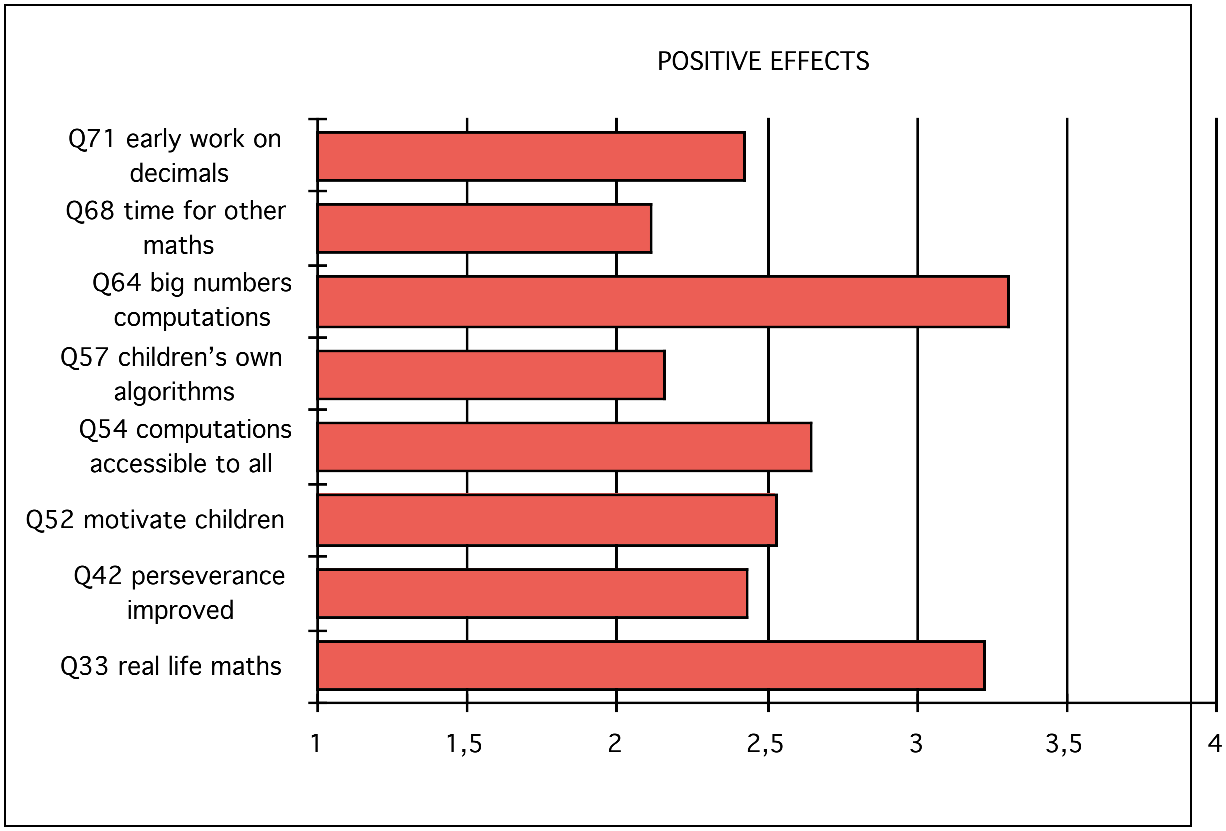
14. There is a significant difference between the students on campus (3,36) and the students off campus (2,94) (T-test: 2,50, $p<0,05$).

15. The results correlate negatively with age (-,2154; $p<,05$) and there is a significant difference between on campus and off campus (2,91 vs 2,42) (T-test: 2,55, $p<,05$).

16. There is a significant difference between on campus and off campus (2,81 vs 2,39) (T-test: 2,22, $p<,05$).

17. This data correlates negatively with age ($r=-,2944$; $p<,01$).

Positive effects of the integration



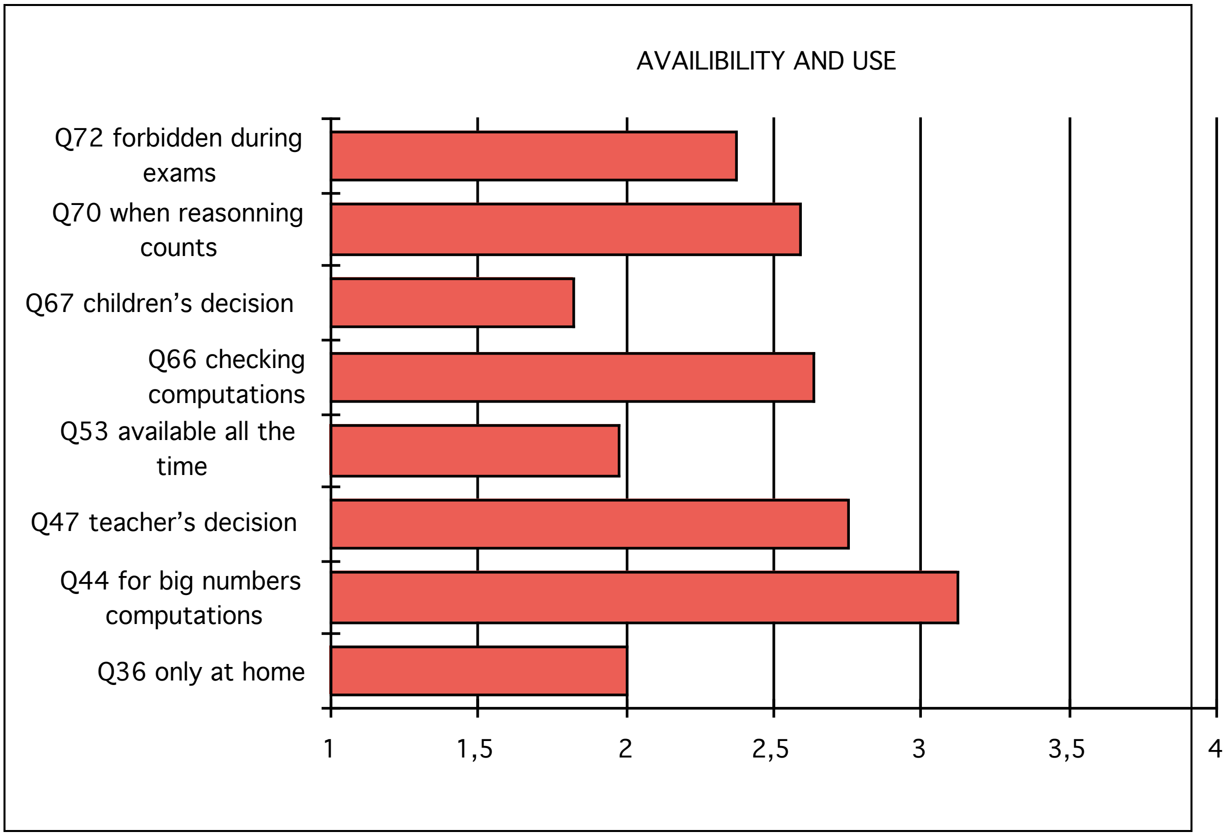
There is a strong agreement with the fact that calculators' use allows real life situations (3,23; 14/86) as well as computations on big numbers (3,31; 14/86)[18]. The students tend to agree that using calculators makes computations accessible to all children (2,65; 42/58)[19] and that using calculators motivates children to learn mathematics (2,53; 46/54). The students are not convinced that the use of calculators improves perseverance in mathematics problem solving (2,43; 54/46) nor that children get acquainted with decimals at an early stage (2,42; 47/53). Finally, the students converge towards disagreement when evoking that calculators' use allows students to develop their own computational algorithms

[18]. There is a significant difference between on campus and off campus (3,19 vs 3.58) (T-test: -2,27; p<,05).

[19]. There is a significant difference between on campus and off campus (2,51 vs 2,97) (T-test: -2,25; p<,05).

(2,16; 71/29) and frees time to work on aspects of mathematics different than arithmetic (2,11; 66/34)[20].

Availibility and use



The strongest agreement is on the use of calculators for big numbers' computations (3,12; 19/81). The agreement is of 2,64 (46/54) when calculators are used to check answers[21] and is of 2,59 (41/59) when calculators are used to work on problems where it's reasoning that counts and not computational skills. As for who should decide to use or not to use a calculator, the students tend to agree that the teacher should be the one to decide (2,75; 39/61) rather than the children (1,82; 78/22). The

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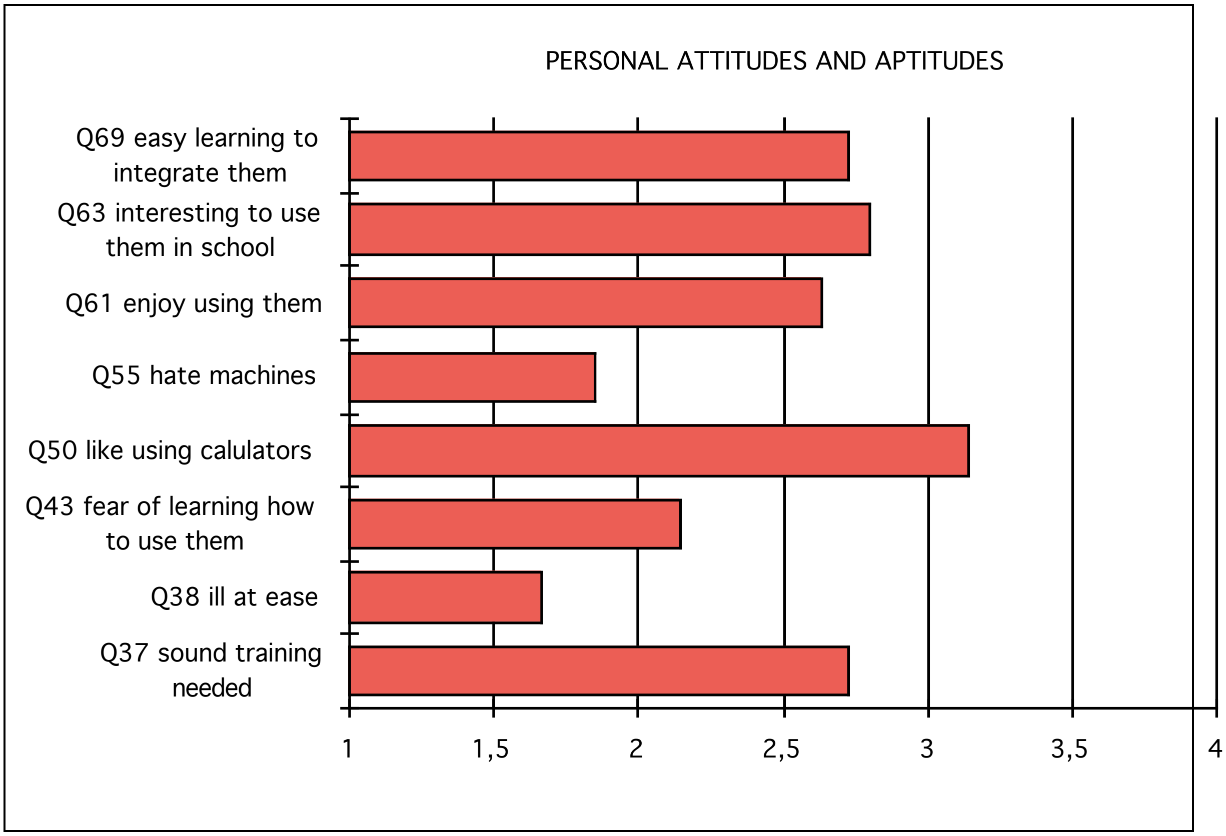
20. There is a significant difference between on campus and off campus (1,99 vs 2,39) (T-test: -2,05; p<,05).

21. There is a stronger significant difference between on campus and off campus (2,82 vs 2,24) (T-test: 2,85; p<,01). There is also a negative correlation with age (r=-,2578; p<,01)

students tend to disagree with the idea of the availibility of calculators at all times (1,98; 77/23), of using calculators only at home (2,00; 78/21)[22], or of forbidding them during exams (2,37; 60/40)

Personal attitudes and aptitudes



In general, the students like using calculators (3,14; 15/85)[23]; find it interesting that they can be integrated in schools (2,80; 35/65); and anticipate that they will enjoy using them in teaching (2,63; 44/66). Most students do not hate machines (1,85; 76/24) nor feel ill at ease with calculators (1,66; 85/15). They don't fear to learn how to use them in teaching (2,14; 75/25). They tend to agree with the statement that they will easily learn how to integrate them in the curriculum (2,73; 35/65) even though this might require a sound training (2,73; 38/62).

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22. There is a correlation with age (r=,1957; p<,05).
23. This statement correlates negatively with age (r=-,2653; p<,01).

Discussion

From the data gathered and the analysis conducted so far, some conclusions and some questions are raised. Students in franco-ontarian elementary teacher education value mathematics (mean: 3,26) the same way it is valued in our society. They do not seem to have difficulty in learning them (mean: 1,76). This apparent easiness and importance of mathematics are nuanced by the fact that 45% of the students find mathematics a difficult subject to succeed in, 38% of them do not find it a field of interest, and 45% of them are not being attracted to the subject. Furthermore, 25% of the students dislike mathematics and 28% would like not to have to do any mathematics anymore. These strong results overshadow the fact that, even though around 25% of the future students do not have any appeal towards mathematics, the rest of the students spread on the continuum of liking and enjoying mathematics, influencing the mean of the pleasure of doing mathematics to a 2,71 and hence compensating for the great dislike of other students.

As for calculators, if 56% of the students own at least one, they use them rarely to a few times per month. In an era of technology, this is not a frequent use of calculators. Furthermore, responses indicate that students, to some extent, seem to avoid using calculators, which could explain their lack of knowledge about them.

The use of calculators in teaching seems to be considered as a good idea. However, this apparent openness is contradicted by a refusal to integrate calculators at lower grade levels. The resistance to integration lowers as the grade level increases. The percentage of refusal to integrate calculators goes from 78% at kindergarten, to 60% at grade 3 level, to 57% once the tables of addition and multiplication are known (ie grade 4), and 37% once the basic concepts on numbers and numeration are acquired. If fractions are included in these basic concepts, then integration can take place after grade 6. The answers to these questions were given before the students were trained to teach and while most of them did not have any teaching experience. Hence training could make the difference provided it includes teaching with the use of calculators[24].. However, these results also reflect similar attitudes found among in-service teachers. If so, it indicates that there does not seem to be any difference on this matter between pre-service and in-service teachers, or at least that both groups will benefit from training.

If calculators are used in schools, pre-service teachers don't agree with their availability all the time nor during exams, revealing therefore a certain reluctance towards their use. In fact, they want to control when to use them and are not ready to give this decision to the children. This seems to contradict their definition of a good teacher which was centered on the children rather than on the teacher. Further analysis is needed here to ensure the analysis.

When examining negative and positive effects of the integration of calculators into teaching mathematics, the evident common sense of the answers is striking. Most students fear that the machines will make the children dependent and lazy; that they will not be motivated to learn additive and multiplicative or computational algorithms. The immediate positive effects are: working with big numbers and real life situations. These positions are adopted without any knowledge on the impact of the use of calculators. The pre-service teachers do not know that calculators' use increases perseverance in mathematical problem solving, or that properly used they allow children to develop their own algorithms. Nor do they anticipate that their use frees time from computational algorithms teaching to explore other aspects of mathematics.

An interesting datum which still needs to be confirmed by further analysis is the difference between the students on campus and those off campus. The former are younger with less work and teaching experience, the latter are more mature and have more teaching experience. Differences between the two groups seem to indicate that the off campus students are less dogmatic about the use of calculators. They are not as strongly convinced that the use of calculators will lower the mental computational skills, will make children dependent on the machines, will lower their motivation to learn the tables, or make them lazy. As a

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24. Information on this aspect will be available as soon as the follow-up questionnaires administered after training with calculators will be matched with the original questions.

group, the off campus students also tend to perceive that calculators' use allows mathematical work on big numbers and makes computations accessible to all students, hence allowing children with less computational abilities to access other types of mathematics. Finally, fewer off-campus students agree to use calculators to check answers. This lower response to checking answers is also found as a response among older students. This does not make this finding more understandable. Further analysis is needed to find some interpretation to this.

Age also plays a role in the type of responses given to some questions. Besides the one mentioned above, older students seem to have a more pragmatic approach: calculators are there, children own them, so let's use them. However, the older you are, the more you think that calculators should be integrated in the teaching only once the additive and multiplicative tables are known. Unexpectatedly, in contrast to this position, fewer older students agree to the fact that using calculators might annihilate the motivation to learn the tables or reduce the interest in learning the computational algorithms. Finally, there are more older students than younger students who do not like to use calculators.

CONCLUSION

From the information gathered so far, some conclusions can already be formulated. First, that the pre-service elementary teacher population is not well acquainted with the calculator technology and that their evaluation of the use of calculators in mathematics education relies on common sense. This first conclusion questions our own teacher education programmes. How well do we prepare the next generation of teachers to teach with the use of technology and to teach how to use technology. If teacher education does not include technology, its use effect on teaching and learning, then where will teachers learn it?

A second conclusion that can be drawn from the research is the reluctance of introducing calculators at early grades of schooling even though it is widely accepted that the use of technology does change teaching. Here again, training is important along with a demystification of the calculators and their use. It is most important that research on the use of calculators and their impact on learning be diffused not only among teachers but also among the population at large. The responses of the future teachers in this research provide a sample of what the population at large might think about the use of calculators in mathematics education and teachers willing to use new approaches will face very sceptical parents who might share the beliefs and attitudes of the respondents in this research.

Finally, calculators are but a small part of technology. If 56% of the students own at least one, they are only 45% to own a computer. What then about their knowledge, their use and their effects? In the case studies I referred to at the beginning of this writing, the students were also asked to check the availibility and use of computers in the classroom. If there were far more computers than calculators, their use varied a great deal from one class to another. To my great surprise, often computers were not used at all for mathematics learning. In an era where mathematics, science and technology are viewed as major factors in designing and constructing tomorrow, the preliminary results of this research show the importance of training teachers and raise the question on when to start educating children to learn through the use of technology and to learn how to use technology. In other words, for how long will technology stay outside the school?

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INTEGRATION OF CALCULATORS	**Mean**
Q34 starting at kindergarten	1,83
Q41 after paper and pencils computational skills	2,50
Q46-after learning tables (*,1967/âge)	2,39
Q48 accessible, hence use them(*,1953/âge; */campus)	2,62
Q51 after basic concepts on numbers	2,68
Q58 ban from schools	2,16
Q62 after grade 3	2,25
Q65 change teaching	3,04

NEGATIVE EFFECTS	**Mean**
Q35 dependancy on machines (*,014/campus)	3,24
Q39 lower mental computational abilities (* ,031/campus - separate)	3,33
Q40 estimation not known	2,46
Q45 reduce maths to its use	2,63
Q49 prevent knowledge of number structure	2,59
Q56 make children lazy (* ,029/campus)	2,68
Q59 prevent learning computational techniques (** -,2944/âge)	2,65
Q60 destroy the motivation to learn tables (* -,2154/âge; * ,012/campus)	2,76

POSITIVE EFFECTS	Mean
Q33- real life maths	3,23
Q42- improves perseverance	2,43
Q52- motivates children	2,53
Q54- computations accessible to all (* ,027/campus)	2,65
Q57- children's own algorithms	2,16
Q64- big numbers computations (* ,025/campus)	3,31
Q68- time for other maths (* ,043/campus)	2,11
Q71- early work on decimals	2,42

AVAILIBILITY AND USE	Mean
Q36- only at home (* ,1957/âge)	2,00
Q44- for big numbers computations	3,12
Q47- teacher's decision	2,75
Q53- available all the time	1,98
Q66- checking computations (** -,2578/âge; ** ,005/campus)	2,64
Q67- children's decision	1,82
Q70- when reasonning counts	2,59
Q72- forbidden during exams	2,37

PERSONAL ATTITUDES AND APTITUDES	Mean
Q37- sound training needed	2,73
Q38- ill at ease	1,66
Q43- fear of learning how to use	2,14
Q50- likes using calulators (** -,2653/âge)	3,14
Q55- hates machines	1,85
Q61- enjoys using them	2,63
Q63- interesting to use	2,80
Q69- easy learning to integrate	2,73