Mathematics Unplugged
A Student Mathematics Conference Opening Eyes and Minds Towards Mathematics

Pamela Hagen
Westwood Elementary

"If a man will begin with certainties, he shall end in doubts, but if he will be content to begin with doubts, he shall end in certainties." *The Advancement of Learning .(1605)* Francis Bacon

Developing any new concept or idea is not without moments of doubt and uncertainty. Will this new idea succeed or will it fail? Are the risks involved worth the potential gains? Doubts and questions certainly surfaced during the planning and subsequent enactment of a highly successful student mathematics conference which took place in May this year at Westwood Elementary in Port Coquitlam. Hearing that a particular need existed to examine the results of the Ministry of Education G4 & G7 math evaluation from the previous year was all that was needed to bring a fermenting educational idea into view.

Teaching experiences during a four - five year period had lead me to suspect that elementary students (and some of their teachers) had a very narrow perception of what math was and also that those students who said they enjoyed math were rare and that this was coming from narrowly focused teaching and lack of understanding and support at home. These suspicions were formed from beliefs that attitudes towards learning, and in particular mathematics, were critical. Experience said that students had a narrow perception of what mathematics was; that it was very arithmetically based, also that few people liked any mathematics.

Having been able to participate in a science fair as a mathematics presenter gave me the idea of having a student conference devoted entirely to math. If adults appeared to benefit so much from conferences which they chose to go to, why not let students have some choices with mathematics for an entire day? The initial proposal made to the Westwood principal, Ron Raible, and staff before Christmas 1996 was cautiously accepted and was then developed into a full proposal by January. On seeing a draft of a possible day enthusiasm and support from staff increased dramatically and a committee was formed to continue the formal planning, which would include developing a timeline plan. The Pacific Institute of Mathematical Sciences (PIMS) readily agreed to become involved with the school in planning and presenting the student mathematics conference.

Five goals were selected for the conference, a) Utilise expertise from the community, b) show students that mathematics is in all aspects of our everyday life, c) show students that Mathematics is more than what they can find in school textbooks, d) offer as many exciting math workshops as possible, and e) keep the number of students in workshops small (20 or less) therefore providing lots of hands-on experiences. It was decided to invite as many areas of the educational community as possible to participate, and indeed every area of the community was represented. This would include Westwood Elementary students as conference participants, nearby junior high school students as assistants, student teachers from Simon Fraser University as workshop presenters. All school staff (office, support and teaching), parents as workshop presenters, school district staff as presenters, Science World school programme staff and university professors from both Simon Fraser University and the University of British Columbia.

It was decided to keep the student conference as close to an adult conference as possible which would include a keynote speaker to start the day, followed by a series of workshops which would take the place of regularly scheduled lessons for the schools' approximately 320 students ranging from Kindergarten to grade 7. The day was broken into five blocks of 40 minutes each and fitted within the regular school day. Kindergarten students would take part in morning only sessions.

Those participants who were going to be presenting workshops were able to select their own workshop topics; select their preferred range for student grades and also to request either a double or single block. Because this was a new venture, presenters were recommended to start with an area of mathematics with which they felt comfortable and to design activities within that area. To those presenters who regularly taught in elementary schools this format of a lesson was not entirely new, but this was not the case for all presenters. Assistance was available for all workshop presenters throughout the planning process from PIMS, if the presenters needed research or workshop ideas. Dr. Kathy Heinrich, President of the Canadian Math Society, and Head of the Department of Mathematics and Statistics at Simon Fraser University kindly agreed to be the keynote speaker on behalf of PIMS.

A workshop description from each presenter was submitted and a brochure developed from which students, in consultation with their parents, could make their own selections of workshops to attend. By allowing students the opportunity to select their own choices it was felt that student involvement, and possible enjoyment, would be further heightened. Brochures were returned to the school, placed in a first-come first-served order, and then students were placed in workshop blocks.

While this process was taking place student package envelopes were prepared on which details of the assigned workshops would be given. These were to be handed out to students immediately after the keynote address. Participation certificates were prepared for both presenters and students and were to be given post-conference with the thematic pens, ordered by the school, along with the gift certificates donated by Macdonald's.

A number of small but important details had to be organised for the actual date which included rooms for each presentation and name tags prepared for guests and speakers. Students were involved with the preparation of the school for the day, hanging posters and decorations which were, in part, provided by SFU's Math Department.

The big day of Friday May 30th 1997 arrived and went ahead like a dream. The enjoyment and anticipation was evident from the beginning of the day with the students' reaction to the keynote address by Dr. Heinrich on "Tiling a Plane" Dr. Heinrich, while speaking about a sophisticated mathematical topic involving the work of Escher, Marjory Rice and tessellations, was able to immediately make the topic relevant to students by relating it to bathroom floors: a stroke of brilliance. A key factor to the whole day was that math became relevant to students in a way they had not previously thought about. The tone of the day was immediately set, math was now something which each of the students could relate to their own world and enjoy in way not previously thought about..

Very few problems were experienced and even the few that were, i.e. some students being confused as to how they should read their workshop locations, name tags for some participants being misplaced, all these were able to be handled with confidence. The success and enjoyment of the event for all participants was probably related to the extent to which the

educational community was involved. No element of the educational community had been left out (students, junior high school students, teachers, parents, student teachers; district staff, Science World programme staff, and university personnel) all had readily welcomed the opportunity to be part of this innovative mathematical learning opportunity.

While the enjoyment factor was quite evident on the day of Mathematics Unplugged, whether or not the day had been successful as a learning opportunity still had to be gauged. All participants, students and presenters were given the opportunity to complete an anonymous evaluation form which invited comment and suggestion for possible future events. Although there were preferences from students about individual workshops only six students from the schools 320 student population stated that they did not enjoy the day, a staggering enjoyment rate of 98%!. All presenters also enjoyed the event, an enjoyment rate of 100%! The most important question from a learning perspective still had to be answered for all participants "Do you think your views about Math have changed? And "In what ways do you think your views have changed?" Two answers from each of the presenters and students responses leave little doubt about the learning success of Mathematics Unplugged. From the presenters " Yes, we can present math in a way that is fun for children, where students are involved in the learning process", "Yes math can be made more relevant to real life experiences", and from students "We were actually having fun doing math", "I was surprised that math could be so much fun".

Bringing members of the educational community together more often with relevant and meaningful opportunities would certainly be something that should be considered and put into effect as often as possible. Perhaps even more importantly, the foundation for an open mind and views of mathematics can be laid at the first formal level of education: elementary school. Activities and groupings not usually considered, as has been proven at Westwood Elementary, can make mathematics learning enjoyable and meaningful.

After the very high degree of success with the first student math conference, the decision to have a second conference proved relatively easy. Westwood Elementary had changed from a K- 7 elementary school to a K-5 elementary school, but this did not affect anything other than the number of students and the required number of workshops. Planning was made easier by the early formation of a committee of school staff, which developed a timeline, and schedule of details to be carried out as the chosen day approached. The basic structure and details were kept the same, which included maintaining the established five goals and addressing some mild concerns such as the quantity of paper used.

Students' comments during the planning for the second conference were indicative that there might have been a lasting effect to a one off event. These included general hallway comments from students such as "Got to get the message out, math can be fun" [students putting up posters for the conference] and "Looking forward to it".

It was fortunate to secure Dr. Maria Klawe, now Dean of Science of the University of British Columbia, as the keynote speaker for the conference. Westwood Elementary was also able to debut the acquisition of some free computer software, Phoenix Quest, from the research group EGEMS (Electronic Games in Engineering, Mathematics and Science) with which Dr. Klawe is involved. Dr. Klawe's presentation related to her research, work which was targeted at mathematics and science education. The visual and interactive aspects of Phoenix Quest mesmerized the students and visitors alike. They were further intrigued by the fact that the software with which they were now directly involved was the direct result of research and not a

commercial item. On the day of the conference the computer lab with its newly acquired and wired file server, was a popular spot for students. It was now possible to interact with software directly targeted at mathematics and science enhancement.

While parent workshop presenters did not come forward as workshop presenters for the second conference, a representative from the British Columbia Association of Mathematics Teachers (BCAMT) was present as were other professional math educators.

Feedback forms were completed again by staff, workshop presenters and students following the conference. Once more the goals of the conference were easily met and it was judged to be a huge success by all concerned. One feedback form completed by a visiting student has come to be an important document for the conference success. When asked if views about mathematics had changed, the student replied "Yes"; the response to the subsequent question "In what ways have your views changed?" is significant. "Before math seemed to have limits it seemed that most of it was plus, division and times. Now math seems like a rainbow each colour is new, different and very exciting!" If only Francis Bacon could know that his statement made some four hundred years ago had validity at the dawn of a new millennium.

The power of the students response has been further strengthened when the significance of the comments was also noted by both the British Columbia Teacher's Federation (BCTF) and the Canadian Teacher's Federation (CTF) as part of a submission which was awarded a Roy C Hill National Award of Great Merit. Westwood's Mathematics Unplugged student math conferences have now received provincial and Canadian recognition as an innovative and worthwhile project.

Educational organizations were not the only ones to recognize the importance of this opportunity to develop mathematics education. Representatives of the media, newspaper, magazine and television now wanted to find out about mathematics at Westwood Elementary. Perhaps more importantly however, were the indirect comments heard again from students and, this time, parents about Mathematics Unplugged. Parents were particularly proud that "their" school had received media attention for a subject, which was traditionally seen as boring, difficult and unexciting. Students in the low primary grades were expressing interest and enjoyment with mathematics and could easily recall "The time the lady came and spoke about bathroom floors" [Dr. Heinrich's presentation about Escher and tiling a plane].

On 30th April 1999 Westwood Elementary held its' third Mathematics Unplugged event, Mathematics Unplugged III; the full evaluation of which is awaiting completion.

Three consecutively successful events, albeit in a small and relatively needy suburban elementary school, could not be isolated and insignificant for the development of mathematics education. Now was the time to document concordant educational research.

Because it has been considered important to the very development of the Westwood mathematics events that expertise from the community be used at the conference; it is similarly considered important that research references be not only supportive but also from the local continental geographic community. Geographic expansion is certainly a possible future consideration.

The Principles and Standards for School Mathematics: Discussion Draft, one of the National Council of the Teacher's of Mathematics Education's (NCTM) most recent publications contains numerous references to the importance of a sound foundation for the development of students successes. For example the NCTM considers that "Children who experience high quality early childhood education have a better chance of achieving to higher levels in schools than those who do not have the experience"[1]. This sound foundation is a fundamental tenet of pedagogy which can be covered in layers of societal pressures and stresses. While research by its' very nature continues to inquire , educators need to take action to uphold the facilitative knowledge aspect of the profession. Educators should not stop learning themselves even while they are educating.

In 1995 the British Columbia Ministry of Education introduced the Mathematics K- 7 Integrated Resource Package, the mathematics curriculum for students in elementary schools. Prior to this, however, moves towards reforming mathematics education began with the establishment of the Western Canadian Protocol for Collaboration in Basic Education K – Grade 12 in December 1993. The four western provinces of Canada, BC., Alberta Saskatchewan, Manitoba along with the territories of Yukon and Northwest Territories agreed to collaborate in basic education because of their shared beliefs. Gradually in each of these areas mathematics curriculum is being aligned with the Common Curriculum Framework for K-12 Mathematics. In the case of BC there is much existing alignment between the Ministry's curriculum and that of the Western Canadian Protocol.

Similarly there has been a tremendous influence of the BC curriculum from the Principles and Standards documents of the NCTM. It is not unreasonable to think that the mathematics learning taking place in the classroom would be enabling students with the solid foundation that is being called for by the NCTM. Indeed results from the significant TIMSS studies carried out in the spring of 1995 show that Canadian students were ranked 10th out of the 41 participating countries. Canadian G8 students attained an average percent correct score of 59, with the general average being 55. Students in BC scored higher than the Canadian average at 63% correct.

The results of the G4 TIMMS testing are very similar in many areas. One important difference however was between the numbers of G4 students in Canada who said they liked mathematics compared with those students who were in G8. The difference was a significant 15%. Unfortunately it is outside the focus of this paper to delve into the reasons for this difference, but it is also interesting to note that the attitudes of G4 students towards mathematics was more positive than those of G8 students. Somewhere between these grades too much is being lost.

There are numerous references to students' attitudes towards mathematics available but the work by Thomas Andre et al.with young students is particularly appropriate to the situation at Westwood Elementary. Andre strongly suggests that the development of attitudinal reactions towards mathematics achievement and attitude begins in the early grades. If students can, at the minimum, have at least an open mind towards mathematics, and if possible as many

[1] NCTM - Standards 2000 Writing Group, (1998).Reston. *Principles and Standards for School Mathematics: Discussion Draft.* p.105.

opportunities to enjoy and experience relevant and meaningful mathematics as they approach the higher grades, then the outlook for students mathematical development is as bright as could be hoped for.

Annual events cannot in themselves raise the level of achievement in the BC Ministry's annual testing. They can however, bring an awareness that much more is possible within mathematics. From that other changes are possible. The key to Westwood's success has been the inclusion of so many parts of the educational community, from parents and students to teachers and mathematicians. All have benefited in a number of ways. Mathematicians have been able to experience the life of the young students and schools; teachers and staff have been able to have professional development opportunities. Most importantly students and their parents have been able to experience relevant and meaningful mathematics.

It is fitting that Francis Bacon, a 17th century British philosopher and statesman, is regarded as one of the earliest and most influential proponents of empiricism. The events at Westwood Elementary did not evolve from theory but from experiences at the grass roots of formal learning. Students should be given opportunities to become involved in their own learning; to have opportunities to experience learning that are not part of their regular routine; to interact with educators from all levels.

In 1620 Francis Bacon translated *The Advancement of Learning* into Latin: *De Augmentis*. To augment is to make greater in strength. If regular mathematics curriculum is augmented with rich learning opportunities the potential for students' learning is limitless.

References

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Thursday, 25 April 1996

Student Evalution

1. Do you think your views about Math have changed? (Yes) or No (circle one).

2. In what ways do you think your views have changed?
Before math seemed to have limits, it seem
ed that most of it was plus, division and
times. Now math seems like a rainbow becau
each colour is new, different and very
exciting.

3. Things you liked/remember about Mathematics Unplugged II?
I really enjoyed the keynote speaker, but
in each session there was something
special that I really enjoyed! I will
remember all those special parts! It is
a very easy thing to forget this confere

4. Things you weren't quite so keen about?
Well .... in the sessions I always seem
to be enjoying myself when ... time to
move to the next session! I found
myself hesitating to leave!

It would be nice if we could order lunch as pizza e.c.t. I also feel that the longer ... the more essential! I also think that maybe you could put decorations around the school!

6. Any other comments?

Please have another conference next year! I think having this conference was great and we owe a BIG thanks to the person responsible Mrs. Hagen and any other person who helped! I have a very positive decision about you're conference! EXELLENT!

Please return to office by Friday May 1998