Math Fair in Meadowlark Mall

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Mike Dumanski, vice-principal and grade 5 teacher of Our Lady of Victories Catholic Elementary School, Edmonton, phoned the Department of the Mathematical Sciences of the University of Alberta in May, 1997. The school had been doing an annual Science Fair, and Mike wanted to know if there was such a thing as a Math Fair. Enquiries such as this usually got routed to my office. I said, "Yes, Mike, there are Math Fairs."

Mike was willing to give it a try. At his invitation, I went to the school and showed his class some mechanical puzzles of a mathematical nature. We also worked on some traditional brain teasers. Then I gave a short talk on binary numbers. The children were very receptive and enthusiastic. The only hitch was that they were not impressed with a binary card trick which I unwisely used to guess the age of one of them. "This is a grade 5 class," the subject of the investigation informed me. "We are all 10 years old."

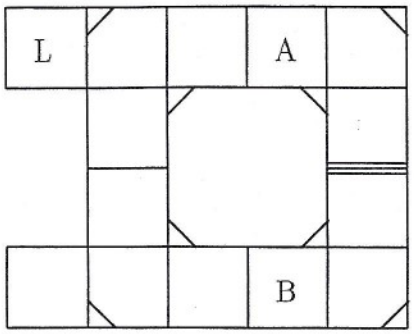
Things rested until early October, when I met with the school's Math Fair Committee, consisting of Mike, grade 4 teacher Linda Hammond and grade 2 teacher Margaret Petruk. The event would involve the whole school, from kindergarten up to grade 6, including students in the Learning Centre and some with special needs. Most of them would be in groups of three or four. As it turned out, very few were of mixed gender.

We agreed on two criteria about the student projects. First, during the preparation stage, the children should have to work things out for themselves. They should not be used merely as demonstration devices. Secondly, during the Math Fair, the children should still have something to do at the table, rather than sit around and be seen and not heard.

Then I put together about 30 projects, mostly based on Martin Gardner's publications. I tried my best to formulate them in such a way that the children would understand the problems and be able to tackle them. One mistake I made was writing things out by hand, and several groups had trouble making out some of the words. In the end, more than half of the projects turned out to be too ambitious, and the teachers wisely left off the worst cases. A few slipped through, and had to be withdrawn later.

Once in each of three weeks in late October and early November, I visited the school to offer help wherever needed. Sometimes, I would wander into a classroom when the children were all working on their projects. They were so engrossed with their activities that all I got was a polite "Hello". I was introduced as Dr. Liu. Probably mistaking me for a physician, a few stuck out their tongues. Once, there was a fire drill. When we returned to the classroom, a burly man appeared at the door. The teacher introduced him as fireman Greg, and the whole class jumped up and shouted "Yeah!" It was tough competition!

Most of the time, I sat at a round table in the corridor, and the children came to me one group at a time. The very first group I met were three boys in Grade 4. They were working on a railway shunting problem, and had drawn a fabulous board. My instruction for the project was too terse, and they misunderstood parts of the given conditions. However, we soon got that sorted out, and they were able to solve the problem then and there.



The stylized board represented a round railway track with two sidings. There were a locomotive on the square L and two carriages on the squares A and B. The two carriages might be pulled or pushed by the locomotive, they might be linked to each other, but neither could move across the triple lines on the right side of the track. Only the locomotive could move on its own, and it must be returned to its starting square after the switch.

This heightened my expectation so much that when I met with another group later, I was about to ask when they would make their good copy. I bit my tongue just in time, suddenly realizing that I was looking at it! I had to keep reminding myself that the children did the projects themselves, and not every group would be as neat and tidy as the first. Apparently, these three were aware of the shortcomings themselves, as one said sheepishly to another, "You know, perhaps we should go and find a ruler!"

The practical considerations for the projects were eye-openers for me. The grade 2 kids, especially, were a hilarious bunch. One group was working on a project which I did not supply. It was about sampling with replacement! I was to draw at random a marble from a bag containing one black marble and two red ones, and the children would record how many tries I would take to get the black one. If a red marble was drawn, it would be put back into the bag before the next draw. If the black marble did not appear in 7 tries, the score would be counted as 7.

I must admit I was not too keen on this project, because while it gave the children something to do at the table, their preparation consisted only of drawing the blank chart with 7 boxes, on which they would place markers to record frequencies. I was not convinced that they would understand the significance of the project. However, I might again be expecting too much. Although I did not expect the people from the other side of the table to get much out of it either, this exhibit turned out to be one of the more popular ones.

I said to the four little boys, "I think this may be too deep for you. You probably would not get to the bottom of it." Then I saw that my remark had another valid but unintended interpretation. The school wanted the children to use household items rather than commercial products. So the kids found an adult-sized pillow case. None of their arms were long enough to reach the marbles!

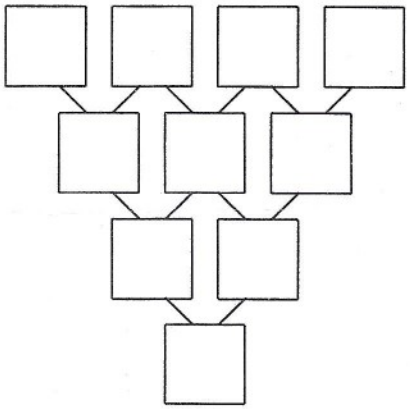
The title of another grade 2 project which I did not supply was "Guess the function". I would have preferred "Guess the rule" instead. Anyway, three little girls showed me a cardboard box with partially cut slots. I was to write a number down on a piece of paper, and slide it through the "In" slot. They would thrust the output through the "Out" slot, and I was to guess the rule of operation of their machine.

We gave it a try. Since the slots were not yet operational, we played it by mouth. I was "It" first, and I used the simple rule of subtracting 1. Their first input was 1 million, and my answer was a real mouthful. They kept using big numbers, and got totally confused. Finally, I suggested a more modest approach, and they guessed my rule shortly after that.

Then we reversed roles. Following my own advice, I submitted only small numbers as inputs. They took turns providing the responses, and for the life of me, I could not fatham any rhyme or reason behind those numbers. I finally admitted defeat and asked them for their rule. They looked at one another, whispered in their ears, looked charmingly at me and said together, "We forgot!"

A grade 5 group got a project from me, in which they had to divide a square pizza into seven pieces by straight cuts, so that each piece has the same amount of pizza and the same amount of crust. I did not realize that the children had not yet come across the base-altitude formula for the area of a triangle. They worked on a substitute project instead.

Another grade 5 group got the following project from me. They had to put the numbers 1 to 10 in the boxes in the following upside-down triangle. Each number below two adjacent numbers should be equal to their difference. This problem was certainly not beyond them, even though the boys could not find a systematic way of attacking it.



We explored the situation before I suggested that instead of using actual numbers, they could start with five markers labelled "odd" and five "even". Below two adjacent like markers must be an even marker, and below two adjacent unlike markers must be an odd marker. The boys solved this problem after a few attempts, and I left them to adapt it to a solution of the original problem.

During this time, words got around that a Math Fair was in the offing. Both the Canadian Mathematical Society and the Pacific Institute for the Mathematical Sciences expressed interest in sponsoring the event. I discussed it with Mike, and while the school was quite prepared to go ahead on its own, involvements of non-commercial organizations were most welcome.

Since the PIMS was itself in the formative stage, it could only manage a grant of $50. We used the money to buy two wonderful items from which substitute projects were extracted for the children: the book "The Puzzle Arcade" by Jerry Slocum, published by Klutz, and the puzzle "Rush Hour" by Nob Yoshigahara, produced by Binary Arts. The PIMS was acknowledged as a sponsor in publicity material, including an article in the neighbourhood newspaper *The Examiner*. A special project was designed in which the children constructed the letters P, I, M and S using tangram sets.

A grant of $250 was approved by the CMS, but due to some technical problems, I was not informed of the decision until it was too late to make any real impact on this year's event. Nevertheless, the CMS would like to use the grant to establish a good working relationship with the school. Some money was used to buy further books and puzzles as resource material for future Math Fairs. A sticker with the CMS logo was designed and a copy was placed inside each item. The remaining amount was set aside to defray photographic costs which would be incurred after the event.

On November 10, the school held a rehearsal in the gymnasium between 1 and 3 in the afternoon. All the children were there, plus a handful of parents who could come during the day. A lot of planning, organization and physical labour went into the effort. Apart from the three Committee members, the other teachers and staff all pulled their weight, under the leadership of principal Chuck Jenkins.

It was an unqualified success! I had been excited but apprehensive, but now I found out that my worries were groundless. The children all took their tasks seriously. They were very keen in showing off their own projects, but they were equally interested in the work of their schoolmates. Since there were three or four kids in each group, they could take turns wandering off and still have someone holding the fort. I took some video recording and still photos.

After I put away my photographic equipments, the children dragged me to their tables. Since I supplied a number of the projects, and had helped some of the children work out the solutions to theirs, I had a rather easy time of it. I was not sure what this was doing to my ego though, espcially since the children all seemed very surprised that I could solve the problems!

I looked for the grade 2 group with the marbles. I had suggested that they should get a smaller bag and larger marbles. Now they held in front of me a tiny bag containing three golf balls! I discovered that one of them was larger than the other two. I drew it out, but it was red. Nevertheless, this improved my chances in subsequent draws, because I was not going to take that one again.

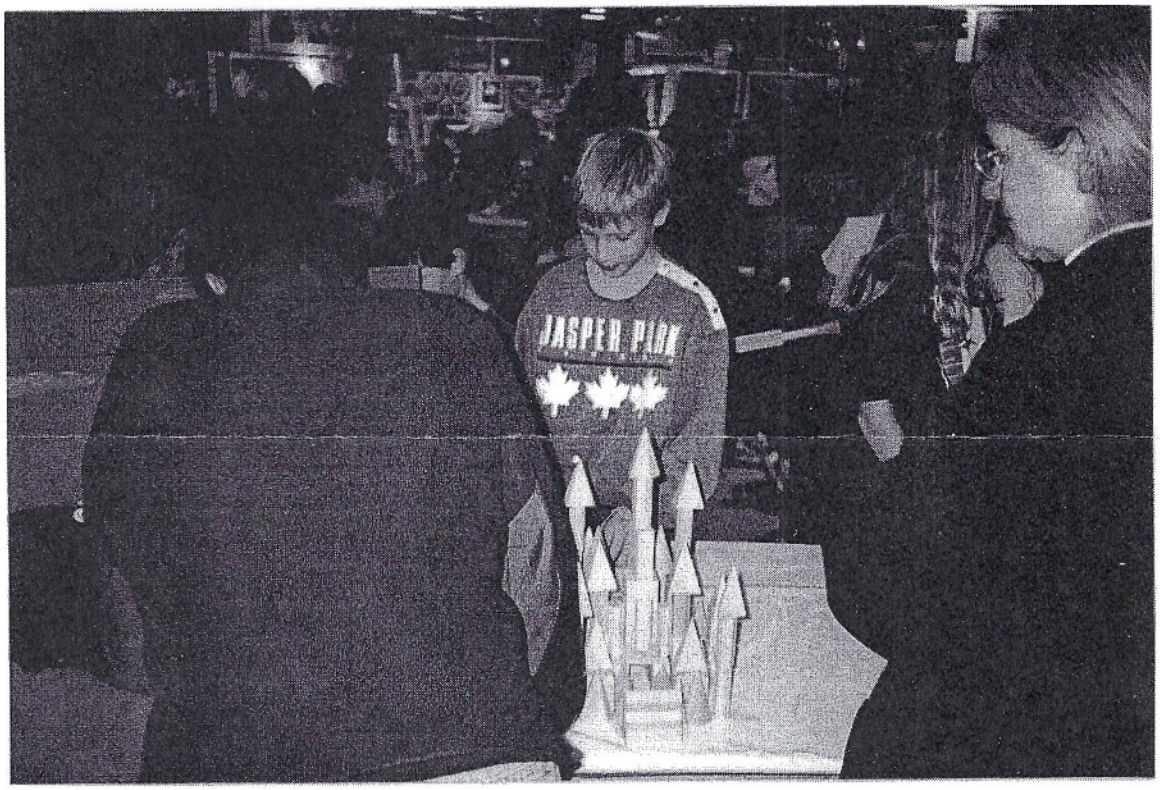
November 12 was the big day, and forty tables were set up in the hallways of Meadowlark Shopping Mall. Most of the children were there, and this time the place was swarmed with supportive parents. However, there were many other visitors, not to mention passers-by who got intrigued with the displays. Unfortunately, the media which the school contacted did not show up.

Betty Morris, a consultant at the central office of the Edmonton Catholic School Board, sent a nice poster and many colourful balloons which livened things up even further. She went through all the projects, and came away most impressed. She planned to encourage other schools to try the same, and I agreed to help. A number of teachers from elsewhere also came too to get ideas.

The Department of Mathematical Sciences was well-represented. Akbar Rhemtulla, site director of the PIMS, was there, as was Associate Chairman Jim Timourian. Jim came with Michael Butler, the son of our late colleague Jeff. Ted Lewis announced the event to his Discrete Mathematics class, and was pleased to see some of his students there. They found some of the children's problems rather challenging.

We looked again for the four grade 2 boys holding the tiny bag. Now they let everyone have 7 draws, and recorded the number of times the black golf ball came out. Ted got it four times in a row, and asked if he had won a prize. One of the little boys put on the cutest smile and said flatly, "No!" Later, Jim had a go. There was so little room that he could not get his hand out. Laughing heartily, he said, "You know, this is how some native tribes catch monkeys!"

I shot more video and photos. I had several groups explain their projects on camera. I also talked to quite a number of the children. They all felt that they had learned a lot, and the Math Fair had changed their perception of mathematics as just number crunching. They had gained valuable experience in problem solving as well as in presentation.



Two hours were about as long as the Math Fair could last. Towards the end, some of the younger children were getting tired, especially since there were no chairs behind the tables. Still, all the children evidently enjoyed themselves. Throughout the evening, there were no discipline problems whatsoever. Their proud, happy faces convinced the teachers, who had put in a lot of extra work, that it was well worth it!

"The school will probably go back to the Science Fair next year, but we plan to alternate that with the Math Fair from now on," said Mike.