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Delta-k

THE ALBERTA TEACHERS' ASSOCIATION MATHEMATICS COUNCIL

Volume XXIII, Number 2 May 1984

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USING TECHNOLOGY IN MATHEMATICS EDUCATION

delta-k

THE ALBERTA TEACHERS' ASSOCIATION MATHEMATICS COUNCIL

Volume XXIII, Number 2 May 1984

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EDPRESS

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Editorial

This long-awaited edition contains some obvious changes in design, function, and content. Your comments "to the editor" would be appreciated. We hope to continue expanding the interest and appeal of *delta-K* to meet the changing needs of our readers.

Problem Solving

This issue explores a new approach, and we welcome Professor John Percevault as a regular contributor. Thanks to Ron for a problem type.

Computer Applications

We also welcome back *delta-K*'s former editor, Professor George Cathcart, as a regular contributor to the "Microcomputer Corner," which has an elementary emphasis. The results of his *delta-K* readership study are included as well.

Perspective

Many thanks to Professor Ediger for leading our thinking.

Letter to the Editor

I read John Curda's article in the October 1983 issue of *delta-K* with great interest, and I enjoyed the manner in which he integrated the use of a microcomputer with the teaching of the coordinate plane.

I would, however, like to point out a small bug in the program listed on page 10. Statement 30 as written (FOR Y = 1 to 119 STEP-1) does not start the "rocket" at the bottom of the screen and move it to the top as indicated in the description. However, by changing the statement to read "FOR Y = 119 TO 1 STEP-1" (as I'm sure John intended), the "rocket" does indeed perform as it should.

R. Heyworth
Supervisor of Education, Math/Science
St. Albert Protestant Separate School District No. 6

delta-K *agrees. Thanks for pointing this out.*

Announcements

Authors Wanted

The editorial panel of the *Arithmetic Teacher* is looking for prospective authors for the "Ideas" and "Let's Do It" departments. Authors will be asked to submit three manuscripts for review by August 1, 1984. For each of the departments, three sets of authors will be selected, each providing three manuscripts to complete the nine issues for the 1985-86 publication year. For more detailed information, write to the Managing Editor, *Arithmetic Teacher,* 1906 Association Drive, Reston, VA 22091 (phone [703] 620-9840).

News Briefs

•*Crux Mathematicorum*, sponsored by the Carleton-Ottawa Mathematics Association, is a problem-solving journal available for $22 from Algonquin College, 200 Lees Avenue, Ottawa, Ontario K1S 0C5. Single copies are $2.25. Try it; you may like it.

•The Association for the Development of Computer-Based Instruction publishes 300 pages of its Twenty-Fourth International Conference in the *Journal of Computer-Based Instruction*. The cost is $30. It's available from Gordon Hayes, Executive Director, ADCIS International Headquarters, 409 Miller Hall, Western Washington University, Bellingham, WA 98225 (phone [206] 676-7860).

• "Edison Kits," ideal for Grade 5 through junior high school, have proved to be effective teaching tools in more than 25,000 classrooms. Directions are simple, and materials are inexpensive. Teachers and librarians will like the seven how-to booklets based on Edison's experiments. Send $1 for postage and handling to Charles Edison Fund, 101 S. Harrison Street, East Orange, NJ 07018. Limit: one kit for each teacher or librarian.

• *What Is a Survey?* is a 32-page booklet containing information on types and characteristics of surveys, designing and conducting a survey, sources of errors, and using the results of a survey. This is interesting reading for a teacher or student about to start a statistics project. Single copies are free (additional copies, 50¢ each) from American Statistical Association, 806 15th Street NW, Washington, DC 20005. Send self-addressed label with your request.

• The Fifth International Congress on Mathematical Education will be held in Adelaide, Australia, August 24-30, 1984. Contact "ICME 5 Travel Planners," P.O. Box 32366, San Antonio, Texas 78216.

• The Canadian National Mathematics League held the 1983-84 Annual Elementary Grades Contest on Tuesday, March 6th, 1984. Forty questions were put to students in Grades 5 and 6; they had 30 minutes to work on them. Book early for next year's contest. Write to Michael Selby, Mathematics Department, University of Windsor, Windsor, Ontario N9B 3P4.

Mathematics 31 Curriculum Developments

Hugh Sanders
Chairman, Mathematics 31 Ad Hoc Committee
Math Consultant, Alberta Education

In March 1979, the Mathematics Curriculum Coordinating Committee was given approval to pursue revision of the Mathematics 31 course in keeping with changes in the Mathematics 10-20-30 and 13-23-33 programs.

A needs assessment was conducted by Alberta Education in May 1982. A proposed course outline was presented for reaction/discussion to postsecondary representatives at meetings held in Calgary and Edmonton in January 1983. The proposed outline was positively received without further revision by the postsecondary groups represented.

The Mathematics 31 Ad Hoc Committee was subsequently established to write course objectives organized into a core-elective format (80 percent core and 20 percent elective). The core would consist of calculus (50 percent of total term) and vectors (30 percent of total term).

	Portion of Total Term
1. Calculus (50%)	
A. Introduction to Calculus	38%
B. Derivative of a Function	
C. Applications of Derivatives	
D. Integration	12%
2. Vectors (30%)	
A. Geometric Vectors and Their Application	11%
B. Algebraic Vectors and Their Application	13%
C. Dot Product	6%
3. Electives (20%)	
A. Volumes of Revolution	7%
B. Trigonometric Extensions	7%
C. Calculus of Trigonometric Functions	13%
D. Calculus of Logarithmic Functions	13%
E. Matrices and Linear Transformations	13%
F. Polar Coordinates	7%
G. Systems of Linear Equations	7%

Negotiations between Alberta Education and Holt, Rinehart and Winston of Canada, Ltd., are currently under way with the aim of producing a single text that will deal with the above-mentioned topics. Appropriate sections of currently prescribed texts will be reprinted.

The *Mathematics 31 Pilot Curriculum Guide* (September 1983) is currently being piloted in 12 schools across the province. Pending a positive response to the proposed course outline, approval to implement the program of studies statements effective September 1984 will be sought from the Curriculum Policies Committee.

The MCATA Math Conference on Motivation

George Mullings
Mistassiniy School, Desmarais

On October 28th and 29th, I attended the Annual Mathematics Conference held on the campus of the University of Calgary. Speakers included Gordon Elhard, Associate Superintendent of the Calgary Board of Education, whose topic was "Motivating the Math Student."

The thrust of his speech was that if we have a one-to-one relationship with the student, most of our problems will go away. Some of the points he made were: (a) Treat each student as an individual, (b) Address each student by name, (c) Always establish eye contact, (d) Get each student to like you, (e) Find some time to have an informal chat with each student, (f) Never compare two students, (g) Never put down a student, no matter how stupid he or she might be, (h) Listen well to each student, and (i) Never ridicule a student. He said we should not see teaching as a job, because it is not: it is a way of life that we have chosen.

Another session I attended that I found very informative and interesting was presented by Dr. Robert E. Franken, Professor of Psychology at the University of Calgary. His topic was "Why We Give Up--Motivation for Persistence." The main point of his address was the apparent shift in the way we discipline students. He advised teachers not to seek respect from students. What teachers should do is seek a working relationship with students, whether respect is an important part of that relationship or not.

Teachers should find a way to motivate students, to make them want to work and enjoy learning. Teachers should clearly define their goals for each student, and not teach them all the same way. Most students are not going to be academic successes, so we should be teaching them accordingly. We should set students up for success, not for failure. If a student feels within him or herself that he or she is doing great, the teacher is a success. Sometimes a teacher goes away from the classroom feeling that he or she taught a great lesson. He or she should ask the question "Did the student learn?" Unless the student decides to learn, the teacher teaches in vain. A teacher should create a teaching situation in order to effect a learning experience.

Finally, he pointed out that teachers in Canada are learning from the American experience that the way to discipline in the schools will have to change. In the U.S.A., many good things came out of racial integration efforts in the schools. In order to handle discipline, leaders of the ethnic groups or gangs were encouraged to form a council which set up the rules and regulations regarding discipline in the schools. When these were approved by the school administration, they became rules that all students must abide by. A violator could choose to be disciplined by the principal or by the council. This method has been working very effectively in the U.S.A. and has brought discipline in the schools to a manageable level.

All in all, I enjoyed the conference. It was very worthwhile.

We Are Doing Okay, But There Is Room for Improvement!

W. George Cathcart
University of Alberta

Over one year ago, a questionnaire was included with each issue of *delta-K* to elicit reactions from MCATA members to the services the Council provides. The survey focused on *delta-K*, the monographs, and the annual conference. Members were also given an opportunity to comment on other areas of service. This article summarizes the responses to that survey and offers some interpretive comments. These comments are the sole responsibility of the author and do not necessarily reflect the interpretation of the executive.

Background

Forty-three responses were received which is a response rate of close to 10 percent. The distribution of the responses is shown in the data following this article. The low response rate could be interpreted as a reflection of general satisfaction with the Council and its activities. Who knows?!

Six of the 43 responses were from members of the executive, and the distribution of these six responses is shown in the data following this article.

The following paragraphs provide some comment on the nature of the responses.

delta-K

About 35 percent of the respondents said they read almost everything in the journal. Another 58 percent said they read only those things that looked interesting to them. The senior high teachers seemed to be the most thorough readers while the junior high teachers appeared to read the least.

Over 50 percent of the teachers said they used some, but not all, of the activities published in the journal. This suggests that teachers are using some discretion in terms of what activities they can profitably use in their classroom. On the other hand, it was disturbing to learn that about 40 percent of the respondents did not use any of the activities. Why? Surely some of the activities were relevant! One teacher explained the problem this way:

> Generally, only a small portion of the book lends itself to one level of teaching. The rest does me little good. Then, chances are, that portion is not what I am working on at that time. There are very good ideas, but in my planning day I just do not have time to leaf through all the material I have to find something applicable.

On the other hand, another teacher said, "The variety is good. I can use what applies, and I hand other information on to other teachers."

At the time the survey was sent out, eight "Problem Corners" had been published. Most elementary teachers said they did not make use of any of these problems in their class. This was expected since the problems were geared to the secondary student. However, over one-half of the senior high teachers said they did not use any of the problems. While senior high teachers seemed to read the most, their utilization was low.

In response to a question about the frequency of publication of *delta-K*, about 80 percent of the respondents said that the frequency (four issues per year) is about right. Written comments about *delta-K* tended to be positive. For example: "Over all, an excellent publication"; and "Excellent--the envy of all other Councils."

Negative comments were worded in the form of constructive criticisms. These criticisms pointed out weaknesses such as a lack of Alberta content and not enough material for elementary, especially primary, teachers, junior high teachers, and teachers of students with special needs. Another suggestion was that more information should be provided on executive meetings.

Canadian Mathematics Journal

The first experimental issue of the *Canadian Mathematics Journal* was included with the fall 1982 mailing of *delta-K*. Responses to the four questions on the survey to this experimental issue indicated a rather ambivalent attitude. Only 56 percent said they liked it, and only 51 percent said that it should be continued. If it was continued, only 40 percent agreed that it should replace one issue of *delta-K*. If it didn't replace an issue of *delta-K*, only 37 percent said they were willing to pay an extra fee for the *Canadian Mathematics Journal*.

Supervisors and teacher educators seemed more accepting of the experimental journal than the other groups. Written comments related to the *Canadian Mathematics Journal* tended to be positive and supportive.

The *Math Monograph*

The first question in this section of the survey asked respondents to check the monographs they had received. The titles went back to 1973. As expected, the majority of respondents checked the more recent publications. However, in each of the six categories, there were respondents who indicated they had received all of the monographs. The first monograph (1973) had been received by about 28 percent of the respondents. This suggests that a large proportion of the 43 respondents were long-standing and, therefore, probably fairly committed members of the Council.

About 37 percent considered the monographs to have been very worthwhile, and another 47 percent said they were okay. Five percent said the monographs were not at all worthwhile. Supervisors and teacher educators seemed to view the

monographs more favorably than the other groups. Four-fifths of the supervisors and teacher educators said the monographs had been very worthwhile. All the written comments were positive. Two examples are: "I am very pleased with them as they are. They make excellent reference sources for teachers, and they are complete." "I do like them. Since they are topical, they are easily accessed for quick information."

The idea of replacing the monograph with a monthly issue of a newsletter was viewed as a bad idea by 30 percent of the respondents; however, the newsletter is now being produced monthly. Another 44 percent said it should be tried on an experimental basis. Only five percent were prepared to accept the idea as a good one. Consistent with the results reported above, supervisors and teacher educators seemed least supportive of the change.

Written comments tended either to be negative or to suggest changes in content. The following comment is representative of the negative comments: "These tend to get filed in piles and forgotten."

A variety of suggestions was made as to content and format. Some suggested a newsletter needed to be "short, frequent, and 'newsy'." Some said that each issue should be thematic, others wanted worksheets that could be photocopied, and still others wanted advice on implementing curriculum changes.

Annual Conference and Business Meeting

The survey asked five questions about the annual conference and business meeting. Of the 43 respondents, 40 percent did and 58 percent did not attend the 1981 conference in Lethbridge. Almost 20 percent had attended five or six conferences in the last six years, another 33 percent had attended three or four conferences, and another 26 percent had attended one or two. Only 19 percent said they had not attended a conference in the last six years.

Lethbridge was not a central location, yet respondents with opinions were evenly split (40 percent and 40 percent) as to the acceptability of Lethbridge as a meeting site. Senior high teachers were least satisfied, and supervisors and teacher educators were the most satisfied.

About 53 percent of the respondents favored changing location for the conference each year, and 28 percent said it should be in one central location each year. Changing geographic regions was favored by all groups except supervisors and teacher educators who were more inclined to favor one central location each year.

About 47 percent of the respondents said they would attend future meetings regardless of where they would be held, but 35 percent said they would attend only if the meeting was in their area. Junior high teachers, administrators, and supervisors and teacher educators were most inclined to say they would attend no matter where the conference were held.

Written comments were positive. Regarding location, one respondent suggested holding the conference "every other year central (Red Deer); alternate years in

various locations throughout the province." Another recommended that the business meeting "should not be held while another session is going on. It should be held in the morning as a breakfast meeting."

Other Services

The following suggestions were made about services MCATA should provide: "In-service on the high school curriculum, on areas of the curriculum that need supplementing, and on statistics, geometry, and so on"; "More questions (challenging type) re Alberta Math Curriculum courses"; "Test item bank should be developed"; "Recommendations for good CAI computer programs"; "Offer a variety of teaching methods which could be used for particular concepts"; and "Perhaps more activities pertaining to individual grade levels and skill areas."

Summary

The following quote from one respondent can serve as a summary:

> I personally feel that MCATA has done a good job for math teachers and math education in Alberta. I have found annual conferences "about right" and more or less on a par with most NCTM sessions. I suppose the biggest problem is time, particularly time for teachers. For example, I feel it would be a major contribution to problem solving in the 1980s if teachers could find time to keep active in problem solving. Perhaps "Problems for Teachers" could be a feature in *delta-K*.

Activities for Gifted Students

Help is available for educators concerned with gifted students Grades 2 through 8 as a result of a project supported by the Mathematics Education Trust. This 36-page booklet, entitled *Mathematics Curriculum Outline and Sample Activities for Gifted Students, Grades 2-8,* is available for $3 from the NCTM Headquarters Office, 1906 Association Drive, Reston, Virginia 22091.

Project coordinator for this booklet was Alexander Tobin, Director of Mathematics Education for the Philadelphia School District. Contributing authors were Alan Barson, Robert Murphey, and Donald Scheuer who are also of the Philadelphia School District.

The Mathematics Education Trust was established by the NCTM Board of Directors in September 1976. The Trust is independent of the NCTM operating budget and is dependent upon gifts from interested persons, organizations, and companies for the support of special projects.

MCATA Survey Data Table

The following table reports the frequency of responses to different items, broken down by group.

Key: Elem = elementary teachers
JrHi = junior high teachers
Jr/Sr = junior and senior high teachers
SrHi = senior high teachers
S/TE = supervisors and teacher educators
Admin = administrators

	Distribution					
	Elem	JrHi	Jr/Sr	SrHi	S/TE	Admin
Total of 43 responses	9	9*	7**	9	1/4	4
Six executive responses	2	0	1	1	1	1

delta-K

	Elem	JrHi	Jr/Sr	SrHi	S/TE	Admin
1. How much of delta-K do you read?						
a) almost everything	3	2	1	5	2	2
b) only those items which look interesting	6	4	6	4	3	2
c) hardly any	0	3	0	0	0	0
2. To what extent do you use the activities in each issue with your students?						
a) I use all the activities suitable to my grade level.	0	0	0	0	0	1
b) I use some of the activities at my grade level.	5	5	5	5	2	0
c) I rarely use any of the activities.	4	4	2	4	3	0
No response	0	0	0	0	0	3
3. Eight problems ("Problem Corner") have been published in the last eight issues. How many of these have you given to your students?						
a) 7-8	0	0	0	0	0	0
b) 5-6	0	1	0	0	0	0
c) 3-4	0	1	1	1	0	1
d) 1-2	3	3	2	1	0	0
e) none	6	4	3	5	4	0
No response	0	0	1	2	1	3

* Including one elementary-junior high teacher
** Including one junior high, senior high, and supervisor

	Elem	JrHi	Jr/Sr	SrHi	S/TE	Admin
4. The frequency of delta-K (currently 4 isaues per year)						
a) should be increased	0	1	0	3	0	0
b) is about right	6	7	7	6	4	4
c) should be reduced	1	0	0	0	0	0
d) should be reduced to zero	0	0	0	0	1	0
No response	2	1	0	0	0	0
5. The June 1982 issue of delta-K was replaced with a special issue of the Canadian Mathematics Journal. Did you like this journal?						
a) yes	4	5	6	4	3	2
b) no	1	0	0	0	1	0
c) didn't look at it	2	2	0	1	0	1
no response	2	1	0	1	1	1
didn't receive it	0	1	1	3	0	0
6. Should the concept of the Canadian Mathematics Journal be continued?						
a) yes	3	5	5	5	2	2
b) no	1	0	0	0	1	0
c) not sure	3	1	1	2	2	1
no response	2	3	1	2	0	1
7. If the Canadian Mathematics Journal is continued, it should						
a) replace one issue of delta-K	1	5	3	1	5	2
b) not replace one issue of delta-K	4	2	3	4	0	1
no response	4	2	1	4	0	1
8. Would you be willing to pay an extra fee for the Canadian Mathematics Journal if it did not replace one issue of delta-K?						
a) yes	1	2	2	6	3	2
b) no	3	4	1	0	1	1
c) not sure	4	2	3	3	1	0
no response	1	1	1	0	0	1

MCATA Survey Data Table (contd.)

	Elem	JrHi	Jr/Sr	SrHi	S/TE	Admin
Math Monograph						
2. The monographs have been						
a) very worthwhile	2	4	1	3	4	2
b) okay	4	4	6	5	1	0
c) not at all worthwhile	1	1	0	0	0	0
no response	2	0	0	1	0	2
3. The monograph should be replaced with a 2-4 page newsletter which would be published more frequently, perhaps 10 times a year. This						
a) is an excellent idea	0	1	1	0	0	0
b) should be tried on a short-term experimental basis	5	4	4	5	0	1
c) is a bad idea.	3	2	2	2	3	1
no response	1	2	0	2	2	2
Annual Conference						
1. Did you attend the 1981 conference in Lethbridge?						
a) yes	3	6	1	3	2	2
b) no	6	3	6	5	3	2
no response	0	0	0	1	0	0
2. How many MCATA conferences have you attended in the last six years?						
a) 5-6	1	2	2	1	1	1
b) 3-4	2	3	1	2	3	1
c) 1-2	3	2	3	2	1	0
d) none	3	0	1	3	0	1
no response	0	0	0	1	0	1
3. Were you satisfied with the choice of location (Lethbridge) for the 1981 conference?						
a) yes	3	4	3	2	3	2
b) no	4	4	3	5	1	0
c) didn't care	0	1	1	1	1	0
no response	2	0	0	1	0	2
4. The MCATA Annual Conference should be						
a) held in different geographic areas each year	5	5	5	4	1	3
b) held in a central location each year	2	4	0	4	2	0
c) other	1	0	0	0	1	0
no response	1	0	2	1	1	1
5. I would attend an MCATA Annual Conference						
a) no matter where it was held.	4	6	1	3	3	3
b) only if it was held in my geographic area.	4	2	4	4	1	0
c) I wouldn't attend under any circumstances.	0	0	0	0	0	0
no response	1	1	2	2	1	1

The Development of Problem-Solving Skills: Some Suggested Activities (Part I)

John B. Percevault
University of Lethbridge

John B. Percevault is an Associate Professor at the University of Lethbridge. During 1982-83, while on administrative leave, he worked with Grade 3-6 teachers in Lethbridge elementary schools. This article presents some of the problem-solving skills and strategies that were used in the schools.

A quick overview of mathematics teaching in Alberta schools would reveal that activity is centred on problem solving. Alberta Education has produced an excellent monograph, *Let Problem Solving Be the Focus in the 1980s.*[1] This service document presents practical ideas for implementing Polya's four-step procedure for problem solving, namely, understanding the problem, developing a plan, carrying out the plan, and looking back. Another excellent monograph has been produced by the Mathematics Council of The Alberta Teachers' Association.[2] At the international level, the National Council of Teachers of Mathematics has produced a yearbook, *Problem Solving in School Mathematics.*[3]

The first recommendation in *An Agenda for Action*, another publication of the National Council, states, "Problem solving must be the focus of school mathematics in the 1980s." To implement the recommendation, recommended action 1.2 states:

> The definition and language of problem solving in mathematics should be developed and expanded to include a broad range of strategies, processes, and modes of presentation that encompass the full potential of mathematic applications.
>
> > Computational activities in isolation from a context of application should not be labeled "problem solving."
> > The definition of problem solving should not be limited to the conventional "word problem" mode. As new technology makes it possible, problems should be presented in more natural settings or in simulations of realistic conditions.
> > Educators should give priority to the identification and analysis of specific problem-solving strategies.
> > Educators should develop and disseminate examples of "good problems" and strategies and suggest the scope or problem-solving activities for each school level.[4]

Is There a Need to Define?

Authors use such terms as problem-solving strategies and problem-solving skills. For the purpose of this article, problem-solving skills are defined as the information the students may have, which includes facts, processes, and algorithms. Problem-solving strategies are procedures for processing the information.[5] Skills become the building blocks for the learner to develop new or different knowledge and to solve problems. Further, problem-solving skills may be taught and/or developed independently of the problem-solving situation. Teachers of elementary school children may wish to identify particular problem-solving skills. Instruction could then incorporate the skill during the teaching/learning situation, not only in mathematics, but in all subject areas. This does not mean that challenging problems should be excluded from the elementary curriculum. Hopefully, attention to the acquisition of problem-solving skills will enhance students' problem-solving ability.

The listings that follow are not intended to be all-inclusive:

Problem-Solving Skills

Reading

Computation

Representations (Models) such as:
--real materials
--drawing a picture
--a diagram

Recognize and continue a pattern

Develop a pattern

Estimate

Computation

Use formula

Collect and record data in:
--unorganized lists
--organized lists
--tables
--graphs

Problem-Solving Strategies

Modeling; for example:
--Develop a formula
--Transform or develop an equation
--Develop a system of notation

Relate to:
--another problem that has been solved
--a simpler but related problem (records and interprets)

Changes point of view

Break problem into two or more simpler problems

Inferencing skills, including:
--guess and check
--trial-and-error
--prediction
--generalize
--hypothesize
--seek relationship

Looks for pattern and then infers

Logical analysis

Synthesize (works backwards)

Asks an alternate question

It should be noted that the problem solver often employs two or more skills and/or strategies in arriving at a solution.

Suggested Activities

Activities that may be used to enhance the development of problem-solving skills should be incorporated into the teaching procedures for introducing the basic processes and introducing other strands of the elementary mathematics curriculum. Some suggestions follow.

Activity 1: Reading in Mathematics

A prerequisite to becoming an independent problem solver is the ability to read. To understand the problem, certain techniques may be employed, techniques that may be used with textbook story problems (routine) or with nonroutine problems.

Every problem in the text does not need to be solved. Use many of the problems for a directed reading lesson. Questions that the teacher may ask include:

1. What is the question? What are we to find? Have students read the question, state the question in their own words, or tell the question to a friend.

2. What quantities are involved? What is the information given? It is suggested that students encounter problem situations that have:

   --only sufficient information; the student states, tells, or writes.
   --insufficient information; the student identifies what is needed and supplies missing information.
   --extraneous information; the student crosses out extraneous information and rereads, omitting extraneous information.
   --information that has to be recalled or inferred; the student supplies the formula and orally states what must be recalled or inferred.
   --information that has to be determined from a diagram, graph, or picture; the student interprets a diagram, graph, or picture.
   --information that needs to be researched; the student uses the library to find information.

3. What process(es) is (are) to be used? Have students support the choice of process(es). Cue words (more, less, in total, and so on) may be identified. Students may also be asked to develop related problems that are at an easier, similar, or more difficult level. Students may also diagram or use a more abstract representation such as a number line.

4. Can you solve the problem? Each step of the directed reading procedure may be used as the basis of a lesson.[6]

Students who are not proficient readers may still develop the skills noted. The teacher or classmate should read the problem to the students.

Activity 2: Developing Models

Children learn to represent problems through the use of real material and through interpreting and developing pictures or diagrams. Textual materials utilize this technique to present the basic processes. Spatial visualization, a geometric skill, may also be introduced with real materials and diagrams. Early experience may help female achievement in spatial visualization, which is reported as being lower than male achievement.[7] Give children a supply of objects. Ask them to arrange the objects so that there are three in a row. Typical arrangements include:

```
   a          b          b          c

  xxx        xxx        xxx       x x x

             xxx        x         x x x
                         x
                           x       x x x
```

Some may note that arrangement "c" actually has eight rows each containing three objects. Vary the activity so that children are asked to represent the following problems:

1.	3 objects	- 3 in a row	- 1 row
2.	5 objects	- 3 in a row	- 2 rows
3.	7 objects	- 3 in a row	- 3 rows only
4.	9 objects	- 3 in a row	- 4 rows only
5.	11 objects	- 3 in a row	- 5 rows only

The configurations may include:

Problem:

```
1.  000          0            0           0
      (1.1)       0  (1.2)      0  (1.3)    0  (1.4)
                    0           0           0

2.  000          000          0           0
      0 (2.1)    0 (2.2)      000 (2.3)   000 (2.4)
      0          0            0           0

3.  0 0            0          0           000
    0 0 0          0          0             000
     0 0  (3.1)  000 (3.2)     000 (3.3)     0    (3.4)
                 0             0
                 0             0

    000            000        0
     0  (3.5)       0   (3.6)  000 (3.7)
    000            000        000
```

Problems number 4 and 5 are left for the reader to determine.

Examine the representations with the children. Questions that may be explored include:

Is 1.1 the same as 1.2 and 1.3? (Rotate a representation using an overhead.)

Is 2.1 the same as 2.2? (2.2 is a "flip" of 2.1.)

Does 2.3 satisfy conditions in problem 2?

Does 2.4 satisfy the given conditions?

Examine 3.2 and 3.6. Are they the same?

How many rows each containing 3 objects are there in 3.5?

Which configurations satisfy the conditions of problem 3?

Geometric concepts of intersection, flips, and turns can be explored. Representations (real objects and diagrams) may be analyzed to determine whether conditions of the problems were met.

See next issue for activities on collecting and recording data, recording and listing, listing-subtraction, and organized lists in a problem.

Notes

[1]*Let Problem Solving Be the Focus for the 1980s* (Edmonton, Alberta: Alberta Department of Education, 1983).

[2]*Math Monograph No. 7: Problem Solving in the Mathematics Classroom*, edited by Sid Rachlin (Edmonton: Mathematics Council of The Alberta Teachers' Association).

[3]*Problem Solving in School Mathematics*, 1980 Yearbook of the National Council of Teachers of Mathematics, edited by Stephen Krulik and Robert E. Reys (Reston, Virginia: National Council of Teachers of Mathematics, 1980).

[4]*An Agenda for Action: Recommendations for School Mathematics of the 1980s* (Reston, Virginia: National Council of Teachers of Mathematics, 1980), p. 2.

[5]Adapted from Sydelle D. Ehrenberg, "Concept Learning: How to Make It Happen in the Classroom," *Educational Leadership* 39, no. 1 (October 1981):36.

[6]For an alternate listing, use Raymond S. Nickerson, "Thoughts on Teaching Thinking," *Educational Leadership* 39, no. 1 (October 1981):23.

[7]Elizabeth Fennema, "The Sex Factor," *Mathematics Education Research: Implications for the 1980's*, edited by Elizabeth Fennema (Alexandria, Virginia: Association for Supervision and Curriculum Development, 1981), page 96.

Problem Solving – Distance, Rate, and Time

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There are many opportunities for problem solving using distance-type problems. The level of information given can vary with the class and individual. For students with a great deal of experience with problem-solving, one might ask the following types of questions:

1. Do different jets fly at different rates?
2. How does the price of a flight compare on a cost/km basis for a short flight compared with a long flight? Why?
3. Does it take longer to fly east or west? Why?

Students would be expected to define the problem, gather the data, make a model, solve the problem, and present the results with little help from the teacher. One way to solve the third problem could be as follows:

PROBLEM: Does it take longer to fly east or west?

INFORMATION: Air Canada flight schedule
Vancouver to Toronto (747) — 0915h-1625h
Toronto to Vancouver (747) — 1930h-2115h

SOLUTION: Flight time east 1625h - 0915h = 7'10"

Subtract time zone change 7'10" - 3' = 4'10"

Flight time west 2115h - 1930h = 1'45"

Add time zone change 1'45" + 3' = 4'45"

4'45"
-4'10"
35"

COMMUNICATION: It takes longer to fly west by 35 minutes due to the prevailing west wind or jet stream.

Other questions that could be answered, using flight schedules, are:

1. How long does it take to fly from Calgary to Toronto?
2. How long does it take to fly from Toronto to Calgary?
3. Why is there a difference between the answers to questions 1 and 2?
4. What is the average speed of a plane going from Calgary to Toronto?

Classes or individuals who are less secure with problem solving will need more structure in order to be successful in problem solving. Less-open questions than the above need to be asked with more secure sources of data supplied. An

assignment such as the following can be used. If you use the assignment you should modify the names to suit your city or town and use the appropriate schedules.

Use the bus schedule to answer the following:

1. How many kilometres is it from Nanton to Barnwell?
2. What is the time in Taber when the #1145 departs to Calgary?
3. How long does it take the #1158 to go from Barnwell to Calgary?
4. How long does it take each bus to run from Calgary to Lethbridge?
5. How long does it take each bus to run from Lethbridge to Calgary?
6. Why do various buses have different running times?
7. What is the average speed of #1185 between Calgary and Lethbridge?
8. At about what distance from Calgary will the #1145 and the #1186 meet?
9. What is the minimum number of buses needed to maintain this schedule?

Bus Schedule (from Greyhound Schedule 704A 6-24-81)

City/Town (distance from Calgary) \ Bus Run #	1185 Read down	1145 Read down	1186 Read up	1158 Read up
Calgary (0 km)	0800h	0600h	0735h	1000h
Nanton (87 km)	Non-Stop Express ↓	Non-Stop Express ↓	↑ Non-Stop Express	0825h
Lethbridge (224 km)	1100h	0915h	0500h	0630h
Lethbridge (224 km)	—	—	—	0605h
Barnwell (262 km)	—	—	—	0523h
Taber (272 km)	—	—	—	0515h

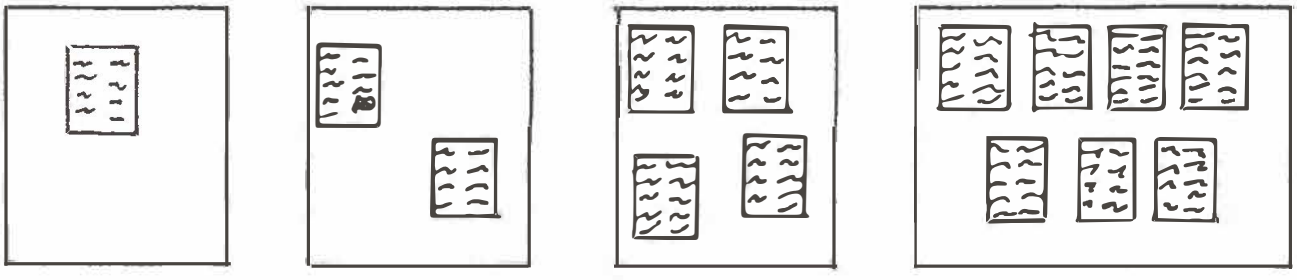
Microcomputer Corner

by W. George Cathcart

Editor's Note: *This is the first in a series of short articles dealing with computer education and applications. The "Computer Corner" is intended to provide practical suggestions for teaching computer literacy primarily at the elementary and junior high school levels. Feedback in the form of comments, criticism, suggestions, and so on is welcome. Correspondence should be addressed to the author at the Department of Elementary Education, University of Alberta, Edmonton T6G 2G5.*

"Gauge the Impact of Computers Using the Telephone Directory"

In the *Elementary Computer Literacy Curriculum Guide* (Alberta Education, 1983), the stated goal for topic 5, how computers affect society, is "to have students assess the current and potential impact of computers on society" (p. 17). To help achieve this goal you might have students collect copies of the yellow pages of the telephone directory for the past several years. Because a major impact of computers on society is indicated by the rapidly increasing number of firms in the computer field, students could: (1) Count the number of pages of computer-related ads for each year. (2) Count the number of firms offering computer sales and services for each year. (3) Compare these statistics on a graph. (4) Use a sharp blade to remove the pages with computer ads, and mount these as a bulletin-board display. Two copies of each directory are needed for this activity.



1981 1982 1983 1984

Your students may also analyze the ads in the yellow pages to determine for each year the number of new firms advertising and the number of firms that went out of business (that is, they advertised last year, but not this year). Your class might speculate on why some computer firms went out of business. These and other ideas for teaching computer literacy can be found in *Learning About Computers* by Gloria M. Cathcart and W. George Cathcart, recently published by Gage.

Issues in the Mathematics Curriculum

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There are salient issues in the mathematics curriculum that need discussion and resolution. Each teacher and supervisor needs to take a position on these vital issues. Which ones are the most important? I have identified four issues for discussion: inductive vs. deductive teaching; active student involvement vs. passive reception; measurable vs. general objectives; and the learner-centred vs. the society-centred curriculum.

Inductive vs. Deductive Teaching

Students may learn significant concepts and generalizations through induction. In this method of teaching, students use discovery techniques to answer questions or solve problems. First, students identify a question or problem. Then the students secure, either individually or in groups, the necessary facts and concepts they will need to answer the question or solve the problem. From the information students have acquired, they develop broad generalizations. These generalizations, which are supported by facts, are used to answer the question or solve the problem.

The opposite of the inductive method of teaching is the deductive method. In the deductive method, the teacher explains a new process to students. Students then apply that new process to a question or problem. In this method, a "one-way street" of communication exists: from the teacher to the student. The students must attach meaning to the process being taught in order that the process can be used to answer a question or solve a problem.

Active Student Involvement vs. General Objectives

Teachers who emphasize active student involvement believe that students learn by doing. Thus, with guidance from the teacher, students identify and solve life-like mathematical problems. To become proficient in problem solving, a student needs to practise specific problem-solving skills. These include selecting a problem, gathering data or information, developing a hypothesis or providing a solution to the problem, testing the hypothesis, and, if necessary, revising the hypothesis. There is no rigid sequence of steps to solving a problem: the steps should be flexible.

In a teaching method in which the student is a passive receiver of information, which may be facts, concepts, or generalizations, no provision is made for the

needs of each student. Ideally, each student will apply to the problem the information gleaned from the teacher's explanation or lecture. In contrast, the active student involvement method of teaching, which has students solve problems relevant to everyday life, demands the participation of the whole person: his or her intellect, emotions, and social and physical skills. This method of teaching mathematics helps integrate school and society.

Advocates of active student involvement believe that: students are capable of and interested in making curricular decisions; students are better qualified than teachers to order the sequence of their studies; and students need to evaluate themselves in order that evaluation be effective, and in order that evaluation have an impact on the student.

Measurable vs. General Objectives

How precisely should objectives for student attainment be stated? When the teacher uses measurable objectives, the learning activities guide students to attain the objectives. Then, the teacher may measure to determine whether a pupil has achieved the stated goal. Successful students then attempt to attain the next sequential objective. Unsuccessful students may need to be taught in a different way in order that they may attain their objectives.

Some methods for teaching that are related to the use of measurable objectives in mathematics are Instructional Management Systems, mastery learning, criterion-referenced testing (CRT), and exit objectives. In each of these methods, precise measurable objectives are used for teaching. Advocates of measurable objectives believe that teachers need to state clearly their intent to students; vagueness and ambiguity are not evident in this method.

Another advantage of using measurable objectives rather than general objectives is that each experience selected is chosen on the basis of one criterion: do the activities guide students to attain specific objectives? If the activity is too complex or if it lacks challenge, it is omitted. The teacher may measure his or her own success in teaching by determining whether students have attained the objectives. Furthermore, the results of learner progress may be expressed clearly and precisely to parents. There should be evidence that students are or are not achieving their measurable objectives.

The alternative to using measurable objectives is to use broad general goals to provide some kind of direction in determining the kinds of information a student wishes to develop and to use evaluation procedures that lack precision in determining whether students have attained objectives.

Learner-Centred vs. Society-Centred Curriculum

Should most of the objectives in teaching and learning come from students themselves? Or, should goals for students be selected on the basis of what society needs and deems significant? How might ends be chosen that reflect personal interests and purposes of students?

First, students can decide which tasks to pursue and which to omit when interacting with learning centres in the school/class setting. An adequate number of

tasks needs to be in evidence at diverse learning centres in order for students to select, as well as omit, sequential experiences. Students may then select truly interesting tasks to pursue. It is hoped that students may perceive the purpose of and reasons for participating in ongoing activities.

Additional teaching strategies emphasizing personal interests and purposes of students include:

1. *Individual Reading.* Each pupil selects and reads a library book, pertaining to mathematics, which has interesting content and which is at the reading level of the student. The student may also choose how to be evaluated in terms of using appropriate word-recognition techniques and comprehension skills. Thus, the student may read a self-chosen selection to the teacher; the teacher might then assist the student to appraise the quality of the student's word-recognition techniques. To reveal comprehension, a student may develop a mural, diorama, model, or creative dramatics presentation to reveal what has been learned from the book.

2. *Contract System.* The student, with teacher guidance, may specify which activities to complete involving mathematics within a particular period of time. The contractual agreement should specify a reasonable amount of time in which the activities shall be completed. Also, the activities must reflect student enthusiasm and must have a purpose.

To emphasize societal needs in the mathematics curriculum, teachers and supervisors need to ascertain what things society believes students should learn. Among other things, these might include:

1. being able to compute the total cost of goods and/or services purchased in any situation.
2. possessing the skill to ascertain the amount of change required for a cash purchase of goods and/or services.
3. being skillful in writing cheques and in keeping a responsible chequebook balance.
4. knowing how to obtain loans to make satisfactory investments.
5. possessing knowledge of concepts involved in interest rates.
6. realizing specific abilities involved in ordering materials from mail-order companies.
7. shopping intelligently for necessary goods and services used in the home.
8. knowing how to buy insurance for property and health.
9. learning to live within a budget.
10. being able to complete job application forms as well as being knowledgeable about required taxation forms at the local, provincial, and federal levels.

Conclusion

Selected issues in the mathematics curriculum need study, analysis, and synthesis. Teachers and supervisors need to become students of philosophical issues in curriculum development. Each issue needs to be resolved in terms of guiding students to achieve the optimum level of achievement in the mathematical areas of their personal interests. Also, students need to understand the purpose and meaning of mathematics; this can be done by using mathematical problems that are relevant to the everyday lives of students.

REVIEW

by Gordon Nicol

"Kids and Computers: An Enrichment Program for Elementary Schoolchildren" by Nancy L. Bloomstrand, *Arithmetic Teacher* 31, no. 5 (January 1984).

Anyone considering a horizontal enrichment program for the top five percent of elementary students in a 400-student school should read this article.

Nancy L. Bloomstrand is a learning centre director and consultant in Rockford, Illinois. She provides good background and lots of "nuts and bolts" details on both the Grade 3-6 and Grade 1-2 programs, including objectives, scope, sequence, timing, and projects.

The Grade 3-6 program includes the chronological development of numeration. Students work with clay, producing their birthdates in fired cuneiform-like tablets: good take-home artifacts. They use other machines including computers, and enjoy a field trip studying Da Vinci's work and art.

The Grade 1-2 topics include counting, bases, chip trading for addition and subtraction, attribute blocks, "Quisinaire" rods, art projects, spatial relations, and a tiling unit. Keyboard study leads into simple computer interaction.

Parental involvement is stressed. A detailed timeline showing scope and sequence is provided. The bibliography of 26 books, five magazines, and two software evaluations (including MECC) is a valuable resource as is the list of materials and equipment.

The stinger is that testing reported no statistically significant results, but favorable evaluation by students, staff, and parents. The second year was, unfortunately, cancelled due to staff turnover.

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