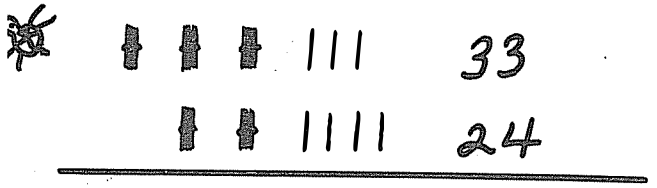
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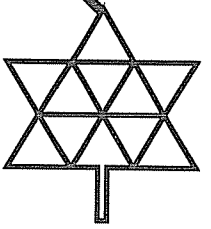
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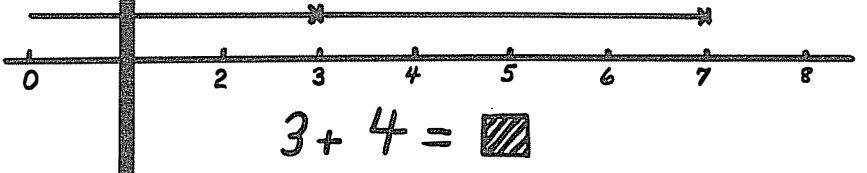


Special Elementary School Edition

OCTOBER 1967







sponsored by
THE SAMUEL BEATTY FUND
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THE ONTARIO ASSOCIATION OF
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ONTARIO MATHEMATICS GAZETTE

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ACKNOWLEDGEMENTS

The Publications Committee of the Ontario Mathematics Commission are grateful to the Ontario Association of Teachers of Mathematics and the Samuel Beatty Fund for the additional grants of $500.00 each and for the special grant from the Mathematics Department, Brock University of $100.00.

Additional copies of the Gazette may be obtained from:

The Secretary,
Ontario Mathematics Commission,
1260 Bay Street,
TORONTO, Ontario.

Price: 50 cents a copy.

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EDITORIAL - A CHALLENGE AND A CAUTION

Two notes are sounded in this prelude to the second special elementary school edition of the Mathematics Gazette. The first is a challenge; the second is a note of caution.

Has there ever been a time of greater challenge in the teaching of elementary school mathematics? The freedom a teacher is now beginning to have to experiment, to explore new ideas, to adapt existing situations and to think creatively is a most exciting breakthrough.

It is hoped that the readers will find this edition a challenge and an encouragement. Mr. MacLean provides the focus on current developments. The report of O.I.S.E.'s Mathematics K - 6 Project presents first hand views of participants in a current experimental project. Challenges to use manipulative material more effectively and to explore new techniques in teacher education programs are also included.

A challenge, however, should not be diminished by a note of caution. It would appear that certain new ideas explored in recent years have lost some of their effectiveness by being expanded and enlarged beyond their logical limitations. The Cuisenaire Method was hailed in some areas as an approach about to revolutionize the teaching of all mathematics in the early grades. Many have now abandoned this method. The topic of sets was developed by some writers initially as a great unifying concept to be developed in almost all phases of elementary mathematics. The topic has now fallen into relative disrepute in some circles.

Perhaps many fell into the trap of generalizing that what appeared effective in a specific area would be equally effective in all phases of mathematics.

What will happen to the current emphasis on the experience or experimental approaches to learning mathematics? Will they suffer similar fates five years hence?

They don't need to. The possibilities of these approaches appear to be most exciting. If teachers and supervisors will realize the potentials and limitations of each method, optimum values should be obtained.

In exploring new methods we must not conclude that what works for some children will necessarily work for all, that methods found effective by some teachers must be employed without delay by all others, that what appears to be successful immediately renders all other approaches obsolete.

Let us continue to explore new methods but let us do so continually assessing the results in terms of our aims of education to ensure a more effective and enduring approach to mathematical learning.

E. R. P.

WHERE ARE WE----IN MATHEMATICS EDUCATION?

by

J. R. MacLean

Assistant Superintendent of Curriculum

Ontario Department of Education

School systems are much like dinosaurs --it takes a long time for a message from the brain to get the whole organism moving. At the moment our system in Ontario is at a tremendously interesting stage. The elementary schools are responding at some speed to a message which has been repeated with increasing urgency, for more than fifty-years.

It is a simple message -- schools should be organized, not for teachers to teach or (which grows to a solemn mechanical state called the administration) but for children to learn. It has been voiced by the few great leaders in western life for three thousand years. More recently, Froebel demanded that children should be treated like children -- and that childish instincts like curiosity, should be harnassed to education. Pestalozzi tried to get away from teaching that was all words, insisting that wherever possible, children should feel what they were learning as tangible objects. Dr. Z. P. Dienes feels that the more sense modalities that can be involved the more efficient learning will become.

If classrooms are to be learning centres rather than teaching centres then provision must be made for 'learning by doing' or more briefly, experiencing. In my opinion, this involves at least two rather substantial changes - a much more flexible program and a new role for the teacher. In practice, the two cannot be separated. While groups of teachers and others can 'design' a course of study, only the individual classroom teacher can make it work.

The flexible program is provided for in P1, J1 Interim Revision

Mathematics. It provides a broad framework within which teachers working alone or in groups may develop a suitable program for children from age 5 to 11 or 12. It acknowledges the unique responsibility of the individual teacher in identifying and meeting the needs of each of his pupils. "No specific assignment of topics to grade levels is desirable" and "mathematics ..... should develop its concepts and its applications from real situations". No longer can our energies be directed to fitting each child into a stereotyped curriculum with the omnipresent examination and threat of failure serving as the prod to a more intensive effort. The program must be tailored to the individual and that natural instinct - curiosity must be carefully nurtured to a deep and abiding love for learning. P1, J1 can be described as a licence - an opportunity for every teacher to perform as a professional. This means a greater freedom and greater responsibility.

How have the teachers, who are in a sense, the living curriculum, responded to this new freedom? In the fourteen or so months since the program was introduced, over 4500 have voluntarily enrolled in either summer or winter courses in Elementary Mathematics offered by the Department. Many hundreds more have participated in other programs provided by the Ontario Institute for Studies in Education, the Ontario Mathematics Commission, the Federations and in in-service workshops and seminars organized by individual school systems throughout the province. Educational television has provided programs that were of great help in getting teachers started on creating this new environment for learning. In a word, the response has been enthusiastic and overwhelmingly positive.

Naturally, when traditional patterns of organization and performance are being altered teachers are concerned about their own ability to fulfil this new role. It is vital that the anxiety we are trying to remove from the children is not transferred to teachers. They must not only be convinced of the value of such change to the pupils, but also be assured of

the full support of principals, parents, supervisors, trustees and others in its implementation.

As part of a continuing effort to make available as many resources as possible, the Ontario Department of Education has arranged for Miss Edith Biggs, one of Her Majesty's Inspectors from London, England, to join the Curriculum Section as Assistant Superintendent for the period September 1st to December 31st. Miss Biggs has achieved world-wide recognition through her outstanding successes in assisting teachers to develop techniques that encourge learning through inquiry. She will direct workshops for teachers in several centres throughout the province during the fall term.

The structure of these workshops is unique on this side of the Atlantic. Teachers, supervisors, principals and inspectors representing Grades 1 to 13 will work together for a period of six full days. This organization not only provides a vertical integration of the mathematics involved but, through the involvement of supervisory personnel, allows the establishment of a cell or unit that will be largely self-sustaining and permits continuous evaluation and observation.

Miss Biggs directs the workshops with the help of ten specially-trained tutors. Through the co-operation of the Teacher Education and Professional Development Branches, the Supervision and Curriculum Sections, several municipal school systems as well as O. I. S. E. and the Colleges of Education, it has been possible to assemble a corps of some fifty assistants who will be able to continue this form of in-service activity after Miss Biggs has returned to England.

The transmission of the message referred to earlier has been given considerable impetus by these developments in Ontario. The schools are responding in a positive way. The future is bright.

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THE MATHEMATICS K-6 PROJECT

1966-7

Two experiments in elementary school mathematics were conducted in 1966-7 in approximately thirty-five centres in the province of Ontario. The projects were administered by the Office of Development of the Ontario Institute for Studies in Education with Dr. H. A. Elliott as project director. The topics, Geometry of Shapes (Grades 1-3) and Graphs and Relations (Grades 4-6) were studied following recommendations of the Report of the Committee considering the Mathematics Programme (K-6) 1965.

The full report of the experiment has been published and is available from:

Publications,
The Ontario Institute for Studies in Education,
102 Bloor Street West,
Toronto, 5, Ontario.

An Interim Progress Report appeared in the May 1967 edition of the Gazette.

Materials developed for the experimental project are being reprinted and should be available shortly from the Publications Office of The Ontario Institute for Studies in Education.

The following articles give some idea of the views of persons participating in the experiment:

A Primary Teacher's Impressions
A Junior Teacher's Impressions
A Supervisor's View
An Interview with a Principal and Four Participating Teachers
Comments of Participating Pupils
Reaction of Parents

A PRIMARY TEACHER'S IMPRESSIONS

by

Mrs. Sandra Rivington

Elmdale Public School

Ottawa, Ontario

Introduction

Last May, when I was invited to participate in the Ontario-wide experiment in geometry grades one to three, unpleasant recollections of my own introduction to geometry in the eleventh grade flashed through my mind. I recalled the many times I had sat up half the night memorizing theorems which I could not associate with anything in my way of life. Needless to say, I often questioned the wisdom of spending time on such an isolated subject. When I had completed the Summer Course which preceded the experiment, however, my views on geometry had done a right-about face. The content of the Summer Course was interesting and purposeful and the method of learning was by doing and understanding rather than by memorizing.

Procedure

In conducting the geometry lessons with my pupils, my plan of procedure was similar to that followed in the Summer School. Each topic was introduced to the class as a whole and definite purposes were set for learning about it. Then the pupils worked in groups at assignment cards which were designed to guide them to make discoveries on their own. They enjoyed the liberty of moving from one group to another of their choice as they completed each assignment. In the final lesson on each topic the pupils met again as a single group to discuss and chart their findings.

Observations

1. "Geometry became the children's favourite subject".
   Why? "Because" they said "we can do it ourselves".

2. The best way of determining what had been learned was by observing

the children at their geometry stations and by questioning them orally during these periods of activity.

3) The children became more aware of shapes in their environment and of the reasons for certain shapes being used in preference to others, For example, Ian said, "Our roof is shaped like a triangular prism so the rain and snow will slide off it".

4) They began to classify items in order of shape and size. This carried through to all subject areas.

5) The topics which were most enjoyed by the children were solids, faces, synthesis and tiling ! They showed little interest in lines and points.

6) Slower pupils showed more interest in learning geometry than in learning numbers.

7) The correlation with other subjects was extremely high. It was particularly interesting to note how the language of geometry permeated all subject areas.

8) The children's art became much more creative as they became increasingly aware of pattern and design.

Conclusion

For reasons stated above the content of the course was of great value to the pupils who participated in the experiment. In my opinion, however, the method of teaching was of greater value than the content in that it sharpened visual awareness, allowed for individual creativity and - most important - the teacher was but the guide while the pupils were the real discoverers and doers.

A JUNIOR TEACHER'S IMPRESSIONS
CHALLENGING NEW TOPICS-BY DISCOVERY

by

Mrs. Barbara Zabel

Duncan McArthur Public School

Kingston

During the 1966-7 experiment in graphing, relations and functions, one enthusiastic grade five boy found that mathematics had become, in his words, a "fun but working subject". This candid comment expresses the attitude of most children who experienced the new and challenging topics. This interest and enthusiasm extends to all phases of the school programme when mathematics as well as all other subjects are taught with emphasis on learning by doing.

The ten week mathematics experiment as outlined by O. I. S. E. involved the introduction of various types of graphs, their construction and use; by means of graphs, the development of the concept of one to one correspondence, extending to more difficult number relationships; experiences with ordered number pairs, functions and the co-ordinate system; mapping, including latitude and longitude; problems of rate, expressed in tables or in graphs. These topics were to be taught without the pressure to cover the course but with the intention of having the class work at the speed necessary for the class to discover the concepts involved.

For the teacher, the most impressive feature of the experiment was the obvious success and interest of the pupils in mathematics when a discovery approach was used. Their interest level was always high, and, since most lessons stressed pupil involvement, inattentiveness was seldom a problem. What a pleasant change to see a normally dreamy boy who listens only for the first five minutes of any lesson, now thoughtfully deciding that he must use a scale of five to one to represent his information on a graph ! For such a pupil the concepts of scaling would have meant

little when introduced in a teacher-designed situation unrealisticly set apart from the student's own experience and interest. Now however, the need for scaling arises in the child's graph experiences and his learning takes place as the result of this need. Other facets of mathematics such as number lines, estimation, rounding off numbers, ratio, fractional expressions, are learned or practised as the need arises. The understanding then is bound to be more meaningful and more lasting.

Any course of study, to be valuable, must be taught with consideration for the individual differences within the class. During the experiment activity areas were designed to accommodate a group of students, either working individually or as a group. The pupils were then able to move at their own speed to construct a graph, play a game using the co-ordinate system, or design related number pairs. The teacher circulates within the class, acting as adviser, guiding the child whose understanding is weak, giving praise to encourage individual and group achievement.

One grade five boy, generally lacking in background and experience, slow to learn and hesitant to question, remarked one day, "It's so much easier when you put your heads together". To this pupil who too often sits through lessons puzzled and bewildered, the co-operative effort in a small group made math lessons an interesting challenge rather than a threat. The opportunity to work at a speed consistent with understanding and in a situation where immediate problems were discussed, allowed this below average child to learn, whereas, during a regular class situation his comprehension would falter after the first few minutes. In contrast the very intelligent child is able to move at his own much faster rate, following a more challenging assignment designed to suit his ability.

In addition to the advantages of the group approach with regard to individual differences, this approach allows also for a much wider scope in learning. During the traditional class situation, the child's thoughts and ideas are channelled in a prescribed direction determined by the teacher's goal. In the pupil-involved activity however, provocative

questions and assignments lead the child to direct his own thought, make his own decisions and create many and varied methods of tackling a problem. The opportunity for divergent thinking creates many more possibilities for learning.

In the traditional classroom with its six neat rows, teacher talking at the front, pupils speaking only when asked, little opportunity for social development is available. Such teaching involves the stimulation of a child's mental capacity only. Within the pleasant atmosphere of group activities children grow as well-rounded individuals, developing personality traits and social ease under the guidance of an understanding teacher. Within group learning situations the individual learns co-operation, sharing, and consideration for others. He learns to value the ideas of another and to disagree politely and reasonably. One student remarked, "I don't like to go in groups because some people want one topic and I want another." This egocentric child needs very much the opportunities for sharing and co-operation provided by the group situation. Good work habits and discussion manners are learned in this atmosphere.

The situation as presented so far would seem very idealistic to many, but understandably the discovery approach with its emphasis on total involvement is not without its difficulties and problems. Certainly this type of teaching makes many demands upon the teacher's time and energy. As well, there are also those few children who remain discipline problems. However, in a group situation where the judgment of his peers becomes more evidently critical of his behaviour, a child is likely to assess his intentions before deliberately being uncooperative. Often the need will arise for class discussions, formal teaching of difficult concepts, and introduction of new ideas. But the children come to these lessons with eagerness, knowing that challenge and discovery lie in the experiments and activities ahead.

Although the discovery approach to the experiment was to me a major aspect of its success, the topics themselves, normally presented

in later years, proved very meaningful to elementary school children. Graphs fascinated the children. The freedom to choose their own topics favourite singing groups or even a comparison of the densities of various objects - heightened the interest as the children became involved in planning their math programme. The opportunity to develop, organize and carry out a graphing activity gave the boys and girls a feeling of success and achievement.

Once the graphs were constructed, opportunities for applying other mathematical learning were limitless. Computational skills were needed daily. As one example, when group graphs were completed, the pupils composed questions to ask their classmates. The motivation was high and basic mathematical facts were given a much more thoughtful study and use than in normal practice and review lessons or seat work. The pupils aimed for challenging questions in order to 'test' their friends.

Fractional comparisons and ratio when used to compare the variables on a graph, became more meaningful when viewed as a pictorial representation. Number lines now had a valid use and the children quickly saw the need for zero, and the relationship of the units. In one grade five class three boys had constructed a graph of the various centennial projects chosen by pupils in the class. However the number line on their graph was developed from right to left. As the boys were reporting to the class, a lively discussion ensued during which the children reached the conclusion that only convention dictated the direction of the number line. This situation is evidence of the increased opportunities for creative thinking resulting from so-called 'new' math.

Another strong advantage to the programme was the occasions given to widen experiences with their environment and correlate math with other subjects. Several activities involved a study or observation of their neighbourhood, of the school-grounds or of other parts of the school. The children also graphed topics in relation to science experiments - temperature, weather, study of solar system, - or social studies -

population of cities, rainfall, climate conditions, historical facts.

One of the purposes of the experiment was to determine the grade level at which topics might best be presented. The children quite readily suggested that pictographs and bar graphs would be easy in earlier years of their school experience. Even topics such as the mapping or graphing of functions, previously left until secondary school, become a challenging and meaningful new learning experience for ten-year olds. When functions are introduced through the 'What's My Rule' game, number relationships are intriguing to the pupils and yet they are building the foundation early for more advanced learning. Instead of visualizing our numeration system in terms of long addition questions and dull division, the children discover that the world of numbers is fascinating and fun to explore.

All of the topics outlined in the experiment captured the interest of all the pupils. Often more difficult questions were too great a challenge for any but the bright pupils. The very slow child had difficulty with some of the simple concepts such as O on a number line or the equality of units on a number line. However, the ground-work of all the topics could readily be laid in these grades so that early experience would facilitate the more difficult learning to come at a later stage.

Pupil reactions serve as evidence of the experiment's success. "Why can't we do everything like this?" "This isn't math, this is fun!" "You learn more when you enjoy what you are doing." Such comments indicate the natural eagerness and fascination of pupils actively involved in a math programme which caters to their curiosity and will to discover.

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A SUPERVISORY VIEW OF THE O. I. S. E. EXPERIMENT

by

H. E. Parliament

Inspector of Public Schools

Galt Board of Education

The 1966-67 O. I. S. E. experiments in geometry and graphing were conducted locally in Grades 1 to 6 during the winter term, though our involvement started last October.

Early in the fall term, the three teachers concerned had the good fortune to attend an orientation workshop in London for teachers participating in the project. They immediately realized the importance of involving the pupils in group activities prior to the ten-week period of the experiment, so that the pupils and the teachers themselves would feel comfortable in what for all of them was basically a new approach. Pupils' desks were rearranged; classes were subdivided into heterogeneous groups and various activities were tried using assignment cards where possible.

The pupils enjoyed these changes and frequently asked, "When is it our turn for 'group activities' again?" The teachers were less enthusiastic. "Should we permit the children to talk to each other?" "How do you know if they're learning?" "Where can I get more manipulative materials?" "Am I doing it the right way?"

As a result of the preliminary work and the questions that followed, our role as supervisors became clearer. We found that we helped the teachers most when we assisted them in understanding their goals, providing necessary supplies, encouraging more pupil participation and reassuring the teachers that their contributions were indeed significant.

When the ten-week project actually began, doubts and fears soon vanished. Both the children and teachers responded to the challenge with new-found interest and understanding.

Several points became apparent. Children in these classes showed better social adjustment. The quiet child learned to express himself; the extrovert realized his limits. Attitudes improved and Mathematics was fun. Insights into mathematical concepts, formerly delayed for higher grades, could be mastered earlier. The skills of listening speaking, reading and writing improved too. Teachers understood for the first time the real significance of pupil involvement and learning by discovery. Pupils no longer were content to be passive desk-sitters. They expected to move about the classroom, manipulate materials, make and share discoveries and be involved in the evaluation.

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INTERVIEW WITH A PRINCIPAL AND PARTICIPATING TEACHERS

Of the schools participating in the experiment, one of the most interesting was Princess Anne Public School in Sudbury, Here the principal and four of his staff took the preparatory summer course and conducted the experiment. This abridged account of an interview with them is included to emphasize that there is considerable merit in having several teachers in the same school involved in an experimental project and in having the principal as an active participant.

Participants:

Mr. William Gilmour, Principal
Mrs. Drene Luck, Grade Two
Mrs. Fraser Simmie, Grade Three
Mr. Brian Fielding, Grade Four
Mr. William Napier, Grade Five

Interviewer:

Mr. E. R. Pipher

Mr. Pipher: "Because you worked as a team, we are interested in finding out some of the advantages or disadvantages of a principal and several staff being involved together in experimentation. First of all let's start off with Mrs. Luck. Would you give us some view of what it meant to you knowing that somebody else in the school was also doing the same work".

Mrs. Luck: " We proceeded with a greater degree of confidence because we had someone else to talk to and discuss with. Problems do not seem nearly so insurmountable when you have someone to talk to. "

Mr. Pipher: " Did you get together in planning any of the lessons or did you go on your own and then discuss informally?"

Mrs. Luck: "Several times we would go into each other's room to discuss what we did during the day and several times we discussed how we could relate to other subjects such as art, drawing pictures and designs with the shapes".

Mr. Pipher: "So most of your discussions were informal ones; you talked over coffee and so on. Did the children from different classes compare what they were doing?"

Mrs. Luck: "The Grade 2 came rushing in one day, after recess, for instance, telling me about the Grade 3's work which was displayed in the hall. They had gone ahead of us. "

Mr. Pipher: "Well, let's take a look at the junior program. To what extent did you work together, Mr. Fielding?"

Mr. Fielding: "The three of us in the mapping and graphing got together and worked quite closely on this. We would meet as the other group did, informally, discussing the problems that we had and what we were going

to do for the next series of lessons. We worked together on making assignment cards. This was the big thing we found with the broken-line graph---getting enough experience that the children could do. We sat down on one occasion and came up with several good ideas on that. Our work together was informal and I honestly cannot see how you could do it alone. We really helped each other a great deal. I did get the feeling, though, at times, the way our schedule was working with Mr. Napier starting on Monday that he was the one to be the pioneer. He was the one to break the ice and then we would try to follow along. We would make adaptations change something or do something just as Mr. Napier did it the first day."

Mr. Pipher: "Mr. Napier, did you find that it would be an extra burden on your part to be the pioneer, so to speak?"

Mr. Napier: "I think I was only the pioneer in working with the class because if by Thursday or Friday I had an idea where I would be and where the other classes would be the next week, I would meet with both Mr. Fielding and Mr. Gilmour and we would discuss the topic. I would ask help about what I could do and I would take these back and work them over during the weekend. As Mr. Fielding mentioned, the first attempts weren't always the best and the other two teachers would adapt them to their own classes. We found sharing of materials a definite advantage. The materials themselves were easy to move from class to class.

Mr. Pipher: "This is addressed to any of the teachers. The majority of your colleagues who came down to summer school and then tried the experiment, if they were not principals themselves, went back and hoped to get the co-operation of the principal and in most cases, they did. Now would you go out on the limb here and say if you think that when an experiment is being conducted having the principal as one of the participating teachers makes any difference?"

Mrs. Simmie: "I think it helps to have the principal on your side because if the work interrupts his class or if he hears a racket going on in the rooms, he understands what is involved in having children working in

groups.

Mrs. Luck: "If you find that you are not covering the regular course as you feel you should be, you realize that there will be understanding on the principal's part."

Mr. Fielding: "I feel that the principal being involved in the project is probably one of the most important aspects of its success because without it you don't get the same kind of co-operation. He knows exactly what problems you are running into and you sort of treat him as an equal in this respect and work out your problems together."

Mr. Napier: "One practical aspect of the principal being involved is the fact that any supplies that have to go through the office are easier to get if the principalneedsthese supplies as well. We were not turned down on anything we asked for.

Mr. Pipher: "Now we will ask the Principal, Mr. Gilmour, to say from his point of view how he felt being one of the participating teachers."

Mr. Gilmour: "To evaluate the programme and to appreciate the full impact of it I feel that the principal should be directly involved. I have sat in on conventions where programmes were outlined but I do not feel that from the principal's standpoint they can be too significant until you become an active member. I feel that it also does a great deal for the staff. I feel that it has knit the group together as a team. I was very fortunate here in the calibre of personnel because they have really gone all out and put their heart into it. You really appreciate the problems that come up because you are part of it. Then you can go to your superiors of the School Board and lay your case and here again, we have been fortunate in the co-operation we have received from the Board. There is one disadvantage and that is the problem of time. As the principal I felt that I used the resources of the other members to help me through on my lessons rather than giving as much in the initial planning. I appreciated it but felt that

I didn't always pull my own weight in this respect."

Mr. Pipher: " Thank you. Now one other question. Were you aware of any reaction among the teachers on the staff who were not involved in the experiment?"

Mr. Napier: " One good example of this was the fact that we have a junior opportunity class here and the teacher in this grade took on the task of making some materials and this certainly helped out her math. program. and it was a big help to us to get these made. As far as many of the other staff members were concerned we had over half of the staff participating so that if they had any complaints it was usually kept among themselves in the staff room, because we didn't hear of any. They didn't object too much or too long and hard about our children going into their rooms to do some polling or moving outside the windows or in the hall"

Mrs. Luck: "I felt slightly disappointed that some of the teachers who weren't involved in the experiment, didn't try some of the things that they had seen in our room with their children."

Mr. Gilmour: " I felt that there was considerable interest from the teachers who did not participate in the experiment, They were probably swept up in the enthusiasm of the participating group who probably overpowered them but there was excellent co-operation and I feel that many of them will be interested in trying this next year. They did ask questions about the project and were quite interested in what we were doing."

Mr. Pipher: "Now as a conclusion to our discussion, I would like you to pass on any suggestions to groups of teachers who may be about to start some experimentation in mathematics. I hope that among our readers there will be many such teachers so what words of advise would you have for them?"

Mr. Gilmour:"I feel that teachers should be encouraged to experiment but they should not be put under obligation. I felt that they must be a group that are very congenial and should be prepared to work as a team."

Mr. Napier: " I also feel that if any school is going to try this experiment that they have to get rid of the traditional idea of a time-table as being a set forty minutes or thirty minutes. We found here that a block of time is best suited to this type of project. I think too that a school should keep in mind if they are trying this type of experiment, the type of furniture in the room. If it is at all possible, tables seem to work better than the types of desks where the seat is fixed to the top part.

Mr. Fielding: " One piece of advise that I would like to pass along is that among the staff members participating there must be complete co-operation and interaction among the group. For example, in this school at the time that the project was going on, it wasn't unusual at all to have one staff member wandering in and out of the different rooms to see what was going on and if someone came up with an interesting idea he might go down to the next room and ask that the teacher come up and look at it and pass his opinion about it. "

Mrs. Simmie: " For anyone trying in particular the geometry part of the experiment, plenty of material should be prepared because of the length of time this requires and also if anything, however significant, or seemingly insignificant, is discovered, any technique or discovery that the children make, the teacher shouldn't be hesitant to pass this along. "

Mr. Pipher: "Thank you very much. I would like to say to Mr. Gilmour and his staff here at Princess Anne School that I know I speak for all of the Math Committee of O. I. S. E. when I say how much we have appreciated the very fine work that you have done here. I wish you success as you continue to develop ideas which you began to explore this year.

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COMMENTS BY PARTICIPATING PUPILS

GRAPHING

My Opinions on the Math Course

The lesson was very different from what I expected. I didn't have any idea what graphs were before the math course. I got a greater sense of responsibility when I did something by myself. When I went and collected the information it was fun. When I worked with somebody else I learned to work as a team. Besides being fun and a great experience it helped me in many other ways too.

David Bliss.

GEOMETRY

Dear Mr. Pipher
I like geometry.
I is fun tracing
shapes.
The cone has a
name you can
remember. Reggie
Peterborough Unger.

REACTION OF PARENTS

Mrs. Carolyn Bishop of King Edward School in Barrie, who participated in the experiment, was asked to obtain the reaction of parents to the activity-centre approach to learning. Mrs. Bishop employed this approach in other subjects and in the work in mathematics outside of the experimental period as well.

"Dear Mrs. Bishop: June 30, 1967.

Many thanks for your interest and the sincere guidance you directed not only to our son Dan, but I am sure to the rest of your class.

During the few times my wife and I had an opportunity to visit your class we were always interested in the ingenuity you injected into what used to be a most stereotyped classroom in our time.

We were impressed with:

1. The students filling our their own activities report card.
2. The casual, relaxed arrangement of the tables and chairs in the classroom, which seemed to invite student-to-student and student-to-teacher compatibility.
3. The liberal use of training aids.
4. The obvious success you have had with your efforts to arouse the students to use their <u>own</u> senses to inquire, to search and to seek out the wonders of nature and science .

Yours sincerely
Dr. A. G. Andrews "

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"Dear Mrs. Bishop: June 29, 1967

I have just finished looking over Jill's report and thought you might be interested in my comments on your teaching methods. To put it in one word I would say they are excellent. You have helped Jill immeasurably and my wife and I would like to thank you most sincerely.

I needn't tell you that when Jill first went into your class... she was a very withdrawn child who would rather be by herself than with a group. Although she was doing very well in school with the three "R's" she would not take part in group discussions or activities that required her to put forth her own ideas or opinions and did not care much for school at all. She had similar problems at home when it came to dealing with her sisters and friends.

My wife and I, through giving Jill extra attention and time drew her out of her shell a bit but it has been the time she has spent in your class that has made the big difference. She is no longer shy and withdrawn but enjoys talking with people and giving her views and ideas.

I think your method of letting the children progress at their own pace and proper guidance when needed and not competing for the highest marks has made a big difference. Jill has developed a healthy curiosity of things that go on around her and enjoys finding out about different things. She is not afraid to ask about something she doesn't understand.

When I visited the school and looked around the room I noticed there was not one bored child. They were all deeply engrossed and thoroughly interested in their particular task. This was quite a change from some of the other rooms where the regimentation was quite evident.

Again may I thank you for instilling in Jill a love for learning and the desire to get along with people which is really what this education business is all about.

Yours sincerely
Bert Verwey "

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THE TRAVELLING LIBRARY

The Ontario Mathematics Commission with the co-operation of the members of the Canadian Book Publishers' Council has prepared a collection of mathematics books suitable for teacher and student reference. This library is available again for display at 1967-68 teacher meetings.

Any teacher group may borrow the library by paying the express charges both ways.

Requests for the library should be sent to:

Professor A. W. Harris,
Department of Mathematics,
Althouse College of Education,
1137 Western Road,
London, Ont.

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MATHEMATICS K-6 PROJECT 1967-68

Objectives of the 1967-68 Projects

1. To study the topics, "Measurement" and Pictorial Representation" at the Grades 1, 2, and 3 level.

2. To study "Geometry" at the Grades 4, 5, and 6 level. This study would presuppose that the pupils have not studied three-dimensional geometry previously. It would involve an adaption and extension of the primary geometry studied in 1966-67.

The purpose of the studies listed above is to discover appropriate content along with suitable methods of approach, to determine the best age or grade level for optimal results, and to consider methods of evaluating pupil progress.

3. In view of the widespread interest in recent months in the laboratory or small-group-discovery approach to learning in mathematics, a further study of this technique appears desirable.

The purpose of this study is to provide a basis on which to give assistance to teachers in determing what goals can be accomplished with this technique; how to organize the classroom; the size and make-up of the groups; what modes of pupil behaviour can be expected; a valid method of evaluating pupil progress; what other techniques are necessary to complement this approach.

The experimental material was developed by a writing committee of O. I. S. E. Participating teachers along with a number of inspectors, consultants, and principals attended a two week course in July in preparation for the projects. The trial period for the Laboratory Approach will be conducted from November

1st, 1967 to March 29th, 1968. The other two projects will begin early in January, 1968 after some preliminary work in September.

A limited number of visits to participating classes can be arranged. Persons interested should contact the Board of Education concerned or

Mr. E. R. Pipher, Field Consultant
Office of Development
Ontario Institute for Studies in Education

Participating Boards

C. R. C. S. S. Bolton
Borough of East York Board of Education
Galt Board of Education
Guelph Board of Education
Hamilton Board of Education
Hamilton Separate School Board
Kitchener Public School Board
Kitchener Separate School Board
London Separate School Board
London Board of Education
Metropolitan Toronto Separate School Board
Nepean Township Public School Board
Oakville Board of Education
Pembroke Public School Board
Peterborough Board of Education
St. Catharines Board of Education
Waterloo Public School Board
Borough of York Board of Education

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ILLUSTRATIVE AND MANIPULATIVE MATHEMATICAL MATERIALS

by

K. W. Kenney

Althouse College of Education

University of Western Ontario

London, Ontario

The success of the mathematics program of any classroom or school is highly dependent on the effective use of illustrative and manipulative materials. Assuming we are cognizant of the aims of the program and fairly confident of the structure and sequence of the subject content, then mathematical materials or learning aids in their proper place can do much to supplement the methods used by the teacher to provide a fruitful learning environment for the students.

If we endeavour to meet the needs of each individual in our class then instructional methods must be flexible and varied. One way to provide flexibility and variation is to consider seriously the role that available illustrative and manipulative aids can play in the mathematics program.

Carefully planned aids allow students to use several senses: sight, sound, touch, kinesthesis and intuition. The phrase "audio-visual aids" seems to place emphasis on sound and sight only, whereas "illustrative and manipulative aids" highlight seeing and doing. If students see demonstrations or, better still, do the activity themselves, the learning experience will undoubtedly be more enjoyable and retention more lasting.

What impact does the use of aids have on the children in the classroom?

Probably the foremost reason for the use of materials is to provide varying degrees of concreteness to abstract mathematical ideas. Often a variety of materials can be used to develop a topic or idea several ways with students and thereby provide reassurance and bolster confidence.

Interest in mathematics is self-motivated when numerous types of materials are readily available in the classroom. When problems are posed, these materials often provide the foundation for student-experimentation. In search of a solution to the posed problem, children are learning with the aid of materials, how to use an organized, scientific approach. When student experiment with materials true discovery will result.

Working with manipulative materials in an experimental manner may spur further inquiry on the part of students and indeed encourage improvisation of apparatus. Creativity and inquisitiveness, so evident in the primary years, must not be dampened as children proceed through the junior and intermediate divisions of our elementary schools. We want children to continue to ask themselves "I wonder what would happen if.....?

As children encounter mathematical ideas that are more difficult or involved, an understanding of the idea may be revealed by a simplified demonstration of materials. A simplified demonstration may be all that is needed to recall or review some previously learned facts that are relevant to the problem at hand.

Mathematical materials can be used to practise and affix mathematical ideas or facts through a "fun and games" approach. There are ever increasing numbers of games and puzzles available commercially related to the mathematics of the elementary school. All are good, provided that the competitive aspect does not override the mathematical ideas and enjoyment that the game or puzzle provides.

Mathematical games and puzzles created or improvised by teacher and/or students are more likely to achieve the desired purposes.

When determining materials for the mathematics classroom, three main sources of materials are available: 1) Commercially Supplied; 2) Teacher-made; 3) Student-made.

Commercially, there is an increasing number of mathematics aids available. A careful observation of any catalogue reveals that more and more of these aids are prepared for use by the students rather than for teacher demonstrations. There also appears to be a trend in schools to budget more money for learning aids. Therefore, commercially produced materials must be carefully considered. If the materials are durable and can be modified for a multiplicity of uses by teacher and students, then the investment is justified over a long period despite original cost.

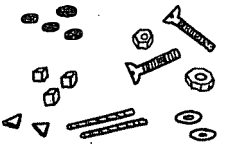
Materials prepared or improvised by the teacher or students at minimal cost are often available more readily and serve a more immediate purpose. Regardless of the source of materials, it is imperative that they be available for student use at all times and students should be encouraged to work with materials whenever a need arises. A mathematics table or corner in the classroom, where materials are on display at all times will reap great dividends. A sign entitled "PLEASE TOUCH" may be a feature on the table; in addition to teacher-prepared assignment cards related to the materials on display.

What are some of the aids or materials that would help to make the classroom a mathematics laboratory in action?

Below, is a list of materials to be considered. No attempt is made to categorize them according to student levels. It is important to keep in mind that these materials may be used for teacher demonstrations, pupil demonstrations, small group activities or individual student invest-

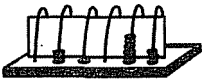
igations. Though an aid is prepared for a specific topic, it may be that new and varied uses for it will be discovered later.

1. COUNTING MATERIALS: checkers, plastic discs, pieces of sponge, cardboard or felt shapes, sticks, sipping straws (plastic), beads, small steel washers, nuts and bolts (available in any hardware store)



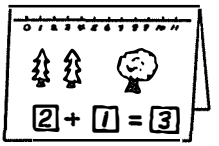
The quantity of counting materials should be adequate for each pupil to have a counting kit of his own.

2. ABACUS: with seven columns of counters



3. FLANNELBOARD: with variety of cutouts for use on board

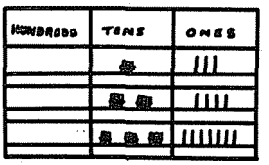
4. MAGNETIC BOARD: should be large enough for easy manipulation of magnetic objects



5. VISEOGRAPH: large sheet of clear plastic behind which prepared problems may be inserted and on which one may write with a water soluble pen



6. PLACE VALUE POCKET CHART:
   - at least three pockets in which strips of coloured paper may be inserted
   - very useful to illustrate exchanging a ten for ten ones and vice-versa

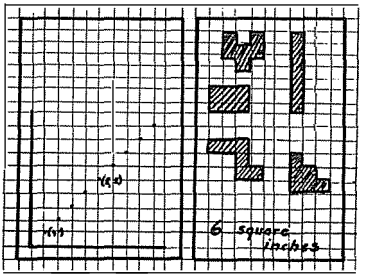


7. NUMBER LINE MATERIAL:

- plain cash register tape with marks equidistant placed along the top edge of the chalkboard, makes it possible to write numerals on board below the points on the line
- individual number lines from masking tape or folding strips of paper

8. LARGE GRAPH PAPER: 1" x 1" squares

- for making graphs
- teaching about the area of a region
- marking points on the cartesian plain
  (3 right and 2 up)
  (graphing ordered pairs)



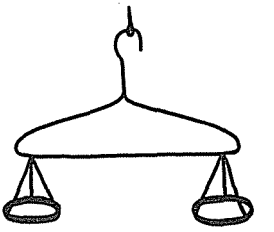
9. OVERHEAD PROJECTOR:

- for teacher or student demonstrations
- exercises or problems can be projected on screen

10. TAPE RECORDER: to be used by individuals or small groups to complete prerecorded exercises

11. BALANCE: one can be improvised by attaching two foil plates to a coat hanger

- fairly reasonable balances are also available commercially
- a variety of improvised weights should also be made available (nuts, washers, marbles, etc.)

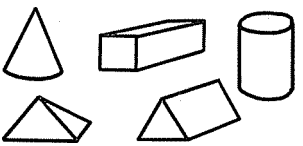


12. COLLECTION OF CONTAINERS: (for measurement of capacity and volume)

- cardboard boxes
- bottles
- jars

 variety of shapes

13. GEOMETRIC MODELS: (three-dimensional and plane figures - to compare shapes and sizes and to categorize according to common properties)



14. GEO-BOARDS: any square board marked off in at least 100 squares and finishing nails at all intersections. With elastics or string, the geo-board can be used for graphing, comparing geometric shapes, measuring area, etc.

15. BULLETIN BOARD AND CHALKBOARD: these two aids are available in all classrooms for illustrative materials. These should be primarily used to display and record work completed by the students.

In addition to those above, there are four other aids that should be mentioned and all four could be classified as visual pictorial projections. I refer to the 16 MILLIMETER SOUND FILM, the FILMSTRIP, the SINGLE CONCEPT 8 MILLIMETER LOOP PROJECTOR and CLASSROOM TELEVISION. All four can play an important role in the program, but we should remember their contribution lies mainly in the area of enrichment, stimulation and reinforcement of ideas. They should be thought of as a supplement to the day-by-day activities in the classroom and every opportunity should be made to incorporate all of them if equipment is available into the program.

The 8 mm. single concept loops are relatively new to our schools. The use of a loop projector certainly provides for individualized learning

and since loops are silent and about three minutes in length, repetition is possible. A loop projector, as well as classroom television can certainly be the springboard of ideas for many additional classroom activities to be investigated.

With so many materials available for classroom use, the mathematics program should display a hive of activities. Mathematical skill will be developed and practised in realistic situations and through a democratic process of solving problems that may do much to develop leaders for tomorrow's world.

EXPERIMENTAL MATERIALS IN GEOMETRY (Intermediate Division) SOME LESSONS AND SUGGESTIONS

A writing team has prepared material for use in classrooms from Grades 7 to 10 based on recommendations of the Report of the K-13 Geometry Committee.

The material consists of a series of lessons and suggestions based upon the "Specific Proposals for Stage B Intermediate" of the K-13 Report. Publication is now in progress and a limited number of copies will be available for experimental use from the Office of Development of the Ontario Institute for Studies in Education.

IMPRESSIONS FROM THE N. C. T. M. ANNUAL MEETING
LAS VEGAS - April 1967

by
J. D. Cadwell
Assistant Superintendent of Public School
Windsor Board of Education

Las Vegas was a happy choice of location for the Annual Meeting, allowing as it did, for many of the convention delegates to apply the lessons of the day to the activities of the evening. Facilities for the convention at the Las Vegas Convention Centre were excellent and the arrangements made by the host organization, Southern Nevada Mathematics Council, were outstanding.

In general the sessions seemed to focus much attention upon the following topics:

1. Problem Solving

Developing the pupil's' ability in problem solving was listed by several of the convention speakers as being the main aim of mathematics instruction. In order to experience success with problem solving the child must first have had multitudinous experiences with physical objects. From these experiences and activities it is possible to make abstractions and develop mathematical concepts which must then fit back into the physical world of a problem. It was felt that the teacher's role is direct in the provision of activities with physical objects in the real world but that in the development of mathematical concepts in someone's mind the role is only able to be an indirect one. The following points were some that were elaborated upon by the various speakers as means by which problem solving techniques might be improved:

a) Dramatization to focus the child' attention upon the physical orientation of the problem.

b) The drawing of pictures and illustrations to show how problem component are related.

c) The making up of problems by the pupils.

d) The development of computational skills.

e) The encouragement of deliberation and a "What's going on here?" attitude.

f) Precision in the making of the model and the equation. Number sentences should parallel the problem situation and although a problem may have more than one correct model, each one should be defensible.

2. Methodology

Several of the speakers and delegates concurred in the idea that we must pay much more attention to our classroom methods and techniques. While the "revolution" was in its infancy new topics were self-motivating and interest sustaining.

Now that we are teaching children who have been exposed to some of these topics for a period of years it is evident that pupil interest is waning. We have cause to fear that our teaching of mathematics may become dogmatic and uninspiring. Teachers generally are not asking for more mathematics but rather how they may be more effective with what they already know. As a result teachers' organizations and individual teachers must be ever searching for ways in which methods and techniques can be improved. This of course, has always been the case, but we must certainly be aware that the need very definitely exists in relation to mathematics instruction.

3. Measurement

"Measurement in the Primary Grades" was an excellent presentation by Professor John Marks of San Jose State College.

Marks felt that it is first necessary with young children to develop a language of measurement through comparison of objects since early measurement experiences are not related to, "How long?", but rather to "Which

is longer?" or "How many of these will fit that?"

Non-standard units which the pupils have developed themselves should be used for a long while before any formal units of measure are introduced. Pupils should be encouraged to make estimates and should have much measurement practice.

Some of the concepts to be developed are:

a) Units for measuring must be of the same nature as the object to be measured.
b) The measure is the number of times the unit will fit.
c) All measurements obtained from the physical application of a measuring instrument are approximate.
d) The measure of an object needs- i) the number of units ii) the name of the units.
e) More than one answer may be correct depending upon the units used.
f) In measurement we are dealing with a continuous object while in counting we are dealing with distinct elements.

Many fine sessions were held during the Annual Meeting and it was indeed encouraging to see several Ontario representatives in attendance. Membership in N. C. T. M. brings with it an automatic subscription to "The Arithmetic Teacher" (elementary) or "The Mathematics Teacher" (secondary) These are both fine magazines which provide invaluable assistance in modern teaching methods.

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SURVEY OF TEACHERS OF MATHEMATICS

(Grades 1-6)

by

E. R. Pipher

In April 1967 the Ontario Mathematics Commission conducted a survey of teachers' reaction to the Department of Education Curriculum P 1, J 1 Interim Revision Mathematics. The survey was sent to 1500 teachers selected at random from the "Blue Book".

Participants were asked to return the forms unsigned. If they did not teach mathematics in Grades 1 to 6 they were asked to pass the letter to another teacher. Those who had not read the curriculum bulletin were asked to return the letter.

The following statements were selected from the Interim Revision Mathematics Bulletin:

1. "No specific assignment of topics to grade levels is desirable." (p. 1)

2. "Sequential presentation of topics is only necessary in a broad sense . . . . . Children may work in groups at apparently unrelated tasks in mathematics, and still develop mastery of basic principles." (p. 1)

3. "A variety of procedures in solving mathematical problems should be accepted. It is desirable that pupils devise their own methods of attack." (p. 2)

4. "Speed of recall is not a necessary concomitant of accuracy." (p. 2)

5. "It is anticipated that television will increasingly provide assistance to teachers of mathematics." (p. 8)

6. "When wide variations in the work of children in a classroom are expected, then the use of class sets of a single textbook is not desirable." (p. 8)

7. "Furthermore, textbooks should not be thought of as having a particular grade designation." (p. 9)

8. "If mathematics appears to merge into science, geography, art and other subjects, so much the better." (p. 9)

9. "No two children, or classes or schools, should be required to follow the same route through this syllabus." (p. 9)

10. "Examinations . . . should be differentiated for groups or individuals that have been following different routes within the class." (p. 9)

Each teacher was asked to indicate which of the following statements most accurately described his opinion:

A. I agree with this statement in principle and am now or will shortly apply it in my teaching of mathematics.

B. I agree with this statement with qualification.

C. I agree with this statement but feel that the implementation of it is not practical in my situation at this time.

D. I do not agree in principle with this statement.

E. I do not understand the philosophy behind this statement.

Space was provided for any teacher wishing to add any comments. Teachers were also asked to comment on the format on Pages 5, 6, and 7 of the Curriculum Bulletin (dots, dashes, solid lines, etc.)

Results

While a full analysis of the results has not been completed an indication of some of the findings is included here.

Total Number Responding

There were 510 forms returned representing slightly over one-third of the teachers selected.

Table of Opinions (Expressed as Per Cent)

Statement Number	Statement of Opinion						
	Blank	A	B	C	D	E	F +
1	1.7	12.3	34.9	19.4	28.6	2.7	.1
2	4.1	22.1	32.5	24.3	13.3	3.5	0.0
3	1.9	70.3	20.7	5.2	1.3	.1	0.0
4	1.9	32.9	36.4	2.3	19.8	6.4	0.0
5	1.9	36.4	33.5	19.2	8.2	.5	0.0
6	2.1	39.6	22.5	22.5	11.7	1.1	1
7	2.1	29.6	27.0	20.3	18.6	2.1	0.0
8	1.9	80.1	11.1	4.1	1.5	.7	1
9	1.9	28.2	33.3	21.5	12.9	1.5	.3
10	1.9	43.7	24.5	21.9	6.0	1.1	.5
Total	2.1	40.0	27.6	16.1	12.2	2.0	.1

n=510
+ Category F indicates that a teacher added his own statement of opinion.

Comparison of Various Categories of Respondents

While the precise level of significance of the data has not yet been determined, preliminary analysis tends to indicate these results. Modifications of these findings may be required when the statistical significance is considered.

COMPARISON OF VARIOUS CATEGORIES OF RESPONDENTS ++

F = Categories Most Favourable Relative to Entire Group
U = Categories Most Unfavourable Relative to Entire Group

	Statements									
	1	2	3	4	5	6	7	8	9	10
Principals	F	U			U				F	F/U
Primary Teachers						F				
Junior Teachers			U							
Experience										
0-2 years										
3-9 years										
10-19 years				F	F				U	
20+ years		U	U				U			
Size of School										
4-9 rooms			U							
10+ rooms										
Municipality										
Rural			U							
Municipal under 5000 population				U	F	U		U		
5000-25000	U		F	F			F			U
25000 +										
Assistance in Maths Departmental Courses (Grades 1-6)	F	F		U	U			F		
Short Course (Gr. 1-6)										
Convention, etc.										
Television Updating Series			F		F					F
Other Courses		U								
No Courses	U	F		F		U	U	U	F	U

++ This information is based on the respondent's opinion as expressed as favourable (A-I agree with this statement in principle and am now or will shortly apply it in my teaching of mathematics or as unfavourable (D- I do not agree in principle with this statement. This explains why one category in question 10 is reported as ranking high as both favourable and unfavourable

ASSISTANCE IN MATHEMATICS EDUCATION

The following is a summary of the recent assistance in mathematics education reported by the teachers polled:

19 % completed a Departmental Summer Course or Departmental Winter Course in Mathematics (Grades 1-6) within the last two years.

31% attended a short course in Mathematics (Grades 1-6) within the last two years.

65% head an explanation of the new Grades 1-6 Mathematics Course at a Convention or other meeting.

18% followed the Television Updating Series for Teachers in Mathematics Grades 1-6.

29% reported that they had received other assistance.

9% did not report any assistance.

COMMENTS ON FORMAT IN CURRICULUM BULLETIN (Pages 5, 6, 7.)

The comments on the format on pages 5, 6, 7 of the Curriculum Bulletin showed wide variations in opinion. Two hundred and seventeen persons offered comments.

Many teachers felt that the information was well-presented, clear, and concise while others used words such as "vague", "ambiguous" and "confusing" in describing their reactions. Some felt that while their initial reaction was one of confusion further investigation especially with committees of other teachers clarified the ideas. Many of the terms were not understood and requests for simplification were numerous.

Some teachers liked the freedom implied in the outline; others felt that specific topics should be assigned to each grade.

Many respondents felt that more teacher education was needed both pre-service and in-service, to prepare teachers to follow the new course.

In general it can be said that the new format was welcomed by a majority of the respondents and that with more time to study, in private or in committees, with some further clarification of terms and with additional teacher education programs this method of outlining courses should prove increasingly helpful and meaningful.

CONCLUSION

As indicated earlier a more complete analysis of the data from the survey is being completed. Preliminary findings would indicate that the survey was successful in determining general reactions to the Curriculum Bulletin. It is believed that the random selection of the participants would tend to indicate that an analysis of the data can be generalized to the teaching population at large. Explanations of the findings listed above are left to the reader.

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A WORKSHOP APPROACH TO MATHEMATICS, by R. A. J. Pethen
McMillan, Toronto, 1967.

Reviewed by Gerritt Brower,
Roding Street Public School
North York.

A Workshop Approach to Mathematics attempts to present elementary children with a programme for developing mathematical concepts in an activity approach.

Since the author believes that " . . . discovery is BUT ONE (emphasis mine) of the mathematical tracks along which children travel . . . ", it is not surprising that he provides them with the precise steps to be followed along each of these "tracks".

To derive optimum benefit from the suggested programme, Mr. Pethen considers it a must to set aside one room in the school to be used as the Mathematics Workshop. Such an arrangement, however, could cause mathematical learning to be divorced from the rest of the child's development rather than integrated with the other facts of the learning process.

Although Mr. Pethen realizes that ". . . class teaching of mathematics in unthinkable . . . " due to the enormous range of mathematical ability, or lack thereof, to be found in a classroom, he considers "computational dexterity a must at all levels. This facility, he claims, is to be achieved through textbook mathematics. "After all," writes the author, "the examination system in the secondary school is a reality and it is based on textbook studies." Consequently, he feels that the time allotment for mathematics should be divided equally between "workshop mathematics and textook mathematics".

The workshop cards to be used in this approach involve a wide range of topics to be explored at the junior level in Great Britain. In the Ontario programme these would be at a level for six to ten-year-olds. Although the majority of the cards could be useful in an Ontario situation, there are quite a large number which specifically refer to a British setting and are, therefore, of little use. Cards 8, 16, 52, 109, 142, 204, 218 for example, deal with pounds, shillings and pence. Card 70 asks children to weigh in stones. Cards 80, 146 and 193 ask questions about a Canteen, Belisha Beacons and dry coke. Five cards ask questions to be answered with the use of the A. A. handbook (Automobile Association) and the Highway Code.

To summarize, A Workshop Approach to Mathematics is a pioneer attempt at individualizing mathematics teaching. Anyone using these materials should be ready to prune, adjust, modify and improve them to suit his particular teaching context.

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MATHEX: MATHEMATICS EXPERIENCE MATERIALS
ENCYCLOPEDIA BRITANNICA PUBLICATIONS LIMITED, Toronto.

Reviewed by L. W. Hooper
Inspector of Public Schools
London Board of Education

This unique publication is a continuing assist particularly to teachers in the primary and junior division of the schools. It is published in monthly bulletins divided into six levels which would appear to be very general guidelines set for convenience rather than to suggest conformity to time or topic. The six articles contained in each bulletin are written by Canadian teachers who have worthwhile ideas to share with their collegues. With the recently published index, and the availability of back issues it is a way

to vicariously visit other classrooms in schools across Canada. It is worthy to note that these situations generally reflect learning situations where objects from the child's experience or readily available simple equipment is used to develop mathematical ideas.

The publication recommends itself by producing an enlarging horizon of ideas and the pertinent investigation which recommends them for consideration. It is not designed nor intended as a course or a text. The statements are brief, interesting and straight forward so that an evaluation regarding the applicability in an individual classroom mathematics programme can be made with ease. This, too, implies that for the ones chosen sufficifient information is given for a good start with the opportunity for the insights of the teacher and the pupils to carry this aspect of their own situation. For some teachers it can be the support required to get acquainted with the experience approach, for others it may be an assist to making a mathematics programme more interesting, and for others it will be a resource to find other facets of experience to parallel those already called upon to introduce a concept. It is within the price range of an annual subscription to a professional magazine and supplies current teaching suggestions related to a subject area in a very fine way.

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MATHEMATICS WORKSHOPS AT LAKESHORE TEACHERS' COLLEGE

by

R. A. Madeley, M. D. Branigan, E. G. V. Bright, T. G. Morgan

At the present time the elementary school mathematics program is passing through a period of considerable change. The Interim Revision Mathematics, Curriculum P 1, J 1, of the Ontario Department of Education, suggests new topics of content for consideration in the primary and junior grades, and at the same time reflects the new emphases in methods of teaching.

As teachers' college masters we are faced with the dual problem of preparing the student teachers to interpret new content, as well as to use effective methods of teaching the content. The new mathematics program contains some topics of content that most of our students have not previously studied. Some of the methods of teaching presently advocated are equally new to the student teachers.

During the past College year, the mathematics masters of the Lakeshore Teachers' College conducted a series of classes specifically designed to introduce the principles of the workshop approach to the teaching of mathematics, and at the same time to develop the concepts involved in the topic of measurement. This workshop method was chosen because it makes allowance for individual differences in ability by enabling elementary school pupils to solve problems in a variety of ways, and provides an active experimental situation resulting in a greater interest on the part of the pupils.

The topic of measurement was chosen as the medium by which the principles of the workshop approach would be developed because we believe that there are common elements in all aspects of measurement which can profitably be applied in a variety of specific measurement topics. The

common elements we chose to develop were:

(a) the role of comparison in measurement
(b) the place of estimation
(c) the advantage of standard units.

In our planning we identified four stages which could be included in the development of any measurement topic. These were:

(a) direct comparison
(b) the use of body units
(c) the use of arbitrarily standardized units
(d) the use of universal standards.

We chose the following six topics:

(a) time
(b) weight
(c) volume
(d) area
(e) liquid
(f) length

Twenty-four assignment cards were prepared, one card for each stage of the six topics. Shown below are cards chosen to illustrate the four stages:

Stage One (direct comparison)

Topic - weight

1. Guess who is the heaviest person in your group.
2. Compare the weights of all the members of your group.
3. Arrange the names of the members of your group by weight.
4. Report your results in a suitable way.

Stage Two (the use of body units)

Topic - time

1. Choose a body unit for measuring time.
2. Estimate the time it would take to walk a complete circuit of the lower halls.
3. Measure the time it would take to walk a complete circuit of the lower halls.
4. Record your results in a suitable way.

Stage Three (arbritrary units)

Topic - area

1. Choose an appropriate arbitrary unit for measuring surface.
2. Keeping your chosen unit in mind, estimate the area of the College parking lot.
3. Measure the area of the College parking lot, using your unit.
4. Report your results in a suitable manner.

Stage Four (standard units)

Topic - linear measure

1. Estimate the distance you travel in going from class to class during one day at the College.
2. Choose an appropriate unit of measure to check your estimate.
3. Report your results in an effective manner.

The material necessary for the solution o f each problem was collected. Each class was divided into six groups and the student teachers went to work on the assignments.

During the four sessions with each class some problems were solved within the classroom, while others involved work in the halls and outside the building.

The different reports prepared by the student teachers involved oral, written and graphic material. By the end of the fourth session the walls of the mathematics classrooms and the nearby halls were almost completely covered with a wide variety of charts, graphs, and illustrations.

Because they were so actively engaged in this workshop approach, the student teachers gained insights from the pupils' point of view and from the teacher's point of view.

Some observations made by the masters were:

(a) The student teachers enjoyed the series of classes. This was indicated by the number of favourable comments expressed and their enthusiastic reaction.

(b) Later in the term when we evaluated the students' understanding of measurement, we found a high level of understanding and retention.

(c) In subsequent practice teaching weeks a significant number of students requested permission of practice teachers to use this approach and the college staff reported favourable results.

The consensus of the mathematics masters was that, in the coming year at Lakeshore Teachers' College, this part of our program would be expanded. As a result we have planned to assign approximately fifty per-cent of our class time to the workshop approach. Some of the topics we intend to develop by this method include geometry, probability, numeration and measurement.

As mathematics masters we found this to be a stimulating and pleasurable experience, and we are looking forward to the coming year.