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ATTENTION, SUBSCRIBERS: At the recent meeting of the Executive Committee of the Council, it was decided that the subscription rate be $5.00, the same as the membership fee. This would entitle a subscriber to all Math Council publications.

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Why are we Teaching Geometry?

David Robitaille
University of British Columbia

Reported by *Walter P. Krysak*, Calgary

Some of our main objectives for teaching geometry involve logical thinking (development, recognizing the sequential process, application, and so on). If this is the case, do we need to teach geometry? Why not teach logical thinking?

When we choose logical thinking objectives in the teaching of geometry, why do we test the comprehension and memory of facts?

Students learn better when they know what is expected of them. Express these expectations clearly to the students.

Before we decide what is to be taught, let's decide why it is to be taught.

Multi-levels of Instruction in Mathematics

G.D. Vannatta
Education Centre
Indianapolis, Indiana

Reported by *Walter P. Krysak*, Calgary

Mr. Vannatta explored numerous approaches to the problem of diverse aptitudes and performance, and presented the following ways of adjusting the learning program:

1. Total individualization (carrels).
2. The human being is too social an animal to be totally individualized. Therefore, cluster the students, or they will cluster themselves.
3. Use inter-class grouping.
4. Group the students on the basis of performance.
5. Vary assignments for the class as a whole - for example, any 10 problems of an assignment of 16.
6. Group for remedial and enrichment instruction.
7. Keep all in one group, doing the same work.

INDIVIDUALIZED INSTRUCTION

- THE PROCESS OF ADJUSTING MATHEMATICS TO CHILDREN

Paul R. Trafton
Indiana University
Bloomington, Indiana

Reported by *J.W. Woloshchuk*, Calgary

1. TASKS OF ELEMENTARY MATHEMATICS EDUCATION

- Develop mathematical concepts.
- Develop mathematical skills.
- Demonstrate the application of mathematics.
- Provide relevant mathematics activities.

2. INDIVIDUALIZED INSTRUCTION

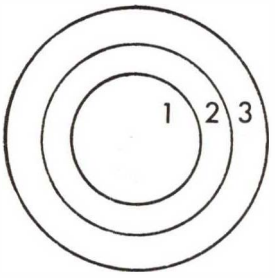
This essentially implies an attitude or point of view towards pupils and their learning.

3. CHARACTERISTICS OF TEACHERS WHO PROVIDE FOR INDIVIDUALIZED INSTRUCTION

- Respect and concern for pupils as individuals and learners.
- Sound knowledge of the mathematics they teach.
- A warm and accepting relationship with their students.
- Involvement of students in the process of learning ideas.

4. TECHNIQUES OF INDIVIDUALIZING INSTRUCTION

In this section, each of three rings represents a different level of individualizing instruction.



Level 1. The group-developmental approach is effective for the initial development of ideas and skills. This approach is a guided discussion, involving materials, questions, and teacher-pupil dialogue. In this approach, opportunities to provide for individual differences may be given as follows:

- Actively involve students in materials.
- Use directed, probing-type questions.
- Use open-ended questions; encourage diversity in response.

- Leave questions for individual exploration.
- Provide further activities; these activities can respresent an extension of the lesson or general enrichment of various types.
- Assist students in written work.

Level 2 represents ways in which whole-group instructions may be modified. These ways are listed below:

(a) Independent Progress - provision should be made for individual conferences to discuss the pupil's progress and determine understanding of concepts and underlying relationships.

(b) Ability Grouping - attention must be given to the quality of experiences provided for slower learners.

(c) Flexible Grouping - allows for the separation of classes into smaller groups for short periods of time on specific content. This approach appears to be effective in skill areas where wide divergence in achievement is present.

Level 3 represents modifying whole-group instruction to include independent self-selected activities. These may be

- laboratory oriented,
- enrichment activities,
- general-interest topics.

The Next Decade in Mathematics Education

Eric MacPherson
Associate Dean of Education
University of British Columbia
(keynote speaker)

Reported by *Wayne J.P. Turley*, Calgary

The next decade in mathematics education will abound in four themes: individualism, getting priorities straight, return to modern mathematics, and educational research.

The old notion of individualization which concerns itself with the needs and abilities of individual students is not as important as the assumption of a child's own rate of learning. This assumption is a fraud until the mode of instruction is specified; otherwise the educational implications of that assumption are horrendous. One implication is that each child would have his own correspondence course; another is that education be approached from a psychological, rather than a sociological, point of view.

One of the most discussed matters in education in the next decade will be priorities in education. Can we dilute staff? Is the killing of the PTA and home and school associations a desirable thing? Should we listen to parents?

There should be a mass return to Modern Mathematics. There has been a steady growth of mathematical skills, but these have continued under the cover of a bizarre collection of topics such as other bases, set language, logic, formal logic and residue classes. But we are getting over this.

The value of educational research is limited, since no major questions in education can be solved by educational research (only minor ones). But what research can and cannot do for education must be found out.

Structuring for Learning in a Mathematics Laboratory

Ingrid B. Weise
Montgomery County Public Schools
Rockville, Maryland

Reported by *Wayne J.P. Turley*, Calgary

Mathematics laboratories are instructional settings which should provide for diagnostic-remedial work, for motivational-enrichment activities, and for individualized learning. The non-availability of funds and the restriction of space, tempered with the ingenuity of a mathematics department, will accentuate the differences in mathematics laboratories as they are established.

STAFFING

The mathematics resource teacher and his staff must be ready and willing to incorporate the mathematics laboratory concept into the school mathematics program. While the initial establishment of a laboratory situation may involve only one or two members of the department, the development of the laboratory as a mathematics learning center is dependent upon total staff involvement.

Dr. Weise suggests that the mathematics laboratory is a different approach to mathematics. Students initially meet in a large group for a daily presentation and assignment, whereupon they proceed to areas labelled:

(1) calculator group
(2) measurement and geometry,
(3) A-V and research,
(4) fundamental skills,
(5) problem solving, and
(6) games.

Groups rotate from day to day until they have performed the tasks or experiments in each area. Each teacher uses his Instructional Related Activity period to help in various areas; thus the students have the advantage of many teachers.

Enrichment Materials

for Senior High School Mathematics Programs

Douglas R. Forbes

Reported by *Wayne J.P. Turley*, Calgary

Enrichment is *not* exclusively for our best students. To think so is a serious mistake. It is for *all* students. Certainly the personal rewards are not less real for average students than for brighter ones.

Enrichment is a function of the classroom teacher because the experts have not done their best to enrich the standard program and, more importantly, because mathematics is an active and personal kind of thing. Consequently, the classroom teacher is the only one who can prescribe what is appropriate to each student.

Enrichment stimulates creative thinking, fosters analytic thinking, helps the student explore beyond, could be recreation or may increase the practical aspects of mathematics.

The following criteria are essential for enrichment:

- Enrichment material should be appropriate to the students. This is often overlooked, but very important. It is also difficult to predict what will be of interest to the high school student.
- Enrichment material should be appropriate to the teacher.
- Enrichment should be appropriate to the teaching situation: the number of students, kinds of students, availability of a mathematics laboratory or library, and so on.
- Enrichment must be valid mathematics.

Here are some examples of specific items:

Paradoxes (for example, Zeno's). Rephrase them and have the students make the calculations, but do not let the answer come out too soon.

False proofs. These are excellent materials, highly motivating, but they must be critically examined by the student - for example, Euclid: all triangles are isosceles.

Historical topics. They represent something that appeals to the human interest aspect. Let's take, for example, the Archimedes approach to areas bounded by curves - there is an incredible amount of mathematics, and five good students would have a ball working on this.

Computers as enrichment. If accessible to the school, these provide an opportunity for students to learn how to write programs. If they are not accessible, then computers could be considered from a social science point of view, or the kinds of problems they cannot solve.

Games. It is the mathematical analysis of the game that is more important than the actual game - for instance, "Instant Insanity".

Number Theory. Casting out nines - *why* does it work? What would happen in other bases, such as, for example, base eight?

Topology. It is loaded with enrichment materials - the four-color problem, the Königsberg bridge problem, and other network problems.

Curve stitching. It is not just the pleasing designs that can be constructed, but rather what kinds of curves, for example, can be generated from straight lines, and why. This is the mathematics.

Probability. Testing reliability of samples is an important consideration for ordinary-life decision making (example: cigarette ads).

Music. Take the themes in any musical score and do geometrical transformations on them.

A View From the Bridge

Charles E. Allen
Garfield High School
Los Angeles

Reported by *Bob Hood*, Calgary

From the bridge, teachers could see students in the river of mathematics - some were having a hard time to stay afloat, some were treading water, some were swimming with the current, and some were making good progress swimming against the current. The teacher could stay on the bridge and shout orders to the swimmers, he could go down on the bank and get closer to the swimmers, or he could get right into the activities of the swimmers, trying to assist each according to his needs.

Chuck suggested that each one of his audience take a sheet of paper and fold it so that there were two equal parts (top to bottom or side to side), then fold it again so that each person had four equal parts. After each fold the number of equal parts was noted. Those who thought they could fold the paper seven times found that they had an impossible job. A record of the results was made as follows:

Powers of 2	Number of Folds	Number of Equal Parts
2^0	0	1
2^1	1	2
2^2	2	4
2^3	3	8

(and so on)

Then Chuck gave his audience the "13 Cookies Problem" - 13 cookies to be arranged in 6 equal rows, no doubling up, no cookies to be broken. Hint: there is something in most kitchens to which mother and the rest of the family make frequent reference. When you discover this, you will know what to do to arrange the 13 cookies.

Names for 2: Chuck gave us one simple name for 2 and asked his audience to suggest all the other names they could think of.

$2 = 1 + 1$ $\quad 2 = 1/2 + 1\ 1/2$ $\quad 2 = 3\ 3/4 - 1\ 3/4$

$2 = \sqrt{4}$ $\quad 2 = 2^0 + 2^0$ $\quad 2 = \sqrt[3]{8}$ (and so on)

He closed his first talk with the suggestion, "Why not start with the complex and move step by step to the simple. By doing this, you pick up students as you move along instead of dropping them off as you move from simple to complex."

INVOLVEMENT - The Only Way to Fly

Charles E. Allen

Reported by *Bob Hood*, Calgary

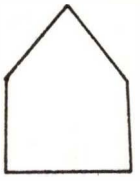
This session was divided into three parts. The first 20 minutes were used to prepare the audience for a 30-minute demonstration class, which was to be followed by a 30-minute session entitled "Allen Raps with Audience".

Chuck told the audience that a group of Grades VII, VIII and IX students were going to be brought into the lecture hall and he would put on a demonstration lesson. He told the audience that at certain times he would want the lights out and asked someone who was near the lights to turn out the lights as quickly as possible when he called "lights". With a little practice he got the speed of response which he wanted.

When the students were ushered in, Chuck introduced his demonstration by reference to "Mod Squad" which he did not mention by name, but by hints and suggestions he got the students to name "Mod Squad". They agreed that to be members of "Mod Squad", you had to be alert and think fast.

He then started off with some transparencies on the overhead projector. One started with a drawing of a domino. He asked them to think of a number of dots in each side of the half domino. He told them to multiply the number of dots on the left by 5 and to that product add 8; this sum was to be doubled, and to that doubled sum the right number of dots was added, and from that sum 16 was subtracted. The first student who noticed something was to hold up his hand. Some of the students saw what was happening right away, and they were told they could join "Mod Squad". When Chuck wanted to change to another part of the demonstration, he called "lights".

He also used a tape recorder on which he had taped instructions such as these: "The man standing in front of you today is not the real Mr. Allen but a robot which has been programmed to carry out certain instructions." The tape went on to tell the robot to hold up what he had in his hands. (It looked like a circular tape, something like a steel measuring tape.) The recorder asked the class, "What original names would you call this figure?" It was a circle. They came up with circle, doughnut, zero, the letter O, wheel, and one student called it a roundee. Then the recorder instructed the robot to change the shape; he changed it to the form  and the students were asked for names - one student came up with "infinity". The next shape was a regular pentagon, and students came up with "house", "pentagon". When the robot held it upside down, they were not so sure what to call it. (It was when the tape was put in the shape of a pentagon that we saw that it was jointed so that there were five equal segments.)



The next part of the recording was a question: "Do you think the robot can make a four-sided figure out of this five-sided figure?" Some thought so, others not. "What do you call the four-sided figure?" "Can a three-sided figure be made from the four-sided figure?" "Yes" and "no" came from the students. "What do you call the three-sided figure?" "Can you make a two-sided figure?" "Lights".

Chuck then went back to the overhead with some transparencies of clock faces, and by turning them to various positions, he got the students to tell him the time. This was done "rapid-fire" and Chuck joked with the students as he went along so that not only students but the teacher-audience were often laughing heartily.

The conclusion of the demonstration took the form of what older teachers would call "rapid calculation". When a student got an answer correct, he was sent to the chalkboard to put down his name, and he was told that he could leave the room when he got another question right. If he made an error, he was sent to erase his name. After about 6 or 8 had left, Chuck told the remaining students that he could not let them go until they had a correct answer. He then asked them something simple like "2 + 2". They all got it and went out laughing.

The rap session started with Chuck telling the teachers that it was usually considered unnecessary to say that it was a good lesson. One question asked was,

"Don't you think that some students would stop trying because they found the pace too fast for them?" Chuck said that was possible, but if the difficulty of the questions was varied, students would find that there were questions which they could do and they would be encouraged to answer by telling the others, "Now you have qualified for 'Mod Squad' and you must remain quiet because we have now sent you on a special assignment, and you don't know what we are doing here."

The laugh was on the whole group when the lights went out during the rap session and no one had called "lights". It turned out that there was a power failure in the building, and, as it was a hot afternoon and as the session room was hot, we were allowed to leave early.

(Any mathematics association looking for an interesting speaker will find Charles E. Allen one of the best.)

Letter to the Editor

Dear Colleague,

The ERIC Center for Science, Mathematics, and Environmental Education is making a concentrated effort during the coming year to collect non-commercial and teacher-made materials for mathematics laboratories, K-9.

We are particularly interested in locating materials that can be easily adapted to direct classroom use. However, lists and references to other sources (commercial as well as non-commercial) will also be of value to teachers.

We would appreciate contacts with creative classroom mathematics teachers who may have developed laboratory worksheets or experiments.

The ERIC system is supported by the U.S. Office of Education as a means of disseminating both educational research and promising materials and programs in education. Products of the ERIC Clearing-houses are not copyrighted.

If you would like further information about the ERIC system, or about the mathematics laboratory project, please contact me. I will keep contributors informed about handbooks and materials compiled by the project.

Jon L. Higgins
Associate Director for
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