Junior High School Math Option

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The introduction of an option in junior high mathematics is a matter of some concern to teachers involved in setting up programs in their schools. To aid the teachers, a panel was formed for the annual fall mathematics conference. This panel, which has also been active at two conventions, includes Ted Rempel, of Londonderry Junior High, Edmonton, as chairman; Dennis Annesley, Avalon Junior High, Edmonton; Jim Barnes, Montgomery Junior High, Calgary; Dick Daly, D S MacKenzie Junior High, Edmonton; and Harry Topolnitsky, Ellerslie Junior High, County of Strathcona. The whole topic of junior high mathematics option was divided into the following subtopics, to which the members of the panel reacted.

Personnel, Resources and Facilities

It is necessary to keep in mind that each school is individual in nature. Personnel, resources and physical facilities available or applicable in one situation may be totally unrealistic in another.

It seems logical to assume that the option should be handled by teachers of mathematics. This may be true for a large number of the possible topics, but when you consider the variety of available topics, you begin to realize that some of them may receive better guidance from teachers other than mathematicians. The section dealing with mathematical instructions could, perhaps, be best handled by a science teacher who is familiar with the calculator, sextant, micrometer, calipers, etc, and art teachers might prove valuable with mosaics, designs, symmetry and optical illusions. The history of mathematics or biographies of mathematicians may be in the domain of the language arts teacher; careers in mathematics may best be handled by the guidance counsellor. Thus we see that the realm of mathematics may be extended to include other teachers because the topics are so varied that no one teacher can be expected to be conversant with all of them. However, the teacher should have initiative and act as a resource person or consultant.

Resources and facilities vary with the size of the school and with the school boards in their allotment of funds for this purpose. It is difficult to say what is ideal in the way of resources and facilities. Some teachers may prefer to have a room assigned as the math room in which all the projects are done and the displays are stationary. Others may wish to have a mobile class. The science laboratory seems like the logical place to work with mathematical instruments. The social studies room, if such exists, might be used for map work, map colouring, topology, etc, which might be left on display for the social studies students. The library should be available for research work and display of art work done in relation to mathematics and mathematicians.

Many devices can be made for a fraction of the cost of commercial ones. A demonstration slide rule may be made by the industrial arts students instead of purchasing one for $47.50. Individual slide rules may be purchased for as low as 87 cents each. Once the students learn to use a slide rule, they prefer to have one for their personal use.

I fully realize that some of the suggestions offered are impractical in view of the resources and facilities of the individual schools. We may be content with or forced into using one corner of the home room for the option.

Classroom Organization

The enrolment in the option may vary from 15 or fewer to 35 per class. Although the election of an option should be on the basis of strength and interest of the student, this is not always the case nor always practical. As a consequence the class may be composed of students who have interest but not much strength, strength but little interest, both strength and interest, and those who had no alternative.

In some situations it may be advisable to have the whole class work on one project. In this case the teacher would present a list of topics from which the students would democratically choose one. If, for example, the topic of paper folding is selected, it might involve all the students in making airplanes as a basis to paper folding. This might be followed by

a lesson on drawing regular polygons. To complete the project, the students might work in groups or independently to construct polyhedrons.

Some teachers prefer to have the class divided into groups of students who have the same interest. Although an ideal group size may be four or five students, it will vary depending on the interest shown.

The interests of the students may be so varied that they would perform best independently. It is also possible to have a combination of groups and individuals. The teacher is in a position to assess which of the above would be suitable to his class.

Time Allotment

The *Junior High School Handbook* suggests that the time allotted to the options be between 75 and 175 minutes, or the equivalent of two to five periods per week. Where feasible, blocking of the options on the timetable is perhaps the most desirable, but with the variety of situations in our schools, this is not always possible. A six-day timetable seems to be the most suitable. This allows for the options to be offered every second day. Schools on the semester or trimester system would offer the option to one group of students for only a part of the year and use a rotation. Another possibility is to offer the core in mathematics for four periods and to use the fifth period for exploring the mathematics option where no regular time can be timetabled for the option.

Setting a time limit for a project or topic is advisable. This should prevent the students' interests from waning. The anticipating of a new project should keep the students interested in completing the project at hand in a minimal time.

Evaluation of Student Progress

The evaluation of student progress in the options varies with the requirements of the different school systems. Some of the methods for evaluation are (a) a five-point scale, (b) a three-point scale, (c) written comment, (d) interview and (e) no indication of progress.

However, where an evaluation is necessary or desirable, some criteria must be used. Following are several points that may be considered.

1. Student participation
2. Quality of records or finished project
3. Growth
4. Use of time
5. Independent study
6. Ability to organize
7. Ability to follow instructions
8. Effort
9. Enthusiasm
10. Completeness of project

A log may be kept for each student in which would be recorded the title the project, the date started, the date completed and any of the above criteria that are applicable.

Evaluation of Program

This may be the most difficult task that we face. However, through participation we can learn about good points or ideas to propagate and pitfalls to avoid. Perhaps an indication of the program might be determined by the students themselves—their desire to re-enrol in the option for another year. Ordinarily, the proper evaluation of a program requires more time than we have had this year. The success of the program depends to a large extent on the teacher in charge—his interest, enthusiasm and suitability will be reflected in the final results.

The program has a lot of merit and gives the teacher an opportunity to use his initiative. It provides increased flexibility in the area of content and methodology. The option should cultivate interest, develop special abilities and provide for research.

To assist teachers and administrators in planning the mathematics option, the mathematics coordinators of the Edmonton Public school system have spent considerable time and effort in the preparation of the topics suggested below.

Business Mathematics

1. Stock market—stocks, bonds, corporations, trading and quotations
2. Banking—savings accounts, chequing accounts
3. Instalment buying—kinds, interest rates
4. Consumer buying—discounts, comparative shopping
5. Mortgages—house, second mortgage
6. Insurance—home, car, life
7. Taxes—kinds, assessment, rates
8. Car operating expenses—fees, operating costs, credit cards, depreciation costs, instalment paying, insurance
9. Bookkeeping
10. Operation of a school business (eg, a store)—organization, shares, operation of the business, reports

Recreational Mathematics

Magic squares, cross-number puzzles, paper folding, number sequences, numerology, math challenges or puzzles. codes, mathematics cartoons, math games (Krypto, Radix, Equations, Wff' n Proof, etc), aestheometry (three-dimensional string constructions)

Number Theory

1. The natural numbers—sums of consecutive numbers, consecutive odd and consecutive even numbers; triangular numbers; Fibonacci numbers
2. Primes and composites—distribution of primes, relative primes, Sieve of Eratosthenes
3. Divisors of a number—prime numbers or factors, GCF, divisors, perfect numbers
4. Facts of number theory—Fermat's two-square theorem, Lagrange's theorem
5. Conjectures in number theory—Goldbach conjecture, Fermat's last theorem

Topology—"Rubber Space Geometry"

1. Two-dimensional topology—simple closed, transformations
2. Networks
3. The Möbius strip
4. Map colouring problems
5. Mazes
6. Three-dimensional topology—Kline bottle

Set Theory and Logic

1. Truth tables
2. Implication
3. Simple proof
4. Relating truth tables to set theory
5. Using intersection and union to teach GCF and LCM

Probability and Statistics

1. Probability
   a) Mutually exclusive events
   b) Independent events
   c) Experiments (coins, dice)
   d) Odds and simple games
   e) Fair games (math expectations)
2. Statistics
   a) Histograms
   b) Measures of central tendency (mean, mode, medium)
   c) Surveys to illustrate the above concepts

Math Instruments

Slide rule, transit, sextant, abacus, calculator, micrometer, calipers

Measurement

1. Direct measure
   a) Metric and British
   b) Greatest possible and relative error
   c) Scientific and standard notation
   d) Significant digits
2. Indirect measure
   a) Scale drawing
   b) Similar triangles
   c) Numerical trigonometry
   d) Vectors

Finite Math Systems

1. Group theory
   a) Modular arithmetic (clock)
   b) Permutations
   c) Plane transformations
   d) 2×2 matrices under addition
2. Fields
   a) Real numbers
   b) Prime modular systems

Geometry

1. Plane constructions
2. Geo-board applications
3. Optical illusions
4. Mosaics and designs
5. Finite geometrics
6. Tangrams
7. Paper folding
8. Symmetry
9. 3-D constructions—prisms, pyramids

Computer Science

1. Numeration systems—base 10, 5, 2
2. Functional relationships between parts of a computer
3. Flow charts
4. Programming in APL
5. Concentrated area in mathematics using flow charts
6. Field trip to a computing centre

Graphs

1. Pictographs
2. Bar graphs—horizontal, vertical
3. Circle
4. Rectangular
5. Line graphs

History

1. Ideas
   a) Need for counting—early methods, importance of zero, calendars
   b) Need for calculating—trade
   c) Need for measuring—surveying, building, navigation
2. People—Thales, Hipparchus, Pascal, Pythagoras, Ptolemy, Newton, Plato, Copernicus, Leibniz, Euclid, Galileo, Boole, Archimedes, Napier, Einstein, Eratosthenes, Kepler, Euler, Apollonius, Descartes, Gauss and others

Mr Topolnitsky was principal of Ellerslie Junior High, County of Strathcona, and a teacher of mathematics.