

Let's Do Some Problem Solving in Junior High

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Problem Solving—An Integral Part of a Junior High Mathematics Program

In the 1980 publication An Agenda for Action, the National Council of Teachers of Mathematics' first recommendation states: "Problem solving must be the focus of school mathematics in the 1980s." Accompanying this statement are six recommended actions that we can follow to help bring this to fruition. The purpose of this paper is to suggest to junior high mathematics teachers how they might make problem solving the focal point of their programs.

Prior to 1980, mathematics teachers had generally incorporated varying degrees of problem solving into their programs, occasionally as an additional exercise if there was time. In the past seven years, teachers have become more aware of its importance and more effort has been made to interweave problem solving throughout the strands of the mathematics curriculum. This awareness level has been raised largely through the leadership of the many mathematics educators' associations and authors of the most recent mathematics resources, in which problem solving is highlighted in virtually every chapter.

In Alberta, not only do the curriculum guides for every level of mathematics emphasize problem solving, but also separate problem-solving monographs (similar in appearance to curriculum guides) have been devised for the elementary and junior high levels. A monograph is also being developed for the senior high programs. The purpose of these monographs is to encourage and assist teachers to make problem solving an integral part of their mathematics curricula.

What constitutes a problem?

For a problem to exist, two criteria must be fulfilled:

1. The person must accept that something needs to be overcome. Such involvement may be either intrinsically or extrinsically stimulated.
2. There is no immediate method of solution. Thus, what is a problem for one person may not be a problem for another. Also, problems need not be mathematical in nature. Teachers often assign students a series of similar "problems." Once the students have solved the first problem, the others are merely exercises to reinforce the algorithm or concept (an important type of activity to have students do, but not necessarily what the teacher had intended that the students accomplish). This leads to the next question.

What constitutes problem solving?

Problem solving is a process that will serve people throughout their

lives. Although problems are a fact of life, not all problems are mathematical in nature. It is essential that mathematics teachers develop in students those problem-solving skills that can be applied to any situation.

Problem solving should not be viewed as a separate entity in a mathematics program; rather, it must be interwoven throughout the strands of the junior high school math curriculum. It must be used to develop and reinforce the skills and concepts of numeration, operation, geometry, graphing, algebra, measurement, and ratio and proportion.

Why should problem solving be taught in the junior high school?

Students often ask why they have to learn a particular concept or skill. When problem solving is incorporated throughout the mathematics curriculum, students can see a closer relationship between the sometimes abstract world of the classroom and the real world.

Teachers who carefully select problems to present to their students create an atmosphere of positivism, success, and enthusiasm in the classroom. As was mentioned before, problem solving can also reinforce and/or clarify previously taught concepts and skills.

Most importantly, students must be taught a model or framework to help them organize their attempts at solving any problem. This can readily be done during the junior high mathematics program. A successful model is illustrated later in this paper.

How can a teacher foster the development of problem-solving skills in the junior high school?

As with any classroom situation, the enthusiasm and positivism of the teacher are the most influential factors in promoting an atmosphere for the development of problem-solving

skills. In addition, the teacher must be open-minded and accepting of a variety of methods and solutions presented by students, ask carefully worded questions, and carefully select the problems presented to students. It is desirable to reduce the total number of problems and to pose a daily problem, as well as keep a balance of success and challenge.

What constitutes a good problem for junior high school students?

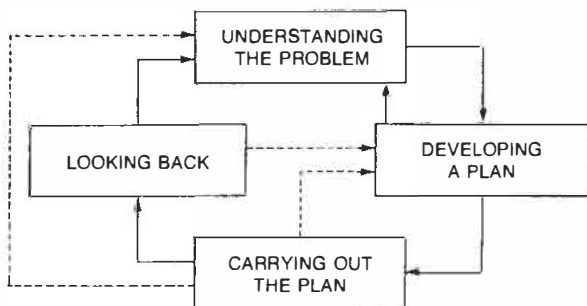
When selecting problems, the teacher should be aware of several criteria. No problem will satisfy all criteria. However, a good problem will satisfy several of them:

1. The reading level is below the students' frustration level.
2. A challenge is presented.
3. A variety of methods and/or solutions is possible.
4. Required skills, concepts, and vocabulary have been previously taught.
5. A realistic situation is evident.
6. Reinforcement of skills and concepts is accomplished.
7. Challenging problems have been preceded with simple problems.
8. Students will be able to achieve successful solutions.
9. The problem is fun and/or interesting to students of that age.

What are some hints for developing a positive attitude toward problem solving in the junior high school?

Some teachers may be uncomfortable with problem solving simply because they have not had enough successful experience in this area. This feeling may be overcome simply with more experience and by following as many of these suggestions as possible:

1. Select problems carefully and assign them in a sequence of easiest to most challenging, shortest to longest.
2. Assign fewer problems, but on a regular basis; for example, assign a problem daily.
3. Select problems that are within the students' knowledge and ability levels.
4. Find problems that are of interest to the age group and to both sexes.
5. Find problems that have an extension component.
6. Feel free to modify a problem to suit the age, ability, or interests of the students.
7. Teach students a framework for problem solving. The following model, taken from the Alberta Education monograph Problem Solving Challenge for Mathematics, 1985, p. 4, has proven to be successful.



Other models are equally acceptable. Whichever model you choose, it is well worth the time and effort to have students record the framework in their notebooks, and to create a wall or bulletin board display for easy reference.

8. Communicate your expectations to the students. Inform them that partial marks for each problem will be awarded for each of the stages suggested by the illustration in item 7.

9. Select a variety of problems that will allow students to try as many of the strategies as possible. Encourage students to keep a set of mathematics notes, including a list of the strategies discovered under the four headings in the diagram in item 7. At the same time, add to the classroom chart. Eventually, you may wish to give the students a list of strategies or have them copy it from the blackboard. A listing of skills and strategies may be found in Alberta Education's Problem Solving Challenge for Mathematics (1985).
10. Whenever possible, involve the students in the problem--by giving it a name, by acting it out, by talking about it, by working through it as a group.
11. Allow students to create problems and exchange them for solving. Generally, a stimulus in the form of a story, a picture, or a previous problem is required. Encourage students to include diagrams, pictures, or extraneous information.
12. Allow students to work together in pairs or small groups. Brainstorming and exchanging ideas can lead students to try other strategies when they reach a dead end.
13. Encourage the students to have and use a calculator. The focus of problem solving should be on the process, not on the computation.
14. If you are comfortable with computers, incorporate available software to enhance problem solving.

What are some sources of problem-solving exercises for junior high school programs?

Textbooks (even those not prescribed by Alberta Education) are always good sources. Some publishers

have supplementary booklets or packets of problems that can be very useful. A school or a school system might find it useful to have some of the publications that can be obtained from the following sources:

The National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091

1. A \$35 (US) annual membership fee entitles you to receive The Mathematics Teacher or The Arithmetic Teacher. Both are journals of NCTM and contain problems and suggested activities each month.

2. Hirsch, C.R., ed. Activities for Implementing Curricular Themes, 1986. Price: \$12.15.

Mathematics Council
The Alberta Teachers' Association
11010 - 142 Street
Edmonton, Alberta T5N 2R1

Math Monograph No. 7: Problem Solving in the Mathematics Classroom, April 1982.

Alberta Education
Curriculum Branch
Devonian Building
11160 Jasper Avenue
Edmonton, Alberta T5K 0L2

Problem Solving Challenge for Mathematics, 1985.

CONCENTRATE

Equivalent Fractions and Memory

PREPARATION

Prepare fraction cards: $0/12$ - $12/12$, $0/6$ - $6/6$, $0/4$ - $4/4$, $0/3$ - $3/3$, and $0/2$ - $2/2$ (32 cards). Place each set in an envelope.

HOW TO PLAY

(2 to 4 players)

Turn all cards face down on the table. Have each player choose one card. The person with the highest denominator goes first. If there is a tie, the person with both the highest denominator and highest numerator goes first. The first person picks up two cards. If they are equivalent, the player keeps them and chooses two more. The player continues until an equivalent pair is not chosen. These two cards are then replaced on the table, and the player to the right has a turn.

Once all equivalent pairs have been found, the person with the greatest number of pairs is the winner.

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