PROBLEM PAGE

Primary (grades 1-3)

Little Ellen, the one with the big appetite, ate half a watermelon, carefully removing 173 seeds, daintily spitting out 59 (12 on her creepy-crawling brother), accidentally swallowing 46, chomping up 15, and leaving 36 in a small chunk of watermelon which her brother ate while Ellen went to get paper towels to clean up her mess. How many seeds were in Ellen's half-melon? (You may have to use a calculator.)

Intermediate (grades 4-6)

If a seed weighs a half-gram (see above problem) and the other half-watermelon had 147 more seeds than Ellen's had, then how much did all the seeds in this watermelon weigh? What percent of her weight (21 kg.) did she consume?

Junior High (grades 7-9)

Ellen's watermelon (see above problems) cost $2.59 including the rind which weighed half a kilogram. Those seeds were 10% as heavy as the pulp, so how much per gram did the edible part of this watermelon cost?

Senior High (grades 10-12)

Ellen can eat a melon-and-a-half (see above problems) in an hour-and-a-half (not counting her brother's theft) if it weren't for those seeds which slow her down one second each. How much would it cost to feed watermelon to Ellen in July if she ate eight hours a day?

Students may submit solutions to the above problems. Give name, grade, school, and school address. Names and solutions may be published if space is available.

POST-SECONDARY ENROLLMENT OPTIONS: WHAT DOES IT MEAN TO MATHEMATICS EDUCATION?

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The time has finally arrived for the implementation of the post-secondary enrollment options program of Senate Bill 140. In short, the bill allows 11th and 12th grade students to apply for admission and, if accepted, enroll in college courses. These courses may be taken for either college credit or both high school and college credit.

High school students who are interested in taking college courses have two options under Senate Bill 140. In the first option, a student may elect to enroll in college courses for high school and college credit. In this case the college or university would receive that portion of the state money allocated to the public school district. For example, if a student from a school running a seven period day enrolled for one class the college would receive 1/7 of $2636 (FY91) provided by the state. If a student were enrolled for two or three classes the amount would be 2/7 and 3/7 of $2636 respectively. Under the second option, a student may choose to take the course or courses for college credit only. In this case all costs are borne by the student.

The post-secondary enrollment options program has been controversial from its inception. Some public school officials see this legislation as a serious threat to established programs in the high school. One of the most outspoken critics is Dr. Richard Denoyer, superintendent of Princeton City Schools in Hamilton County. Dr. Denoyer contends that the enrollment option will have a negative effect on the advanced placement program, the International Baccalaureate Program, and high level academic courses in the high school. (Denoyer, 1989) Similarly, professional associations like the Ohio School Boards Association and the Buckeye Association of School Administrators have voiced opposition to numerous aspects of the Post-Secondary Enrollment Options Program. (BASA, 1991; OSBA, 1990)

Private school leaders have been somewhat undecided concerning participation in the program. Currently, Diocesan officials for Catholic schools in Cincinnati, Columbus, Toledo, Youngstown, Steubenville, and Cleveland have
approved participation on a school-by-school basis. On the other hand, Cincinnati officials initially decided not to participate in the program but reversed this decision after considerable debate. Some parochial high school principals seem to think it is an opportunity to improve the curriculum in their respective schools, while others fear the option would result in fewer students.

In an attempt to measure the opinion of current educators, a survey was made of 476 Ohio teachers who were asked to respond to the statement "High school juniors and seniors should be able to take courses at local colleges/universities for high school or college credit" using a Likert scale. The results showed overwhelming disagreement (t=4.80, df=475) at the 1% level of significance.

Needless to say, the first option for both high school and college credit will be attractive to many students and could result in an exodus of the best students from Ohio high schools. However, the school can do much to keep high school age students on the high school campus. In fact, high school mathematics departments are in an ideal position to be leaders in the curriculum reform invited by Senate Bill 140. Senate Bill 140 provides an opportunity for schools to improve the total instructional program through advanced placement courses taught in the school. The College Entrance Examination Board (CEEB) provides course descriptions and tests for college credit in virtually all high school subjects. These traditional advanced placement courses are taught in the high school by high school faculty. Students who successfully complete these programs are awarded college credit that is accepted by almost every university in the country. On the other hand, Senate Bill 140 allows students to leave the high school environment in favor of the college environment for all or part of the school day. Some educators feel that such a social change is not appropriate given the ages involved. Others feel the overall school environment will suffer due to a loss of students who have traditionally assumed leadership roles.

The Critical Role of Mathematics

We can meet this challenge by providing the opportunity for students to earn college credits through advanced placement courses in a variety of subject areas. Mathematics, however, can play a critical role in the curricular reform needed to implement advanced placement in other subject areas. Many Ohio schools already offer advanced placement calculus through the CEEB. A survey of a random sample of 200 of Ohio's 856 high schools has shown that a total of 85% already offer

| \( \frac{\pi}{2} \) | 1.570796237 |
| \( \frac{\pi}{4} \) | 0.785398163 |
| \( \frac{\pi}{3} \) | 0.523598776 |
| \( \sqrt{3} \) | 1.732050808 |
| \( \sqrt{2} \) | 1.414213562 |

It is possible to get a variety of numbers to appear without using the number keys. It is clear that all rationals within the range of the calculator and the decimal approximations of quite a few irrationals and transcendentals can be obtained. Teachers may wish to ask their students, "Is there a specific class of numbers which cannot be obtained?"

Be certain to remind students to write the mathematical expression being evaluated.

\[ \tan^{-1} \left[ \sin \left( \cos^{-1} \theta \right) \right] \rightarrow 45 \]

Either you can provide all problems or let the students create and try to stump each other.
USING SCIENTIFIC CALCULATORS

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Students in trigonometry classes often own very sophisticated calculators but have limited working knowledge of them. The following exercise is designed to increase awareness of the function buttons on a calculator, review the order of operations from algebra and familiarize students with the decimal values of certain irrational numbers.

The examples given emphasize the use of trigonometric functions but the concept can be expanded easily to include logarithms, exponentials, hyperbolic functions, factorials, and whatever else may appear on a student's calculator.

Object of the Exercise: To have the given number appear on the display of a scientific calculator without pressing any number keys.

Procedure: 1) Note when a calculator is turned on, a "O" is displayed.
2) Note that the calculator has various modes of operation such as degrees, radians, etc.
3) Create a mathematical expression (using "O" as the original argument of a trigonometric function) which has a value equivalent to the desired number.
4) Decide the order of keystrokes needed to evaluate the expression.

For those students who possess a calculator which shows a blinking cursor rather than a zero, the rules may be changed to allow the use of the number key "O" as needed for the entered expression to be valid. Teachers should realize that these students will have an advantage when writing the expression which was evaluated.

Examples:

<table>
<thead>
<tr>
<th>Number Displayed</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>DEG, COS⁻¹</td>
</tr>
<tr>
<td>1</td>
<td>DEG, COS⁻¹, SIN</td>
</tr>
</tbody>
</table>

Similarly, CEEB programs in English, foreign languages, and social studies can be modeled after successful math programs. Even the CEEB science programs are designed for success in the standard high school environment.

The traditional mathematics programs in place in many of Ohio's schools are preparing students for calculus during their senior year. Schools that do not offer the CEEB calculus programs can easily make the necessary changes. Offering courses for college credit in the high school building will help keep many above average students on our high school campuses and among their peers.

In the past, some school administrators have skirted CEEB advanced placement courses for financial reasons. They have said that advanced placement courses are too costly because classes are small. Now there is a valid response for all teachers or departments wanting to offer courses at the advanced placement level. Further, advanced placement will make college credit available to students in rural areas that are not near a college or university.

Recommended Curricula for Advanced Placement

While not all high school students are capable of college level work, a surprisingly large number of students can do such work. Recall that an estimated 85% of Ohio's high schools offer a course in calculus (see Table 1). Table 2 shows a proposed curricula that can prepare top students for advanced placement calculus and computer science.
Table 2
A Curriculum Model

<table>
<thead>
<tr>
<th>Year</th>
<th>Plan 1</th>
<th>Plan 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td>Algebra 1</td>
<td>Algebra 2</td>
</tr>
<tr>
<td>Sophomore</td>
<td>Algebra 2</td>
<td>Geometry</td>
</tr>
<tr>
<td>Junior</td>
<td>Precalculus</td>
<td>Precalculus</td>
</tr>
<tr>
<td></td>
<td>AP Calculus</td>
<td>AP Pascal</td>
</tr>
<tr>
<td>Senior</td>
<td>AP Calculus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AP Pascal</td>
<td></td>
</tr>
</tbody>
</table>

Note that the curricula include existing courses that are in place in many schools currently operating successful advanced placement programs. It should also be noted that such courses are not static. They should reflect current research as reflected in such documents at the National Council of Teachers and Mathematics’ Curriculum and Evaluation Standards for School Mathematics (1989) and the new Ohio Model Curriculum (1990).

A key to success is keeping Algebra 1 and Algebra 2 in sequence. This approach is common in many schools offering successful advanced placement calculus courses and minimizes the loss of algebraic skills. For students who do not take Algebra 1 in the eighth grade, the concurrent Algebra 2 and Geometry courses in the sophomore year have proved successful. The traditional preparation in Algebra 1, Algebra 2, and Geometry are essential prerequisites to the more in-depth precalculus course to be taken during the junior year. The precalculus course should include three quarters of in-depth work in the conic sections, trigonometry, logarithms, graphing, and analytic geometry. At least one quarter should be devoted to the study of probability and statistics.

The precalculus course will not be for every student in your school. Rather, it is intended for those students who want a solid preparation for calculus. Typically this would mean high school juniors preparing for advanced placement calculus during their senior year or high school seniors preparing for calculus for their freshman year in college.

References


Some of our older readers, referees, and editors remember when similar arguments were made for slide rules, adding machines, and hand-cranked and motor-driven desk calculators. Napier’s Bones, logarithms, and the abacuses must have had good press in their time, also. Our Journal could use a few articles on what kids should think about with all their free time!

Solutions to Alaskan Cryptarithms:

<table>
<thead>
<tr>
<th>82</th>
<th>568</th>
<th>7033</th>
<th>42</th>
<th>859</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>132</td>
<td>1526</td>
<td>579</td>
<td>2661</td>
</tr>
<tr>
<td>164</td>
<td>700</td>
<td>8559</td>
<td>621</td>
<td>3420</td>
</tr>
</tbody>
</table>

1
benefits of using calculators are exciting; children are eager to do mathematics when calculators are available (Shumway, 1976). In a technological society our children need to master the one electronic device that is the most common, affordable, and practical: the calculator.

Some say that learning basic facts will not occur if hand-held calculators are made available in the schools and that school must ban the use of calculators to ensure facility with the basic skills of arithmetic (Shumway, 1976). The "back-to-the-basics" bandwagon or the more "traditional" arithmetic program has undoubtedly played a part in the use of calculators in schools, especially at the elementary level, but research projects find that, "Students who use calculators for instruction achieve scores at least as high as students not using calculators even though the calculator is not used on the test... The decrease in time spent on paper-and-pencil practice did not appear to harm the achievement of students who used calculators.", (Suydam, 1982). Also, studies show that children who use calculators find mathematics more interesting, spend more time checking their work, and become more involved in learning (Hembree and Dessart, 1986).

A calculator does not solve problems; the problem solver has to press appropriate keys. The emphasis in problem solving is in selecting and using appropriate strategies, not in computing. The most valuable benefit for the students is to reason logically through a problem. Even when calculators are used in the problem solving process, students must do the thinking.

This kind of mathematical thinking is not reserved for the academic elite, but with the appropriate use of the calculator all students can have the time and instructional support to learn to think through problems, knowing that lengthy computations will not be a barrier to success (California, 1985).

In summary, the overall goal is not to produce a calculator-driven school mathematics program, but rather a mathematics program that integrates the calculator in meaningful and useful ways. The impact of technology and its implications for mathematics education can no longer be ignored (California, 1985). The time is now for enriching and strengthening the mathematics education our children receive. Instead of requiring students to spend years studying arithmetic as a series of rules and rote procedures, it is time to provide the opportunity for all students to experience the richness and beauty of the study of mathematics as a whole.

Conclusion

Although the post-secondary options program of Senate Bill 140 invites our best students to leave our secondary schools, we can do much to retain these talented students. It is important for us to view the college option as an opportunity to improve the curriculum of the high school rather than as a problem to be solved. Due to the already strong curricula in place in our high schools, mathematics departments are in an ideal position to provide the leadership to get successful advanced placement programs into operation.

In short, the options program of Senate Bill 140 can be a motivating force to help strengthen the curriculum through advanced placement. Credits secured through advanced placement have traditionally been considered prestigious and flexible. There are countless examples of successful advanced placement programs working in Ohio schools of all sizes. These successful programs all exhibit high teacher motivation and a commitment to excellence. Mathematics educators can take the lead in this important venture where Ohio students will be the winners.

References


Ohio Department of Education. Ohio Model Competency Based Mathematics Program. Columbus, OH: 1990.


Senate Bill 140 is controversial. We welcome your comments on the Flick-Boothe article - either a letter or an article. How do you feel about SB 140?

The Editors