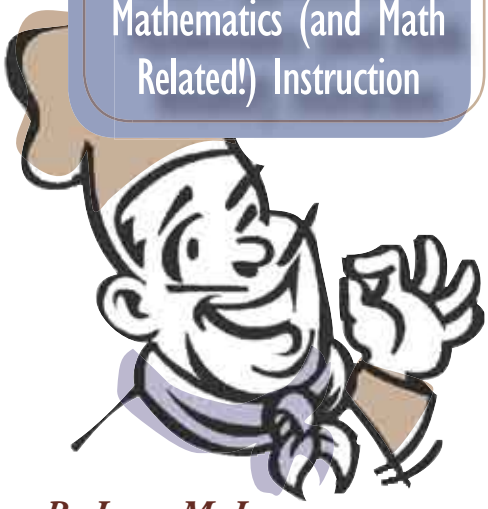
A Baker's Dozen

13 Palm Applications for Mathematics (and Math Related!) Instruction



By Lynn M. Lary

Subject: Math, economics, science

Grades: K–12 (Ages 5–18)

Technology: Palm OS handhelds

Standards: *NETS•S* 3; *NETS•T* II (http://www.iste.org/standards/). *NCTM* Grades K–2, 6–8 Geometry (http://standards.nctm.org/document/). *NCSE* 2, 12 (http://www.ncee.net/ea/standards/). *NSES* Grades K–12 Unifying Concepts and Processes (http://www.nap.edu/readingroom/books/nses/html/).

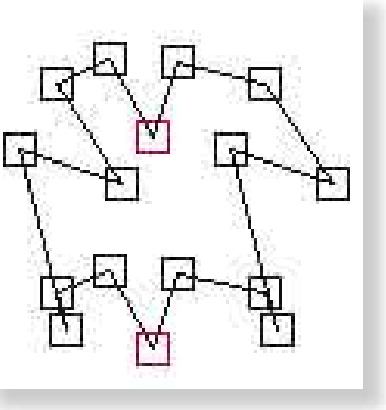
During the course of the last year, I have had the privilege of working with approximately 90 Grade K–8 teachers in the use of Palm OS handhelds. I have found many applications that can help you integrate handhelds into instruction on math topics, whether it is in math, economics, career exploration, or science. Prices range from free to $25. Many of the shareware programs have fully functional, time-limited demos available.

As a former high school math teacher, I taught everything from basic math to AP Calculus. At the basic math level, particularly in high school, many of the students have not had success in learning mathematics or any love for mathematics. For this reason, I believe it is imperative to teach these students how to use tools that have real-life applications and help them become smart consumers and smart citizens.

If you are considering using handhelds in your classroom, you have a number of things to consider: equipment management, student contracts for out of class use, tutorials, curriculum integration, success stories, and current research on handheld effectiveness. To help teachers learn more about classroom use of handhelds, the Organization for Educational Technology and Curriculum (OETC, formerly known as Oregon Educational Technology Consortium) has worked in conjunction with the South Lane and Eugene 4J School Districts, both of which are recipients of U.S. Department of Education, Enhancing Education Through Technology (Ed Tech) grants to develop the Northwest Handheld Project (http://www.nwhandheld.org).

MATH

Geometry Manipulatives. Two easy-to-use programs that are popular at the elementary level include Tessellation and Tan Free. In each case, these programs allow teachers and students to quickly access "virtual manipulatives."



Tessellation V1
Publisher: David Rasch, http://tesselation.sourceforge.net
Grades: 2–12
Cost: Freeware

The National Council of Teachers of Mathematics (NCTM) Grades 6–8 Geometry Standard indicates that all students should "Use visualization, spatial reasoning, and geometric modeling to solve problems" and "recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science, and everyday life."

Tessellations have been incorporated into math classrooms for many years as teachers draw connections between geometry and art. In the old days, students spent hours trying to draw their own tessellations. The beauty of this program is that it allows students to create tessellations from a base figure (e.g., triangle, square, diamond) within seconds. (Some Web sites do the same thing,

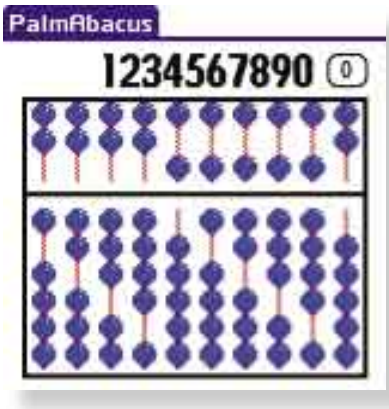
but you may not have access to a computer lab.) Students can click-and-drag vertices and edges to modify the shape. With the click of a button, the image is tessellated! This is an excellent tool for quickly exploring how shapes are tessellated and what tessellations are.

Tan Free V2.1.1
Publisher: smallWare, http://www.freewarepalm.com/games/smallwaretangramsfree.shtml
Grades: 1–12
Cost: Freeware

Tan Free allows students to solve tangrams. The student starts with a silhouette and seven pieces. The pieces can be rotated, flipped, and moved; the goal is to replicate the silhouette using all seven pieces. This is a great virtual manipulative because unlike physical manipulatives, this program allows students to ask for hints in solving the tangram. If a hint is requested, the program will show the correct location of the selected piece. The student can then continue solving the puzzle.

The use of TanFree is a fun way to teach the NCTM Grades K–2 Geometry standard of applying transformations and using symmetry to analyze mathematical situations, as students must "recognize and apply slides, flips, and turns" to successfully complete the tangram.

Place Value/Number Systems. The NCTM Number and Operations Standard indicates that all students should "Understand numbers, ways of representing numbers, relationships among numbers, and number systems." This includes using "multiple models to develop initial understandings of place value and the base 10 number system." Abacus and Numerus are two programs that allow students to work with place value within other number systems and reinforce their understanding of our number system.



Palm Abacus V0.961
Publisher: David Zimmerman, http://www.palmgear.com/index.cfm?fuseaction=software.showsoftware&SID=2AC2C8E2-CF18-AC2E-71CECC6D14120A19&PartnerREF=&prodID=54506
Grades: 3–12
Cost: Freeware

Abacus is a free, easy program that simulates a Chinese abacus. As the user moves the beads, the Arabic numeral equivalents are shown. This allows students to deduce the values of the beads in different rows. In addition, when students select multiple beads of a smaller value, the program automatically exchanges them for the correct number of higher value beads. The benefit of using Palm2 Abacus is that students have immediate feedback regarding the value of the different beads, which is especially helpful in teaching the concept of place value in a number system.

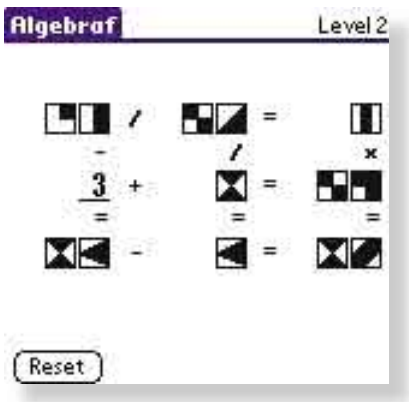
Numerus V 1.4
Publisher: Laurent Duveau, http://www.palmblvd.com/software/pc/Numerus-2001-10-11-palm-pc.html
Grades: 3–12
Cost: Freeware

This program is a Roman numeral calculator in which students can enter Roman numerals and then add, subtract, multiply, and divide them. The corresponding Arabic numbers are displayed along with the Roman numerals. The cool thing about this program is that if a student enters an "I" and then another "I," the number 2 is displayed. If another "I" is entered, the number three is displayed. When the forth "I" is entered, it automatically changes to "IV" and displays the number four. When a student tries this with an "M," the following happens:

M	1000
MM	2000
MMM	3000
MMMM	4000
MMMMM—changes to V.M	5000

Notice that when you enter MMMMM, it changes to V.M and 5000 is displayed—I learned this notation from using Numerus! If you are interested in using this application, I would suggest that you take a look at fifth-grade teacher Tony Vincent's Exploring Roman Numerals Web Site at http://www.mpsomaha.org/willow/p5/handhelds/activities/romannumerals.html. It contains some useful activities for teaching students about Roman numerals.

Mental Math. Most math teachers want their students to be good thinkers and problem solvers and to be proficient at numerical calculations. The programs below can be used to sharpen these basic skills.



AlgebrafV1.0
Publisher: Seba Software, http://www.freewarepalm.com/games/algebraf.shtml
Grades: 4–12
Cost: Freeware

This is one of my favorite problem solving pieces of software. Ten symbols that represent the digits 0–9 are displayed. The symbols are displayed in three rows of three with +, -, /, and × between each adjacent symbol (both vertically and horizontally; see image). The goal of this "game" is to decode the symbols so that the math equations are true in all three rows and in all three columns. In level one, eight of the numbers are one-digit numbers; there is one two-digit number. After successfully playing the "game" multiple times at level one, the user progresses to level two, which includes more two-digit numbers. Each level gets progressively more difficult. The downside is that there is no way to change the levels if multiple students are using the same handheld (i.e., once you get to the second level, there is no way to return to level one).

Mental Arithmetic V1.2.1
Publisher: Bubbling Solutions, http://www.bubbling.com
Grades: 4–12
Cost: $25, shareware

This program uses student feedback to adjust the level of difficulty. Each problem involves either addition, subtraction, multiplication, or division. The first time a student uses the program, he or she is presented with 10 questions. If the student answers all 10 correctly, the student proceeds on to Level 2. If not, the program offers more practice. One difference in how this program displays the questions is that symbols (e.g., +, -, ×, /, ÷) are not used; instead, the problems contain math vocabulary (e.g., plus, minus, multiplied by, divided by). One positive aspect of this program is that if a student is having difficulty, he or she can request help. Help is provided in the form of suggested approaches to problem solving. For instance, to find the answer to 43 + 68, the help suggests breaking the numbers up using the associative property of addition (though not identified in this way):

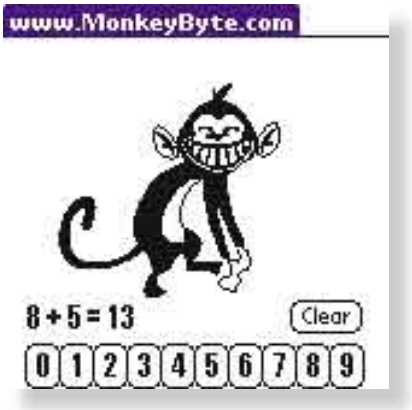
43 + 68
"Try splitting into tens and units, and adding these separately."
43 + 68
(40 + 60) + (3 + 8)
100 + 11
111

Mental Arithmetic keeps several statistics for the student, including the overall percent correct.

BeSmart V1.4
Publisher: Dmitri Vokhmine, http://www.palmgear.com/index.cfm?fuseaction=software.showsoftware&prodid=6950
Grades: 4–12
Cost: $8, shareware

This drill-and-practice software allows students to add, subtract, multiply, or divide two numbers. The student can select one type of operation as well as the number of digits in both the first and second number (up to five digits). The student can also determine whether to use negative or positive numbers. I particularly like two features about this program. First, there is a work area so that if a student needs "virtual scratch paper" he or she can work out the problem right on the handheld. Second, the student's percent correct is shown on the screen at all times. If a student

doesn't like a 75% rate of accuracy, he or she can simply reset the tally and go for 100% accuracy. Speed in which the problems are completed is not a factor; the only feedback a student receives if he or she is wrong is the correct answer.



Monkey Math V0.5
Publisher: Monkey Byte Development, http://www.pilotzone.com/palm/preview/160071.html
Grades: K–2
Cost: Freeware

This is similar to BeSmart, however it has fewer options. This program only allows the user to select from +, -, and × and to only use one-to three-digit numbers. It offers no tally of correct answers and no virtual scratch paper, making this truly a mental math exercise. One aspect that might be appealing to younger students is the monkey that provides feedback when the correct answer is entered.

ECONOMICS

The National Council on Economic Education (NCEE) Standard 12: Role of Interest Rates says "interest rates, adjusted for inflation, rise and fall to balance the amount saved with the amount borrowed, which affects the allocation of scarce resources between present and future uses." This is a fairly abstract concept for students to understand. Through the use of tools such as InflationMaster, students are able to explore the value of money, how it changes over time, and compare today with yesterday.

InflationMaster V2.7
Publisher: John Mayo-Smith, http://www.freewarepalm.com/calculator/inflationmaster.shtml
Grades: 2–12
Cost: Freeware

This is a gem of a program that can be used across the curriculum to provide financial context for students. This program allows a student to enter a dollar value in a particular year and to calculate the value in today's dollars. For instance, if students are studying the Oregon Trail and learn from the National Oregon/California Trail Center (http://www.oregontrailcenter.org) that in the 1850s it cost $100 for a covered wagon, they can use InflationMaster to find that it would cost $2,170.59 in today's dollars. Finding the cost of making the trip West seems like a simple activity, but it is a terrific way to engage students in discussions about who was making this trip—simply put, these pioneers had the means to travel.

Inflation Master's calculations are based on the actual rates of inflation for the years 1800–2003. This is important to know, because some sectors of the market do not increase with the rate of inflation (e.g., real estate, medical services). For older students, this can generate a whole topic of discussion about what factors influence different sectors of the market. The fluctuating value of a dollar is sometimes a difficult idea for students to grasp. For instance, InflationMaster is a tool students can use to understand the inflation/deflation and the early 20th century as the United States entered into the Great Depression. One of the social studies teachers involved in the South Lane Ed Tech grant had her students make charts covering the years 1920–1940 and the associated value of money over time. By graphing the data, students could see the concept of inflation/deflation.

$100 in 1920 was worth $100; how much was the same $100 worth in each of the following years?

1920	$100
1921	
1922	
…	
1940	

powerOne Personal V3
Publisher: Infinity Softworks, Inc., http://www.infinitysw.com/products/poweronepersonal.html
Grades: 7–12
Cost: $9.99, shareware

This is a nice tool that allows the user to calculate sales tax, markup, and percent change (click the Business button). Clicking on the General button allows the user to calculate tips. This tool may be helpful in role-playing and teaching students about making purchases and/or running a business.

Lemonade Tycoon V1.0.0

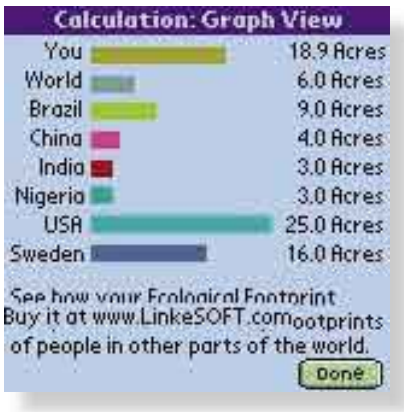
Publisher: Hexacto Games, Inc., www.jamdat.comjamdatweb/catalog/us/en/game/palm/productdetailoverview/view/product249
Grades: 7–12
Cost: $14.95, shareware

This simulation can be played as a game or used as part of an ongoing assignment. The goal is simply to maximize profit made at a lemonade stand. Students have to develop a recipe for lemonade and then set a competitive price. They must also determine how many supplies they will need, based on weather, location, and current events, to meet the predicted demand. Purchasing too many supplies may result in a net loss; charging too high a price may deter customers. You may want to develop a spreadsheet template where students can track their progress and help them make future predictions. A key to the supplies would be helpful, as it can be difficult at first to determine what some of the icons represent. The use of this program can be tied into many concepts including marketing, product supply and demand, and capitalism. Student activities could include graphing data and identifying relationships (e.g., sales versus temperature, sales for different recipes, sales by location), researching recipes, making and testing lemonade, and designing signs for their stands.

SCIENCE

"Evidence, models, and explanation" is a part of the Unifying Concepts and Processes Standard in the National Science Education Standards, and it is nicely supported by the use of the Ecological Footprint Calculator.

Ecological Footprint



Calculator V3

Publisher: Kidsolve, http://www.kidsolve.com/products/palm/efc/
Grades: 4–12
Cost: Freeware

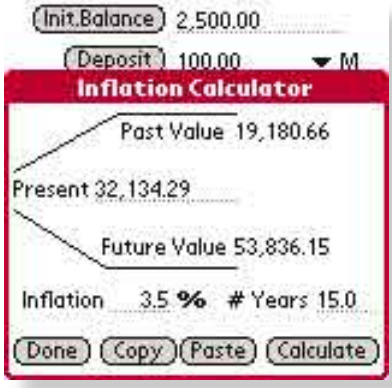
Students are asked 13 questions about their lives: how much food they waste, how big their homes are, what kind of transportation they use, and so on. Once they enter their answers, students learn how their lifestyles affect Earth. The data is presented in four ways:

1. how many Earths would be needed to support all humans if everyone lived the way they do
2. how many football fields are needed to support their lifestyle
3. how their consumption breaks down (e.g., acres needed for housing, transportation, food)
4. how individual consumption compares with the average American; the averages of people living in Sweden, Nigeria, and five other countries; and the world as a whole

This program is a great way for students to see how they compare

with others and provides opportunities for them to read graphs and test their own hypotheses about the effect changing their lifestyles has on the earth. Depending on the ages of the students, they may not know the answers to all of the questions the program asks. Teachers may want to use this program as a part of a home-based activity in which students discuss the questions with their parents to make their data input more realistic. Related activities might include conjecturing about ways that humans can have less impact on Earth or students answering the questions from the perspective of a person in a developing country and comparing/contrasting the outcome to their own responses.

CAREER EXPLORATION



Salary Utility V2.6
Publisher: Witkowski-Design, http://www.freewarepalm.com/calculator/salaryutil.shtml
Grades: 6–12
Cost: Freeware

Salary Utility helps students understand that an hourly wage isn't necessarily worth its face value and supports NCEE's Marginal Cost/Benefit Standard 2: "Effective decision making requires comparing the additional costs of alternatives with the additional benefits. Most choices involve doing a little more or a little less of something: few choices are 'all or nothing' decisions."

This program allows students to calculate how much they really make once you take into consideration the costs of commuting, paid vacation, insurance, and so on. This is a good tool to help students understand that an hourly wage isn't necessarily worth its face value.

A drawback to this program is that it doesn't take into consideration social security, retirement, or taxes. In addition, teachers would want to supplement the use of this program with discussions about topics such as how much commuting to a higher paid job located farther away would cost (is public transportation available? is a car necessary?) as compared to a lower paying job within walking distance.

This program would complement a unit on careers quite nicely. Student activities could include an analysis of several different career options with students doing online research for job requirements (e.g., college degree, experience) as well as the related salary and benefits. At higher grade levels, students might also do a cost-benefit analysis of getting a college degree in order to qualify for a higher paying job.

Handhelds are not just for keeping track of your calendar! Palm handheld computers are being used in classrooms across America in creative ways to engage students in learning. The applications I reviewed in this article represent a very small portion of the thousands of programs available to Palm-using educators.

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