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The Internet as Instructional Tool: A Consideration of Its Potential Role in the Elementary Mathematics Classroom

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This paper considers, through text and "live" visits to Internet sites, the potential role of this innovative technology in classroom teaching of elementary students (ages 6 to 14 years). Mathematics educators are challenged to consider the Internet as contributing to actual instruction through: (1)Opportunities for students to interact with real-time data, a context which engages them in applying mathematical principles. (2)Virtual manipulatives, which allow students to manipulate objects onscreen and observe the effect of the movement. In this "hands-on" environment, students can actively explore abstract concepts from number to ratio to linear equations. (3)WebQuests, in which students investigate a real world problem by finding information on the Internet and reaching a conclusion through mathematics applications. (4)A growing repository of shared problem sets, created by educators as both practice and challenge for their students. When accompanied by prompts and solutions, these can serve a tutorial function. In conclusion, a technology which has proved a source of games and glitz can paradoxically serve the role of instructional tool in the mathematics classroom.

In support of the above thesis, this paper will describe the four unique educational contexts referred to and give examples of each. The paper would be more valuable and its argument more convincing if read with "computer at the ready," that is, with the Internet accessible in order to experience the sites given as examples. With that idea in mind, the addresses of all the Internet sites are included.

(1) Interaction with real-time data. Students working with such data operate in an ideal context for investigating applications of mathematics. They connect to real-time statistics, then explore the mathematical questions presented with teacher guidance. Such contexts offer opportunities for problem solving and mathematical modeling.

As an example, in the Stowaway Adventure http://www.k12science.org/curriculum/shipproj/ students supposedly have stowed away on a ship. Given the identity code of an actual ship at sea, students use data retrieved from online marine observations to find their ship's latitude and longitude, as reported by maritime law every six hours. Using the data, they calculate not only their ship's present position but also its direction of travel, its speed, most likely intended port and time of arrival.

As another example, in A Functional Housing Market http://teachertech.rice.edu/Participants/sboone/Lessons/Titles/lphouse.html students search the Internet to find information on houses actually for sale in Houston, Texas. The location of the housing market can be changed to suit the school situation. Using such data as the selling price and the square footage of living areas, students can calculate the price per square foot and assemble a graph showing the information. Most interesting can be the price per square foot in various areas of a city.

(2) Virtual manipulatives. This refers to interaction with an online object. Computer-generated objects are manipulated through some user interface. Students move these onscreen objects or change parameters that affect the object's image, and immediately observe the effect of the interaction. Virtual manipulatives in mathematics education are also termed "mathlets," for each contains an embedded mathematical concept which the learner explores through the interactive experience. Working in this environment allows the learner to explore in a "hands-on" mode those abstract concepts not readily accessible in other mediums.

One example, Understanding Distance, Speed and Time Relationships, http://standards.nctm.org/document/eexamples/chap5/5.2/index.htm offers a simulation of two runners along a track. Students control the starting point and speed of each runner. A time-versus-distance graph is created as the race is run. Students can observe the runners race as figures on a track, while simultaneously seeing the graph develop. Depending on the students'

level, questions of the relationships among time, distance, and speed can be considered as well as concepts of slope and change over time.

As another example, a site from Japan, Manipula Math with JAVA, offers an extensive set of interactive experiences covering a wide range of mathematical concepts, from elementary geometry to calculus. In one exercise on Figure and Ratio of Area http://www.ies.co.jp/math/java/geo/ratioAB/ratioAB.html, students see two grids, each with a rectangle made of two squares. The user can change the width or height of each rectangle and observe the resulting ratios of width to height, and width to area of the figures.

Even very young children can consider angle and unit distance as they try to get the Turtle to the Pond http://illuminations.nctm.org/imath/prek2/GeometryConcepts/index.html Children enter a sequence of commands, telling the turtle which direction to go and how far; once the commands are decided, the turtle's pathway is drawn. The interactive tool allows for some creative problem solving!

(3) WebQuests. In these Web-based units, students investigate a real world problem by finding information on the Internet and applying it to solve the problem. Students usually work in small groups to both find information and solve the problem. Examples include the problem of buying a car, which would necessitate finding prices of cars, including supplementary components such as radios, window wipers for the back windows, special braking systems, etc. An extension of the problem could be calculation of the buying price plus interest, and the salaries of jobs that would allow the purchase of the desired car. Teachers set the real world problem, often provide a list of selected sites for harvesting information, and usually set a rubric for assessing the group's work.

A complete example of the process is given in this task for older children: Buying Your First Car http://www.otsego.k12.oh.us/bernthisel/carshoppingwebquest.htm. A task is set, a process outlined, sites for investigation offered, and an evaluation scale presented.

In Home Improvement http://www.gal-220.org/homeimp.htm students must work from a scale drawing to figure areas and perimeters of rooms, cost of carpets, wallpaper, paint, etc., and calculate the total price for the renovation.

In one example for young children, Cruisin' to the Southeast http://www.manning.k12.ia.us/Technology/southeast/index.html, students plan a trip through the southeastern United States. The lesson idea can be easily modified for any part of the world. They look into information on the weather, distances and driving between cities, and products of the region. Finally, they present the information as a brochure. Older children could look into hotel rates, gasoline prices, etc., and figure the entire cost of the trip.

(4) Shared lesson ideas. The Internet serves an archival function for educators by holding the problem sets, lessons, and even entire courses created by teachers as well as organizations, all ready to be mined freely. A very few examples will show the value of this service to mathematics education:

Word Problems for Kids http://www.stfx.ca/special/mathproblems/welcome.html, a Canadian site, contains problems aimed at improving skills; each problem contains a link to hints as well as the solution.

The Japanese Math Challenge http://www.japanese-online.com/math/ offers 20 logic-based story problems for 12-year-olds. Each problem, translated from Japan's Junior High School math placement test, includes a hint to help the student attack the problem and a complete explanation of the solution.

New Zealand Maths http://www.nzmaths.co.nz/ features weeklong units of work with reproducible lesson materials based on the New Zealand Mathematics Curriculum Strands. The units, developed for both elementary and higher levels, are based on statistics, geometry, measurement, algebra, and statistics. Also included is an area on problem-solving techniques

Figure this! Math Challenges for Families http://www.figurethis.org/index40.htm These problems for 11- to 14-year-olds offer hints to "get started" as well as a detailed solution. The site features math challenges that use concepts and objects found in everyday life.

These examples highlight the potential contributions of integrating computer technology into mathematics instruction at the elementary level. This technology encourages students to participate in real world problem solving; actively engages them in an experimental, inquiry approach; and enables them to explore abstract concepts in a virtual "hands-on" environment. Moreover, the Internet connects teachers, even on an international scale, and enables them to share their accumulated problem sets and enrich the experiences they can offer their students.