

Family Math

Barbara Misechok
Student Achievement Center

Overview

Developing problem solving skills is critical for the future success of students including students with special needs. The current curriculum often lacks opportunities for students to develop problem-solving skills. This is particularly true for students with special needs. Teachers focus on rote exercises to teach basic skills. The abilities for students with special needs to use problem-solving techniques are overlooked. The latest recommendation of the National Mathematics Advisory Panel March 2008 state that mathematics instruction needs to be a combination of conceptual understanding, computational fluency and problem solving. These capabilities are mutually supportive.

At the high school level, students have been doing the same types of activities to learn to add, subtract, multiply, and divide for eight years. Many students lack motivation to continue with this effort. Introducing students to problem solving in mathematics can increase a student's motivation to perform. Success in one area leads to confidence and success in other areas of mathematics.

In reading, research has shown that brains can be reprogrammed to learn to read for students with dyslexia. Ninety-seven percent of people can learn to read. While no research has shown that ninety-seven percent of people can perform mathematics, it seems logical to me that the brain can be reprogrammed for math as well. Additional research is needed to confirm this hypothesis.

The students with special needs get labeled as slow or with limited abilities. Because the student's brain does not process the same as most people does not mean the student cannot learn. Students with special needs can be and should be taught problem solving skills. The perception that students with disabilities are not able to do more challenging problem solving activities is inaccurate.

Research indicates that problem solving begins with your background knowledge. One must process the knowledge of the strategies in order to use them. If the students are not exposed to problem solving situations they will not be able to develop the skills to solve problems. Too often students receiving

instruction in the resource room are not presented opportunities to develop problem-solving skills. With no experience from which to draw, the student does not have any ideas about how to approach problems.

This project will use graphs, tables, charts and advertisements to develop problem-solving skills. The students will learn how to represent data, conduct research about a product, and to design an advertisement for the product. The students will analyze data to determine falsifications or untruths in advertisements. Technology will be a part of the project for the construction of the charts and graphs as well as the design of the advertisement.

Rationale

This project is important for me because I teach special education students in high school. Many of these students are near graduation. I am preparing these students for life after high school. Teaching my students to have strategies to tackle problems is important. Everyone faces problems in everyday life.

The approaches to problem solving need to be taught. Students do not automatically know the various techniques that can be applied to solve a problem. Repetition is used in most classrooms to help students attain skills. This approach is successful; therefore this is also the case for problem solving skills. Students need to be repeatedly exposed to problem solving skills to feel competent in utilizing the approaches to solve problems. With special need students, the problem solving skills must be explicitly modeled, taught, explained, and repeatedly used. This idea is reinforced by the results of the National Mathematics Panel March 2008. The report states that explicit instruction for students who struggle with math is effective in increasing learning.

Some research has suggested that there are benefits to teaching the problem solving skills to students with disabilities (Wilson & Sindelar, 1991). The more recent research suggests the curriculum should include a balanced approach that teaches basic skills combined with problem-solving experiences. If the students can be pulled into problem solving activities this may lead to greater success with the remedial basic skills instruction.

The workplace continues to become more challenging. Rote jobs where very little thinking is required are done by robots or are low paying positions. The Council for Exceptional Children reports that longitudinal data collected from the 1980's show a trend of increasing low-wage service industry jobs for students

with disabilities. Failure in math will only limit the options for these students even more.

Changes in economic organization and new technologies have changed the nature of most workplaces. The new global market, democratic workplace decision-making and new technologies have led to jobs with multiple roles. (Mikulecky & Kirkly) Clearly, workers with problem-solving skills are critical. As a teacher, I am educating the future workers. What I teach must prepare my students to be ready for this workplace.

The mathematics scores of youth in the United States are not what are expected of a world leader. The United States may no longer expect to be able to import workers with strong mathematics for engineering and other important jobs. The global work markets with other strong markets in the world are making immigration to the United States less appealing. Our country must find a way to improve our math instruction according to the National Mathematics Panel March 2008. Curriculum without integrated problem solving clearly will not be acceptable to achieve this aim.

Problem solving needs to be taught as an integral part of mathematics instruction. Just learning basic skills is not enough. Problem solving involves using several processes and strategies. Students with learning disabilities do not process problem information effectively. They lack the cognitive or self-regulation strategies that help successful students understand, analyze, solve and evaluate problems. A number of strategies will need to be taught to the students. Cueing, modeling, and verbal rehearsal can be used by the teacher to help the student with a disability to learn problem-solving strategies.

The National Council of Teachers of Mathematics states that all students should have exposure to problem solving in mathematics so that

“students become confident in their ability to tackle difficult problems, eager to figure things out, flexible in exploring mathematical ideas and trying alternative paths and willing to persevere” (1)

The council also states that it is a disservice to mathematics to reduce the discipline to a set of exercises and skills devoid of problem solving.

Why repeat the techniques of basic math computation with disabled students again as their high school instruction when they need to learn how to manage information, how to communicate their information with others, and how to use technology? Basic skills are important, but if the student did not learn the

skills in kindergarten through eighth grade, why not try a new focus? Technology, like a calculator or computer, could perform the basic skills portion of the problem, freeing the students to focus on tackling the problem solving.

One concern I have about students with disabilities is that people will take advantage of the students because they have a disability. This exercise will provide the students with some background knowledge to help them analyze things they are told. The students will learn that just because it is in print backed by some type of research does not prove the statement should be believed. I hope this lesson will lead the student to question things they are told and not to accept statements without question.

Students need to understand how data is collected, compiled and reported. Statistical problem solving skills will enable students to seek answers to questions using data. The students will see how data is used to answer questions. This may lead the students to question data pretended in advertisements.

Objectives

Students will be able to use problem-solving strategies to complete a review of the data accompanying an advertisement to make a judgment about the truth of the advertisement.

Students will write a survey to obtain an opinion from fellow students about a product and conduct an opinion survey. This requires the student to formulate and refine questions. How to word the questions and how to record the data will be important in this task.

The students will compile the data collected from the survey into a chart and formulate a graph depicting the data. The data must answer the question posed. Students will use either Microsoft Word or Excel to type the chart. Excel or a web page will be used to construct the graph.

Finally the students will design an advertisement for the product in the survey. Students will use their knowledge of number patterns to identify the patterns in the data from their survey to develop the graphs and advertisements. Students will understand the importance of the scales on graphs and charts to insure an appropriate scale is used.

Students will use technology to enhance their learning experience. All charts will be typed on Excel or Word software. The students will use computer software to create their graphs. The website <http://nces.ed.gov/nceskids/createagraph/> is a simple site for making graphs that can be used if the student is not familiar or comfortable with using Excel to make the graphs.

Strategies

Learning-disabled students have normal intelligence but are not performing at a level that would be expected. The problem with learning can be caused by many reasons. Research indicates that students with learning disabilities are not making adequate math progress. Despite spending one third of their time in the resource room learning mathematics, the increase in math levels is only one year for two or more years of instruction. (Cawley & Miller, 1985) Problem-solving applications might motivate the students to progress further. An interactive problem-solving approach can be more interesting and engage the students in instruction. It is okay for math to be fun and engaging. Experimentation combined with direct instruction needs to be combined to successfully teach my students problem solving skills.

When attempting to teach problem solving strategies start with simpler applications and move to the more complex and challenging skills. This will be a beginning to developing background knowledge for the students who possesses the simpler applications of the strategies. Research data presented in chart and graph format will be used to provide opportunities for students to develop problem-solving strategies. The data can start simple and build to more complex information. The unit will begin with reading charts and lead to analyzing data.

Explicit instruction will be used for this project. For the purposes of this project, the definition for explicit instruction will be the one used by the National Mathematics Panel

“teachers provide clear models for solving a problem type using an array of examples, the student receives expansive practice in use of newly learned strategies and skills, that students are provided with opportunities to think aloud (i.e. talk through the decisions they make and the steps they take), and that students are provided with extensive feedback.” (1)

Prior to beginning the project portion of the unit, I will begin by assessing the student’s background knowledge by administering a pre-test. This will enable

me to develop a starting point. Students have been introduced to graphs during their math, social studies and science courses; however, the level of their understanding is the unknown.

To teach the reading and construction of graphs portion of the unit, each type of graph will be reviewed. The parts of the graph will be identified. The situations in which the graph is used will be explained using a Power Point presentation. Next the class will practice reading the particular type of graph. Then the students will practice reading the graph independently. Homework will be assigned for additional practice. After that I will model how to construct the type of graph. The class will work together to develop graphs. Subsequently independent practice will follow. This format will be followed until students have learned each type of graph in the unit.

The next portion of the lesson will move to analyzing. Now that the students can read and construct basic graphs, the focus will be to develop a deeper understanding of the graphs and data used to construct the graph. Students would benefit from understanding that graphs are used to present data in a pictorial manner to help show the patterns. The graphs can also be deliberately constructed to mislead or give a false impression.

To help the students begin to think about data in a critical manner, we will look together at some examples. We will start with very obvious examples of misleading information and move to more subtle examples. We will look at examples that leave out important components like titles or scales. Advertisements that use deceptive scales to make their point will be discussed.

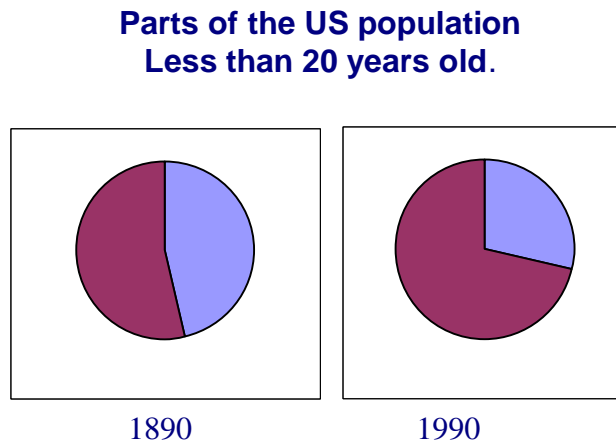
Classroom Activities

The focus of this project will be on data analysis and problem solving. Prior to this project, the students will complete work on a graphing unit. This unit will begin with a series of lessons in reading and constructing different types of graphs. We will study bar graphs, pie graphs, histograms, line graphs and scatter plots. First, we will review each graph individually using a PowerPoint presentation. Parts of the graph will be reviewed. As a class, we will practice reading the graph types. Next the students will read the graphs independently. Then this process will be repeated to construct each type. Hopefully most of this will not be new information. Typically, my students have been introduced to charts and graphs during their educational career.

The focus will move to analyzing graphs. The students will compare the types of graphs. We will discuss the different uses for each type of graph. Situations and data will be presented and the students will determine the appropriate type of graph to use in this situation. This will become key when the students determine which type of graph to construct for their project.

To further develop problem-solving skills of the students in understanding data we will examine data and answer questions about what can or cannot be said about the data. We will spend a class period looking at data and determining what we can say about the data. Students will decide which statement is true based upon data given. For example:

The pink shaded slices of these circle graphs show the parts of the population in the United States who were less than 20 years old.



In which year was a greater percentage of the population less than 20 years old?

Does it follow that there were more people in the United States less than 20 years old in that year than in the other? Explain.

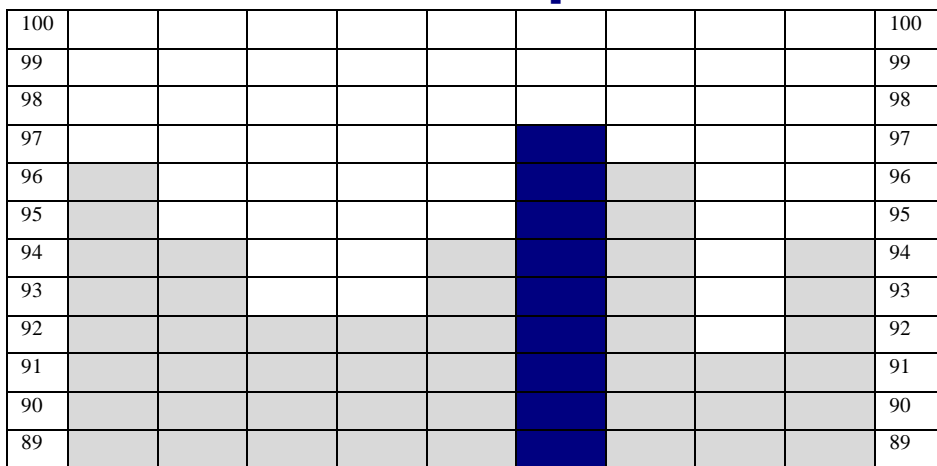
The class will examine the circle graph and questions. A discussion will help the students see that while a higher percentage of population was under 20 years of age in 1890 than in 1990, the population in each of the years is not provided. It cannot be assumed that more people in the United States are less than 20 years old in 1890 than in 1990. (2)

When approaching the assigned project, the students need to use the problem-solving strategies developed by George Polya. First, the students must understand the problem or assignment. Next, they need to devise a plan to complete the assignment. The students will carryout their plan. Finally, they will look back and reflect on the results. What have they learned? Do the results seem to make sense?

The students will be introduced to the project by reviewing some advertisements. We will look at the data used to support the data and identify the problems with the data. How is the data twisted to show what the advertiser wants the data to depict? Are false impressions given by the advertisement? Student’s will decide if is they agree or disagree with the advertisements. For example, one of the activities is the following:

This bar graph appeared in an ad of an insurance company.

The simple truth.



HOW THE 10 TOP CAR INSURERS PAY OFF

Does this graph really show the simple truth?

Roughly how many times as tall is the shortest bar in the graph compared to the tallest one?

Make a list of the “payoff” of 10 insurance companies.

Graph this information to give a more honest picture of the situation.
Number the vertical scale in 10's from 1 to 100.

Why do you suppose the more honest graph was not used in the ad? (3)

The goal of these examples is to help the students see how data can be used to make a point. While the advertiser did not lie, there is not a significant difference between the companies. As a class we review a number of advertisements to determine how credible the advertisements are. The claims made by the advertisement will be discussed. Does the data substantiate the claim?

The class will discuss that often a sample used for advertising has a built in bias. For example,

- If you read that the average American brushes his teeth 1.5 times per day, how is the data collected? Who would admit to not brushing his/her teeth? (4)
- If the toothpaste company claims that 4 out of 5 of dentists recommend this brand, how many dentists were asked what brand they recommend? The answer could be 5.
- A hotdog that is 80% fat free, this means that the hot dog is 20% fat. One fifth of what you are eating is fat.
- This laundry product gets your clothes 30% cleaner, but you don't know cleaner than what.

As a consumer, the public has no idea of how many times five dentists were asked what brand they recommended before the advertiser get the results they wanted. Students will look through magazines to find some examples of advertisements that may be misleading.

Other ways that advertisers or researchers may use statistics and data to give a false impression may be discovered during the advertisement review. The advertisement may use an average that does not truly represent the middle of the data. For example, average income in a neighborhood could be skewed by a couple of millionaires. The rest of the neighborhood might be farmers making low wages. Another example is when the research is legitimate but not truly linked to the product. Using statistically inadequate samples is another trick.

For the next portion of the assigned project, students will follow a four step statistical problem-solving approach to conduct research. The steps include: ask a question; collect appropriate data; analyze the data; and, interpret the results.

First, students will develop a survey. The focus of the survey will be about a product. The class will discuss the importance of the wording the questions appropriately to get the data that is being sought. Student will practice their question on fellow students in the class to see if the wording gets the desired information or if individuals are confused by the questions. All surveys will be very short with five or less questions. Next, the students will conduct research with students at the Student Achievement Center utilizing their survey. The class will discuss the limitations of the data that will be collected. Our sample will be limited to students who are attending the alternative high school. This population may not be typical of other high schools in the district or other urban districts because students are at this school because they have violated the code of conduct or are behind in credits.

The students will compile the data collected into a chart. Organizing the data will be key for the student. The students will use either Word or Excel to make the chart. Each student will make a graph based on the data collected. It will be critical for the students to choose the correct type of graph to represent their data. Computer technology will be used to construct the graphs. As previously stated, all charts will be typed on Excel or Word software. The student will use computer software to create their graphs. The website, <http://nces.ed.gov/nceskids/createagraph/>, is a simple site for making graphs that can be used if the student is not familiar or comfortable with using Excel to make the graphs.

The final activity will be the development of an advertisement for the product that was the focus of the survey. Students will use what they have learned about manipulation of data when developing the advertisement. The advertisement must use the data collected to make a statement about the product. It cannot be totally false but the student may choose to use the data to give a false impression. The student may choose to represent the data collected in an upfront manner.

A rubric will be used to evaluate the work of the students. The rubric will evaluate the advertisement, survey, graph and chart that will comprise the project. The neatness, accuracy, and creativity will be the key components of the rubric. See Attachment 1 for a copy of the rubric.

Notes

- (1) National Council Association of Teachers of Mathematics, 2000, p. 21
- (2) Jacobs, Harold R. (1994). Mathematics a Human Endeavor. New York: W.H. Freeman and Company. Third Edition. p568
- (3) Jacobs, Harold R. (1994). Mathematics a Human Endeavor. New York: W.H. Freeman and Company. Third Edition. p.567
- (4) Huff, Darrell. (1954). How to Lie with Statistics. New York: W. W. Norton & Company

Annotated Bibliography/Resources

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Provides list of recommended classroom practices for special needs students based on the latest research.
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Textbook that approaches math in non-traditional manner. Designed to make the reader enjoy mathematics.
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Recreational mathematics to challenge the ingenuity and sharpen the powers of deduction and reasoning of everyone who is fascinated by numbers.
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Provides information about how to use graphing to teach problem solving to special needs students.
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Book that provides an introduction to statistics. Uses many problems and examples to show the components of statistics.
- Kirkley, Jamie. (2003) Principles for Teaching Problem Solving PLATO Learning, Inc. http://www.plato.com/downloads/papers/paper_04.pdf
Provides a guide for how to teach problem solving
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<http://jwilson.coe.uga.edu/emt725/PSsyn/Pssyn.html>
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Wilson, C. L. & Sindelar, P.T. (1991). Direct Instruction in Math Word Problems: Students with Learning Disabilities . Exceptional Children, 57, 512-519.
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Woodward, John. (1999). Redoing the Numbers Secondary Math for a Postsecondary Work World. *Teaching Exceptional Children*, Vol. 31, No 4, pp. 74-79.

A Problem-Solving Process. Retrieved April 23,2008 from http://www.learner.org/channel/courses/learnignmath/data/session1part_a/index.html

Internet site that provides information about data analysis, statistics and probability.

Numerical and Categorical Data. Retrieved April 24,2008 from <http://illuminations.nctm.org/LessonsDetail.aspx?ID=L368>

Article outlines a unit designed to help students formulate and refine questions that can be addressed with categorical data.

Appendix-Content Standards

Problem Solving Standard for Grades 9–12

Instructional programs from prekindergarten through grade 12 should enable all students to—

- build new mathematical knowledge through problem solving;
- solve problems that arise in mathematics and in other contexts;
- apply and adapt a variety of appropriate strategies to solve problems;

monitor and reflect on the process of mathematical problem solving

Number and Operations Standard for Grades 9–12

Instructional programs from prekindergarten through grade 12 should enable all students to—

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems
- Understand meanings of operations and how they relate to one another
- Compute fluently and make reasonable estimates

Representation Standard for Grades 9–12

Instructional programs from prekindergarten through grade 12 should enable all students to—

- create and use representations to organize, record, and communicate mathematical ideas;
- select, apply, and translate among mathematical representations to solve problems;

use representations to model and interpret physical, social, and mathematical phenomena.

Connections Standard for Grades 9–12

Instructional programs from prekindergarten through grade 12 should enable all students to—

- recognize and use connections among mathematical ideas;
- understand how mathematical ideas interconnect and build on one another to produce a coherent whole;

recognize and apply mathematics in contexts outside of mathematics

Communication Standard for Grades 9–12

Instructional programs from prekindergarten through grade 12 should enable all students to—

- organize and consolidate their mathematical thinking through communication;
- communicate their mathematical thinking coherently and clearly to peers, teachers, and others;
- analyze and evaluate the mathematical thinking and strategies of others;

use the language of mathematics to express mathematical ideas precisely

Attachment 1

**Student Achievement Center
Advertisement
Rubric**



Name: _____

Teacher: Misechok

Date Submitted: _____

Title of Work: _____

	Criteria				Points
	4	3	2	1	
Components	Advertisement uses data collected, survey, data chart, graph	May be missing a component or incomplete component	Missing more than one component or incomplete components	Misses key components.	_____
Use Of Visuals	Pleasant looking, neat, creative	Neat, somewhat creative	Somewhat neat, not very creative	Messy lacks creativity	_____
Mechanics	No math errors. Chart and graph correctly depict data	No major math errors, chart and graph correctly depict data .	May be some serious math error or chart representation is not totally correct	Major math, chart and graph errors	_____
Demonstrated Knowledge	Shows complete understanding of the assignment, mathematical ideas, and processes.	Shows substantial understanding of the assignments, ideas, and processes.	Response shows some understanding of the assignment.	Response shows a complete lack of understanding for the assignment.	_____
Requirements	Goes beyond the requirements of the problem.	Meets the requirements of the problem.	Hardly meets the requirements of the problem.	Does not meet the requirements of the problem.	_____
				Total---->	_____

Teacher Comments:

