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Tasks that Facilitate Connections for the Middle Grades

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Introduction

The National Council of Teachers of Mathematics (NCTM) lists Connections as a Process Standard for all students grades K-12. Teachers are encouraged to become facilitators helping students (a) recognize connections between mathematical ideas, (b) apply connections between ideas, and (c) apply mathematics in contexts outside of the discipline [1]. Designing tasks that will captivate students can be challenging. It may help to reflect on another type of connection, one that considers individual student interests and prior knowledge.

When teachers find a way to share their enthusiasm about mathematics it can foster learning [2]. Extending our thinking of the NCTM Process Standard to include the "connection" a teacher makes with each student helps teachers discover ways to motivate learning and brighten the classroom experience. The following tasks are broken down into three parts: (I) activities to foster a connection between teachers and students, (II) activities connecting students with basic concepts, and (III) activities that help students inter-relate mathematical concepts and connect them to the real world.

Teacher Notes and Tasks

Section I: Activities to Foster a Connection Between Teachers and Students

Activity 1: I Know What You Did Last Summer©

Description: This activity borrows a title from a popular 1997 movie to help provide the teacher with information about what each student values outside of school.

Preparation:

(1) Create a rubric outlining the grading system for the poster presentation (sample below).

(2) Count the length of summer break (days).

(3) Prepare a presentation poster based on your own summer activities to serve as both a guide for the project and a means to foster a connection.

First day of class: Ask students to:

a. withhold information about their summer

b. make a list of at least 10 things they did over the summer (sleep, eat, vacation, etc.)

c. calculate how many hours they had for summer break

d. estimate the number of hours they spent on each activity (only a rough sample, multi-tasking will not be represented).

Remind students how to construct a histogram and circle graph (early grades can estimate portions), giving them the first day of class to reflect on their summer and calculate their data. Share your presentation poster - which should included your chart, bar graph, circle graph, and a reading of your paragraph. Students are surprised that over 1/3 of the circle is dedicated to sleep. Offer a time for questions and assign a day at the end of the week for presentation of their posters. Younger students should be encouraged to develop their own graphs while older students can exhibit technology skills by using a spreadsheet.

Sample Rubric:

Poster Items	Description	Points
Written Paragraph	Briefly describe your summer	20
Conversion Chart	10 activities (minimum) "school appropriate," time expressed in hours, fraction and percent form	20
Histogram (Bar Graph)	Reflects the data from your chart	20
Circle Graph	Reflects chart / bar graph data	20
Presentation	Well-spoken / Good listener	10
Visual Appeal	Art, photos or design	10

Sample Conversion Chart:

Activity	Hours	Fraction	Percent
Sleep	480	1/3	33.3%
Eating	60	1/24	4.2%
Phone	120	1/12	8.3%
TV	120	1/12	8.3%
Beach	240	1/6	16.7%
Work	120	1/12	8.3%
Mow Lawn	60	1/24	4.2%
Video Games	60	1/24	4.2%
Friend Time	120	1/12	8.3%
Family	60	1/24	4.2%
Total	1440	1	100%

Activity 2: What's the Meaning of This?

Description: This activity provides the teacher with information about student interests while measuring their knowledge of (and connection to) rational numbers. It can be useful as an "ice-breaker" for older students in an effort to make a connection with their interests.

Preparation: Review natural numbers, integers, and fractions with students giving real-life examples of each. You will need colored paper and/or markers.

Task: Students make a decorative list of 10 numbers assigning meaning to each number chosen (using at least 3 fractions, 2 negative numbers and a zero). Meanings for the number can be listed on the front or the back (for suspense purposes). As students share meanings, it provides opportunities to clarify understanding.

Sample of student responses:

(1) -2 = the number of dogs I have lost (should reflect something removed)
(2) $\frac{3}{4}$ = the ratio of girls to my entire family
(3) 0 = how much money I have in my wallet
(4) 13:3 = a favorite verse from Hebrews
(5) 10 = the month I was born
(6) 19 = my volleyball number

Section II: Activities Connecting Students with Basic Concepts

Activity 3: The Slope of Letters

Description: To connect the concept of slopes with something familiar — capital letters.

Preparation: Discuss the slopes of horizontal, vertical, and slanted lines.

Task: "I am thinking of a capital letter...", then describe the segments of the letter in terms of their slopes.

Example 1: "I am thinking of a capital letter that contains 2 segments with slope equal to zero and one segment with positive slope" (Answer – Z).

Example 2: "I am thinking of a capital letter that contains a segment with a positive slope, a segment with a negative slope, and a segment with slope equal to zero." (Answer – A).

Students can also choose their own letters and give clues for their slopes [3]. Use of mini-white boards can be incorporated into this activity.

Activity 4: Proportion and Disproportion

Description: Students will apply operations to the vertices of various geometric figures and predict the outcome prior to drawing the figure.

Preparation: Review of similar figures, labeling vertices and plotting points. Students will need graph paper and rulers.

Sample Task: Draw a triangle with vertices $(2, 1)$, $(6, 1)$, and $(2, 5)$. Ask students what type of triangle is formed (right triangle).

Ask students: "What would happen to the (x, y) vertices of the triangle if you multiplied the x value by 3?"

Example: $(x, y) \xrightarrow{\text{multiply } x \text{ by } 3} (3x, y)$ After discussion, let the students sketch the new triangle to check their responses for accuracy. The new triangle would have vertices $(6, 1)$, $(18, 1)$, and $(6, 5)$. Is it still a right triangle? (Yes. Teachers will note that this only works when the legs are parallel to the coordinate axes.) Are the triangles proportional (i.e. similar)? (No, the new triangle is wider, but has the same height). What happens if we use the operation $(x, y) \xrightarrow{\text{multiply } y \text{ by } 3} (x, 3y)$? (The triangle is taller, but has the same width.) What about the operation $(x, y) \xrightarrow{\text{multiply } x \text{ by } 2,\ y \text{ by } 5} (2x, 5y)$? What about the operation $(x, y) \xrightarrow{\text{multiply } x \text{ by } 2,\ y \text{ by } 2} (2x, 2y)$? (The triangle is similar (proportional) to the original.) Discuss why (Equal operations on x and y coordinates preserve the proportion). Students can test other shapes while making predictions. They may want to try $(x, y) \xrightarrow{\text{multiply } x \text{ by } \frac{1}{2}} \left(\frac{1}{2}x, y\right)$

Fun extension: Allow the students to do a simple pre-made plot-dot. Let each student choose different operations to distort their plot-dot shapes on a new graph.

Activity 5: To Tell the Truth

Description: Students will be given an equation with several numbers in sequence; all of the operations have been removed. Students must place the correct operational symbols in the equation to make a truth statement. The activity can be done as a class or in small groups. Students can create their own truth statements.

Example: $2(8 \circledcirc 4) \circledcirc 2 \circledcirc 1 \circledcirc 7 = 11$

Solution: $2(8 - 4) \div 2 + 1 \cdot 7 = 11$

Activity 6: Breaking Apart the Order of Operations (and/or Verbal Expressions)

Description: Students create a chart of mathematical symbols and written ideas that represent each part of the order of operations and give examples of each. Students are connecting notation to applications that may have been previously misunderstood. This activity allows the teacher to identify potential weaknesses in the basic understanding of operations as well as in translating verbal expressions.

Sample:

P	E	M	D	A	S
Parentheses	Exponents	Multiplication	Division	Addition	Subtraction
$(\ldots)$	Powers	Stars	$\div$	Plus	Minus
$\{\ldots\}$		Dots	$/$	Add	Less than
$[\ldots]$		X	Fractions	Sum	Less
Tops of Fractions	Square Roots	Parentheses Product	Quotient	And	Decreased by
Bottoms of Fractions	Radicals	Distributive Property	Long Division	Increased by	
	$\sqrt{16}=4$	$2*3=6$	$6\div 3=2$		
	$2^5=32$	$2\times 3=6$	$6/3=2$		
		$2\,(3)=6$			
		$(2)\,(3)=6$			
		$2(2+1)=6$		The sum of 3 and 4 is 7	5 less than 7 is 2
$\frac{2+3}{5-4}$ is really $\frac{(2+3)}{(5-4)}$	$(2-5)^3 = -27$				7 minus 5 is 2 etc.

Activity 7: Which Steps Are the Steepest?

Description: At the earliest stages of learning slope, students predict which stairs (bleachers, risers) seem to be the steepest throughout the school. They can then confirm their predictions with a quick walk to these locations using measurement tools to check the variation between the rise and the run.

Preparation: Pencils, task-sheet, tape measures and/or rulers. Know the location of stairs throughout the school. Discuss slope as the relation between the rise and run. The task sheet should include an area for choices of three (or more) sets of sample stairs, a prediction of which set will have the highest slope, a place to record the slopes (in fraction form and in decimal form), and a place for any additional findings. Students can work in groups but each student should measure one riser of stairs. Back in class, students can discuss whether or not their predictions were accurate.

Section III: Activities That Interrelate Concepts and Connect Them to the Real World

Activity 8: Visualizing the Graduation Rate

Description: Encourage students to set attainable goals and work toward them to avoid becoming a statistic. Students can connect percentages and statistics presented in the media to their immediate school setting.

Preparation: Investigate local graduation rates for your system and school. Discuss data representation in the media and how it directly relates to their lives. Character education is easily incorporated into this lesson.

Task: Randomly number all of the students and have them stand on one side of the room (giving them a number tag is helpful). Give each one a calculator. As you present your data (one figure at a time), have the students calculate what percentage of the class would be affected by the statistic if they were the representative sample. Continue with each piece of data until you are finished separating the students into three representations (dropouts, high school graduates, college). Discuss the results with the students.

Sample - class of 30 students:

Step 1: Nationally 33% drop out of high school; $(0.333)(30) = 10$, students #1-10 move to another side of the room to represent the national dropouts.

Step 2: Use school data to bring students back to the original group or to move more students over to the dropout representation. (e.g., Given a 27% drop out rate (same as a 73% graduation rate), $(0.27)(30) = 8.1$. Students #9 and #10 move back to the high school graduate group.)

Step 3: Ask for a show of hands: how many plan to attend college? In reality, 38.4% of the students remaining in high school will enroll. (e.g., $(0.384)(22) = 8.4$; students #22-30 will represent college enrollment after high school.)

Step 4: Existing representations are 8 dropping out, 14 graduating high school and going straight into the workforce, and 8 enrolling in college. Discuss the results. If it seems appropriate, continue with the following statistics on the college enrollment group: 11.5% earn a certificate, 17.3% earn an Associates degree, 9.7% earn a Bachelors degree, and 61.5% will not complete a degree. Discuss the data representations with the class.

Activity 9: Barbie® Bungee Jumping

Description: This popular activity is on the NCTM website and is perfect for helping students connect their knowledge of functions, slope, equations, data collection, and lines of best fit; this activity can be done as an interactive presentation or in small groups.

Preparation: You will need a Barbie® doll or similar action figure, rubber bands, a large sheet of white butcher paper, a pencil, a student recorder for the data, and 2 observers to mark the lowest point that the doll reaches. The paper is taped vertically on the classroom wall. The doll has one rubber band around its ankle (this is the "bungee chord") when it falls from a fixed standing position. Students mark how low the doll's head drops for the first jump, measuring the distance. The experiment is repeated by adding a rubber band to the "bungee cord" with each jump. The number of rubber bands is represented by x, the distance the doll falls is y. After several jumps, plot the points and use a line of best fit to calculate the maximum number of rubber bands that can be used as the Barbie Doll "bungee jumps" from a nearby stairwell (or some other perch) without hitting her head. Worksheets and specific instructions are available through NCTM Illuminations at: http://illuminations.nctm.org/LessonDetail.aspx?id=L646.

References

[1] National Council of Teachers of Mathematics (2000). Principles and Standards for School Mathematics. Reston, VA: Author.

[2] Ruskai, M. (1995). Notices of the American Mathematical Society. *From the Editor.* Vol. 41 (7), 740.

[3] Wilson, Jim (2008). Slope of Letters Game. Retrieved on February 29, 2008 from:
http://jwilson.coe.uga.edu/emt669/Student.Folders/
Bailey.Marcia/slopegame (with permission.)

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