

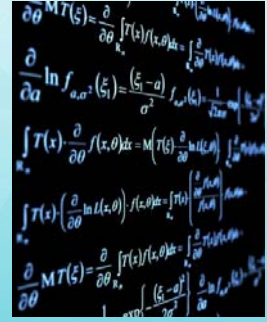
Teaching For Understanding



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Overview

- Background and Literature
- My involvement this summer
- Results
- Implications



http://www.uofaweb.ualberta.ca/computneuro/lab/images/math_400.jpg

What is Understanding?

- How do you explain a good understanding of a procedure ?
- How would you assess understanding?
- Have a procedure in mind and answer these questions in groups...

Framework for Procedural Understanding

Procedural Knowledge



- 1a) What is the goal of the procedure?
- 1b) What sort of answer should I expect?
- 2a) How do I carry out the procedure?
- 2b) What other procedures could I use?
- 3) Why does the procedure work?
- 4) How can I verify my answer?
- 5) When is this the "best" procedure to use?
- 6) What else can I use this procedure to do?

The Difference Between Skill and Understanding

What is the solution to the equation: $y/(-7) = 21$?

How could you check to make sure your answer to the previous question is correct?

What is the solution to the equation: $(3x)/4 - 2 = 7$?

Compare the methods you used to solve number 7 and number 9. Then complete the following sentences:

Similar: _____

Different: _____

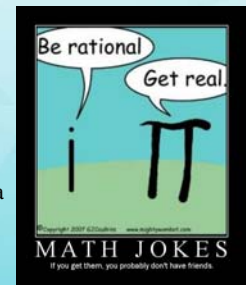
Skill

Und

Is it worth it?

• If existing knowledge is understood, new knowledge is easier to learn and understand.
(Hiebert & Carpenter, 1992)

• Knowledge that is understood lasts longer and can be applied in a variety of situations.
(Carpenter & Lehrer, 1999; Hiebert & Carpenter, 1992; Van Hiele, 1986)



Is it worth it?

- Decrease fragile learning

(Styllianides, 2007)

- With understanding, procedures are executed 'intelligently' and with fewer errors.

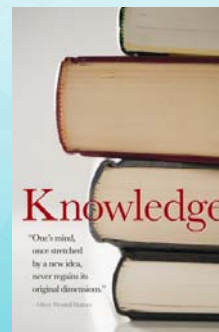
(Rittle-Johnson & Koedinger, 2002; Star & Siefert, 2002)



Edgar Allan Poe's "The Murders in the Rue Morgue" (1841)

What we need?

Researched-based strategies for teaching mathematics for understanding....



Dr. Hasenbank and Dr. Kosiak

- NCTM Framework adaptation

- Success in 2005

(Hasenbank, 2006)

- Workshops in 2007

- Implemented in 2008 school year



http://cecilcountycorrection.com/blog/cecilcountycorrection/wp-content/uploads/2008/03/school_building_21611_7.jpg

Study Design

- 9 treatment classes

- 5 control classes (untrained)

- Three tests during the year

- Over 400 received tests



http://www.banffcentre.ca/media_room/images/facilities/images/tcp_classroom_1.jpg

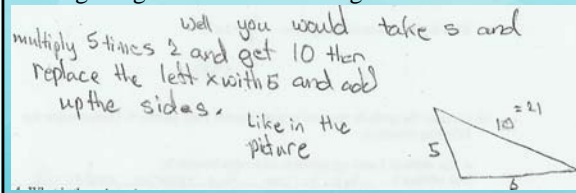
The General Rubric

0: No degree of understanding

1: Low degree of understanding

2: Moderate degree of understanding

3: High degree of understanding



Sample Question

15. Evaluate $\frac{2}{3}x$ when $x = \frac{9}{4}$. Simplify your answer if possible.

$$\frac{2 \cdot 9 \cdot 3}{3 \cdot 4 \cdot 4 \cdot 3} = \frac{35}{12}$$

$$\frac{2 \times 9}{3 \times 4} = \frac{18}{12} = \frac{3}{2}$$

Sample Rubric

Possible errors:

- Finding a common denominator
- Computational error
- Simplifying incorrectly

0: Blank or no honest effort (e.g. "I don't know (IDK.)")

1: Two or more errors, or used cross multiplication to solve, or an incomplete attempt, or a solution that is way off track.

2: Only one error is present as listed above.

3: Correct answer is given in lowest terms.

Sample Question

15. Evaluate $\frac{2}{3}x$ when $x = \frac{9}{4}$. Simplify your answer if possible.

Scored: 1

Scored: 2

Sample Question 2

16. Explain how you could use estimation to see if your previous answer was wrong.

Round $\frac{2}{3}$ to 1, and $\frac{9}{4}$ to 2 and multiply and if its not between 1 and 2 its wrong.

you could have estimated that the answer could be about half to figure out the answer.

Scored: 3

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Sample Question 3

15. If $3x + 4y = 14$ and $y = -\frac{5}{2}x$, what is the value of x ?

$$\begin{aligned} 3x + 4\left(-\frac{5}{2}x\right) &= 14 \\ 3x - 10x &= 14 \\ -7x &= 14 \\ \underline{x = -2} \end{aligned}$$

$$\begin{aligned} 3\left(-\frac{5}{2}\right) + 4y &= 14 & 4y &= \frac{21.5}{4} \\ -7.5 + 4y &= 14 & y &= 5.4 \\ +7.5 & & & \end{aligned}$$

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The lines would touch at $(-2, 5)$ if you were to graph them.

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2a

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4

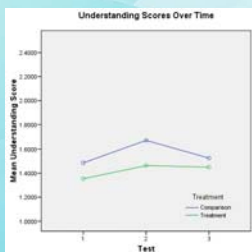
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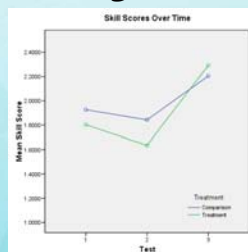
1a

Skill and Understanding Results



Gains in understanding from test one to test three...

Test1 \rightarrow Test3, $p=.413$
(not significant)



Gains in skill from test one to test three...

Test1 \rightarrow Test3, $p = .003$

Audience Opinion?

- What might explain the lack of gains in understanding for the treatment group?
- Is teaching for understanding even worthwhile?

Skill vs. Understanding

15. If $3x + 4y = 14$ and $y = -\frac{5}{2}x$, what is the value of x ?

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Improvements?

		Understanding				
		0	1	2	3	Total
Skill	0	40 (15.6%)	5 (1.9%)	0 (0.0%)	0 (0.0%)	45 (17.5%)
	1	35 (13.6%)	73 (28.4%)	11 (4.3%)	1 (0.4%)	120 (46.7%)
	2	5 (1.9%)	36 (14.0%)	3 (1.2%)	0 (0.0%)	44 (17.1%)
	3	8 (3.1%)	32 (12.5%)	5 (1.9%)	3 (1.2%)	48 (18.7%)
Total		88 (34.2%)	146 (56.8%)	19 (7.4%)	4 (1.6%)	257 (100%)

What kind of support do students and teachers need to better teach for understanding?

Teaching for Understanding

- What does it take to teach for understanding?
 - Raise “understanding questions” during class. (“Sprinkle them in”)
 - Think out loud – ask and answer these questions as you go.
 - Active participation by students is **important**.
 - Give group tasks, assign as individual homework, and include on formal assessments.