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Learning Collaboratively and Individually Through the Use of an Intelligent Tutoring System

How can we support collaboration using intelligent tutoring systems? What are the complementary strengths of collaborative and individual learning? How does combining collaborative and individual learning compare to either alone?

Project Design

The students were supported in learning through intelligent tutoring systems.

- Standard intelligent tutoring system cognitive support
- Social support through embedded collaboration scripts

Lessons Learned

- It may be productive to combine collaborative and individual phases of learning within the classroom
- It is important to not just provide support for the students, but to also support teachers in orchestrating the learning activity

Equivalent Frac	tions				
A Let's make some equivalent fractions.					
The purple circle shows the fraction: $\frac{1}{4}$	Make a fraction by cutting all of the sections into two equal pieces.	Make a fraction by cutting all of the sections into three equal pieces.	Make another fraction where the pieces would be 4 times smaller than the purple fraction.		
Name the fraction	8	3	4 16		
Both the numerator and denominator are:	 2 times smaller 2 times larger the same 	 3 times smaller 3 times larger the same 			
^B What makes fractions equivalent?		 multiplying the numerator and keeping the denominator the same. adding the same number to the numerator and the denominator. multiplying the numerator and denominator by the same number. multiplying the denominator to make the pieces smaller and keeping the numerator the same. 			
1 If you have a fraction, you can make an equivalent fraction by:					

Example of a conceptually-oriented tutor. The students are asked to find the parttern in what makes an equivalent fraction.



Equivalent Fractions		
A Let's make equivalent fractions.	B Let's see how the fractions are related.	
This is the unit of the fractions.	For each of the fractions below on the left, name the fraction to the left of the equals sign and label what the numerator and denominator of the purple fraction needs to be multiplied by to get the new fraction to the right of	
The purple circle shows the fraction $\frac{1}{2}$	the equals sign.	
Make a fraction where the numerator and denominator are 2 times larger than the purple fraction.	$\begin{array}{c}1\\\hline 2\\\hline 4\\\hline \end{array} = \begin{array}{c}1\\\hline 2\\\hline \end{array} \times \begin{array}{c}2\\\hline 2\\\hline \end{array}$	
2 Make a fraction where the numerator and denominator are 3 times larger than the purple fraction.	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	
3 Make a fraction where the numerator and denominator are 4 times larger than the purple fraction.	$\frac{3}{8} = \frac{1}{2} \times \frac{4}{4}$	
4 Make a fraction where the numerator and denominator are 5 times larger than the purple fraction.	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	

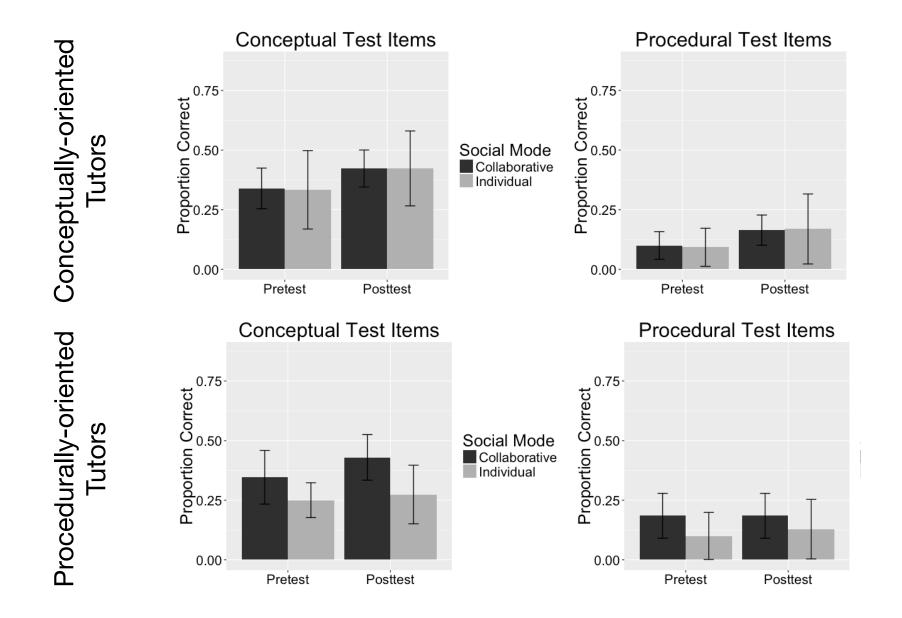
Example of a procedurally-oriented tutor. The students are asked to make equivalent fractions by multiplying the numerators and denominators by the same number.

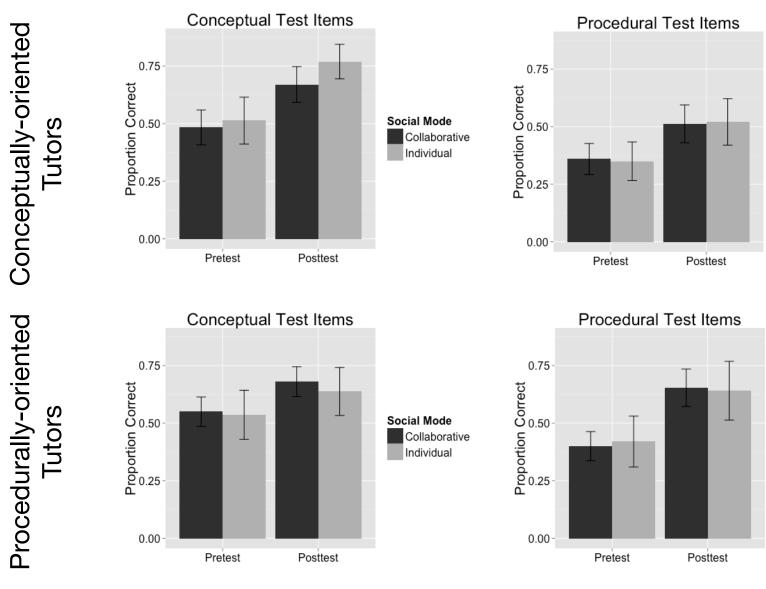
Leas	st Common Denominator - E	rroneous Example
	Kaitie made an error. Can you help er? Kaitie made the incorrect answer to the problem below: 96 for the least common denominator.	 B Help Kaitie correct her error. 1 Correct the errors on the problem to the left. When the step is correct, both you and your partner must press of
_	is the least common denominator for the fractions? 5 4 12 8 least common denominator 12 x 8 = 96 = 12 x 8 OK OK OK	
A W	hat error did Kaitie make?	
	hich answer best describes what Kaitie's mistake is? ag an answer and then discuss with your partner.	Your answer: Product of both denominators
L	argest number that goes into both denominators	Your partner's answer:
s	mallest number that goes into both denominators	Product of both denominators
	errest multiple of both dependences	
	argest multiple of both denominators	Your group answer:

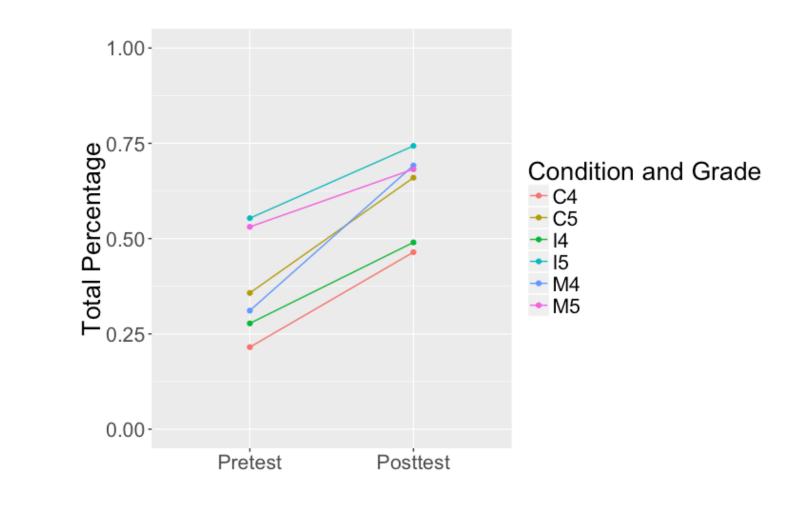
Example of an erroneous example. The students are asked to recognize the error the student in the problem made and to fix the error.

Project Evaluation

Although we found no complementary strengths for the collaborative and individual learning, we did find evidence that a combination may be more productive than either individual or collaborative learning alone. In addition, we found that we could successfully support both the individual and collaborative learning through the use of intelligent tutoring systems.







Experiment 1: 81 4th and 5th grade students worked in a pull-out design for 45 minutes with the tutor. The students either worked on the conceptually-oriented tutors or the procedurally-oriented tutors and either worked collaboratively or individually. Students working individually and collaboratively had the same learning gains from pretest to posttest.

Experiment 2: 189 4th and 5th grade students worked in an in-vivo design for three 45minute sessions. The students worked on the conceptually-oriented tutors or the procedurally-oriented tutors and either worked collaboratively or individually. Students working indivdiually and collaboratively had the same learning gains from pretest to posttest.

Experiment 3: 382 4th and 5th grade students worked in an in-vivio design for three 45-minute sessions. The students worked either collaboratively and individually (M), only collaboratively (C), or only individually (I). The students in 4th grade and in the mixed condition had significantly higher learning gains than other 4th grade students in the other conditions.



