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# Expert and Novice Algebra Tutor Behaviors Compared

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## The Experiment

Analyzing computer-mediated, keyboard-to-keyboard algebra tutoring transcripts (Kim & Glass, 2004), we studied quantitative differences in tutoring behaviors between an expert and a novice tutor. This should highlight the kinds of behaviors expert tutors acquire that set them apart from novices. The most pronounced difference is that the expert is far more likely to set procedural goals.

In this study the expert tutor is Dr. Kathy Cousins-Cooper, a professor in the Mathematics Department at NC A&T State University who has taught and tutored basic algebra for many years. The novice is an upper-level undergraduate mathematics student who prior to these sessions had the typical student tutoring experiences of a mathematics major. Students were volunteers from an undergraduate elementary algebra class. The problems that were addressed in a tutoring session were selected by examining student performance on a pre-test, so in all cases we had reason to believe the student could not solve these problems beforehand.

We focused on the two symbolic manipulation problems shown in Figure 1. We have 9 examples of problem 1 taught by the expert and 6 by the novice tutors. For problem 2 we have 8 expert and 4 novice examples. Over all, we have 24 expert sessions and 10 novice, but not every problem was tutored in every session.

Problem 1: subtract	$\frac{x}{x^2 - x - 6} - \frac{2}{x^2 - 7x + 12}$
Problem 2: solve for x	$5x = 2x^2 + 1$

Figure 1: The two problems studied in this paper.

Phenomena we examined included: learning gains, time to tutor the problem, number of turns needed, frequency of goal-setting acts, and tutor responses to impasses.

## Results and Discussion

The mean learning gains were 0.47 for the expert sessions and 0.24 for the novice, where learning gain is calculated as: (posttest – pretest) / (1 – pretest)

This difference is only weakly significant,  $p < 0.1$ .

The most marked difference is that the expert engages in significantly more goal-setting episodes, see Table 1.

Table 1: Goal-Setting Episodes

	Expert		Novice		t-test
	Avg./Prob	n	Avg./Prob	n	
Collab.	3.88	66	1.00	10	$p < .001$
Informed	1.59	27	0.50	5	$p < .001$
Total	5.47	93	1.50	15	$p < .001$

This finding is consistent with teaching algebra as a procedural skill. In this table, collaborative goal setting episodes involved both parties deciding the next procedural step, while informed episodes consisted of the tutor telling the next procedural step to the student. Chi-squared shows that despite the difference in numbers of episodes, there is no significant difference between novice's and expert's choice of collaborative vs. informed goal-setting.

Average dialogue turns per problem was significantly ( $p < 0.01$ ) higher for the expert at 17.5 turns (divided between both parties) vs. the novice at 12.4 turns. Combined with the goal-setting results, this shows that the bulk of the expert tutor's nine turns were devoted to goal setting.

Consistent with the findings of VanLehn et al (2003), we discovered that for the expert tutor most student impasses (4.5 out of 4.7 per problem tutored) were recognized by tutor intervention. The novice intervened in significantly fewer instances, 1.7 out of 3.9 impasses. The two tutors did not differ in their responses to the impasses.

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