



TASK DESIGN IN MATHEMATICS CONTENT COURSES FOR PRESERVICE ELEMENTARY TEACHERS: A COLLABORATIVE APPROACH

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INTRODUCTION

- We are a group of MTEs who teach specialized content courses for prospective elementary teachers.
- A subgroup of a PME-NA working group begun last year, *Developing Elementary Teachers' Mathematical Knowledge for Teaching*
 - Focus of our sub-group: Designing, modifying, and implementing mathematical tasks for prospective elementary teachers

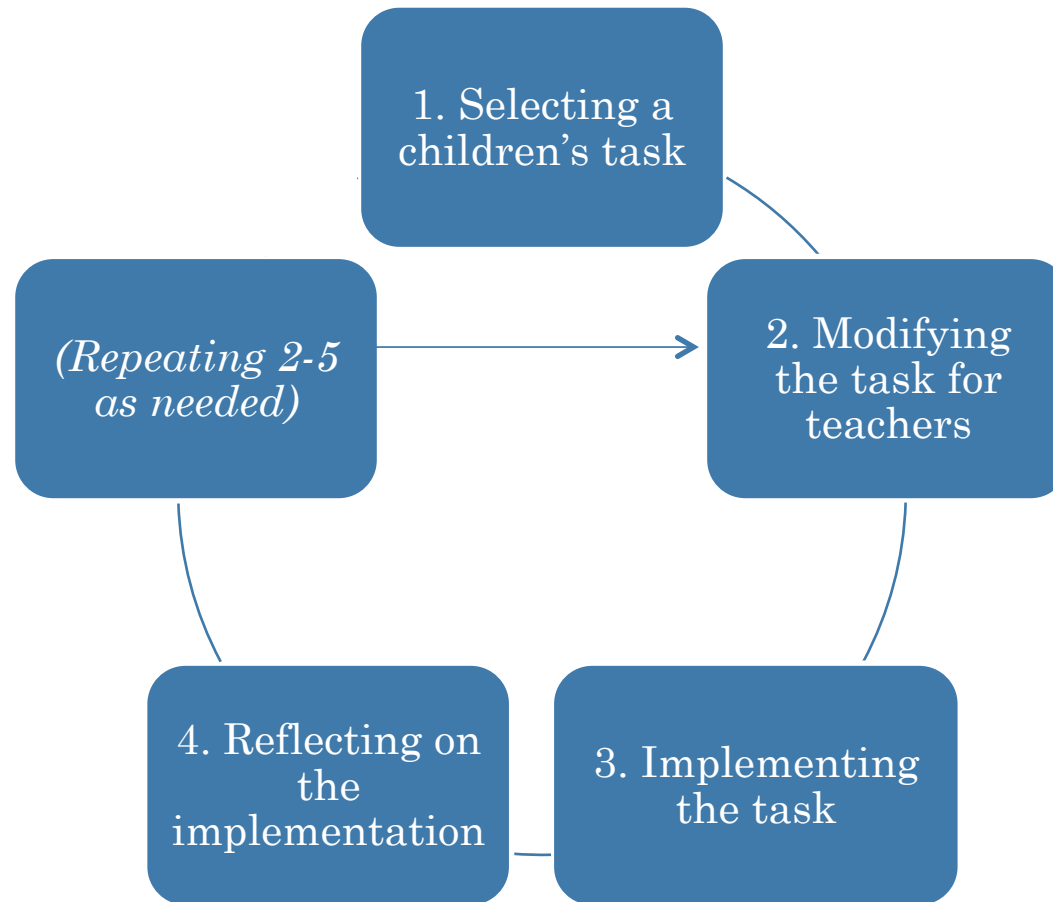


SELECTED RESEARCH ON TASK DESIGN

- Liljedahl, Chernoff, & Zazkis (2007)
 - used an iterative cycle for task design consisting of *predictive analysis, trial, reflective analysis, and adjustment*
- Yackel, Underwood, and Elias (2007)
 - modified children's tasks for use with PSTs, which provided them with “experiences similar to those children encounter and for which the [prospective] teachers could not draw on familiar knowledge” (p. 354)



CYCLE FOR OUR WORK



PHASE 1: SELECTING A CHILDREN'S TASK

- Content focus: Fractions
 - Central topic in both the elementary grades (CCSS) and mathematics content courses for PSTs (Masingila, Olanoff, & Kwaka, 2012)
 - Difficult for children and teachers (e.g., Behr et al., 1984; Tobias, 2013; Yang et al., 2009)
- Specific focus: Comparing fractions using reasoning and sense-making



PHASE 2: MODIFYING THE TASK FOR TEACHERS

- Identifying the mathematics that the children's task could elicit and our learning goals for our students
 - Ensure a high level of cognitive demand (Smith & Stein, 2011)
 - Discourage teachers from using procedures they (likely) already know (e.g., finding common denominators)
 - Encourage solving problems in multiple ways
- Helping PSTs develop MKT (Ball, Thames, & Phelps, 2008)
 - Elicit a variety of strategies including those not elicited from children's task (e.g., *greater-number-of-larger-pieces*)
 - Design problems that would elicit variety of strategies
 - Analyze a child's misconceptions



PHASE 3: IMPLEMENTING THE TASK

- Spring 2013: 4 implementers
- Fall 2013: 3 of 4 same implementers, as well as doctoral students of one of the implementers
- Data sources
 - PSTs' written work on the task and related assessments
 - Implementers' field notes
 - Artifacts from the implementation



PHASE 4: REFLECTING ON THE IMPLEMENTATION

Comparison problem	Number of PTs who answered correctly	Number of PTs who used the target strategy	% of PTs who used the target strategy (based on PTs who answered)	% of PTs who got the problem right (based on PTs who answered)	Number of PTs who answered incorrectly	Number of PTs who did not answer
1. $1/2$ vs. $17/31$	54	39	67%	93%	4	3
2. $2/17$ vs. $2/19$	58	47	77%	95%	3	0
3. $4/7$ vs. $9/14$	55	23	40%	95%	3	3
4. $3/7$ vs. $6/11$	58	34	58%	98%	1	2
5. $8/9$ vs. $12/13$	46	30	56%	85%	8	7
6. $13/15$ vs. $17/19$	41	27	57%	87%	6	14
7. $5/6$ vs. $6/5$	57	51	88%	98%	1	3
8. $7/10$ vs. $8/9$	51	3	6%	98%	1	9
9. $1/4$ vs. $25/99$	38	28	58%	79%	10	13
10. $24/7$ vs. $34/15$	41	35	81%	95%	2	18

PHASE 5: RE-MODIFYING, IMPLEMENTING, & REFLECTING

- Modifications based on first implementation & reflection designed to:
 - better elicit *greater-number-of-larger-pieces* strategy
 - go beyond using benchmarks of 1 and $\frac{1}{2}$
 - encourage PSTs to design problems that truly elicit intended strategy
- Currently implementing again with modifications
 - preliminary data indicate that our new modifications are supporting these goals



DISCUSSION

- Implication for MTEs: Design principles for modifying children's tasks
 - Reduce the usefulness of procedures that prospective teachers (likely) already know
 - Elicit a variety of strategies that go beyond what children need to know
 - Include prompts that will help PSTs develop MKT
- Future work
 - Examine PSTs' learning of the strategies across our courses
 - Use these principles to modify/design other tasks



THANK YOU FOR COMING!

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For more information, we have a paper about our task design process that will appear in NCTM's APME 2014, and we will be presenting a workshop at AMTE 2014 during which we'll begin to modify children's tasks focusing on content other than fractions.

