ACTIVITY #2: Mathematics Lesson/Tasks Development

Goals for Pre-service Teachers

- PSTs will plan a problem solving based mathematics lesson or activity that draws upon knowledge and understanding of the practices, activities and resources of students' communities.

Description of Mathematics Lesson/Tasks Development

The purpose of this activity is to support PSTs to design a problem-based task or lesson that connects to the Community Math Exploration (Activity 1). This activity is done once as part of the CME module. However, it can also be an additional context to practice lesson planning/task design. The lesson/task design is an important product of this module. It is also used as part of the final reflection commentary and optional presentations (Activity 3).

In groups in the methods class, PSTs will develop a lesson (or a set of mathematical tasks) incorporating knowledge they have gained about students' communities from community visits (Activity 1). The lesson (or tasks) should be problem solving based, and should include opportunities for students to investigate/solve problems that are related to a particular community context. It is critical that the lesson (or set of tasks) draw on community contexts, practices, issues or activities to help students to deepen their understanding of a specific math concept. In other words, the lesson must have a specific and significant math focus AND be connected to authentic practices/contexts observed and discussed in the community math exploration. The lesson (or set of tasks) should indicate that PSTs are drawing on what they know about children's mathematical thinking in a particular domain. Additionally, the lesson (or set of tasks) might include opportunities for students to use mathematics to investigate an issue of equity or justice in the community, and/or the lesson might include having students do a similar activity (e.g. conducting their own community walk).

Lesson Outline for Mathematics Lesson/Task Design

Version A: Mathematics Lesson Plan Development

PSTs create a standards-based lesson based on what they learned (e.g. photographs; interviews with families/workers; observations of math practices) from their community math exploration (activity #1).

The lesson design can be done outside of class or included as part of in-class activity work time. In-class time can be devoted to analyzing exemplar CME Lessons and/or brainstorming mathematical questions and possible problem-based tasks to include in the lesson. PSTs should use a common lesson plan template for this activity. A lesson plan template is provided to guide this process (see Aguirre et al, 2012). But, use of program lesson template is encouraged.

Some major components of the lesson plan should include:
• High cognitive demand tasks (Stein et al, 1998)
• Attention to student mathematical thinking (strategies; possible confusions; number justifications; task structures)
• Differentiation (task extensions for students who struggle or need extra challenge)
• Connections to contexts, practices, activities observed in CME
• Links to CCSS-M and/or state math standards

LAUNCH
To support PSTs in generating ideas for lesson plans, instructors might lead a whole group brainstorming session. Suggested discussion prompts follow.

- Brainstorm ways that you could build upon / draw upon your knowledge about the mathematical funds of knowledge of students' communities in a math lesson. Try to generate specific lesson ideas. As you are brainstorming ideas, consider both the math content of the lesson, and the connections to community knowledge and practices.
- What mathematical activities did you observe in students' communities? Is there a way you could design a lesson that highlights these particular mathematical activities, and that provides students opportunities to deepen their understanding of the related math concepts/skills as they are engaging in these authentic and relevant activities?
- What kinds of problems arose in the daily practices of employees, business owners, customers, community members, etc. that you talked with during your community visits? (For example, problems related to how to maximize profits, how to make a product, how to determine prices, how to budget, how to arrange a space, how to make consumer decisions, how to organize events, how to create work/event schedules etc.). Is there a way that you could adapt these problems to make them appropriate for elementary students?
- What kinds of problems did you pose during/after your community visits? How might you adapt those problems to make them more appropriate for elementary students?

Another way to support PSTs as they brainstorm lesson ideas is to share a sample lesson plan created by previous groups of PSTs (Lavandaria; Las Socias; Pizza Parlour). For example, instructors might share the "Lavandería Lesson" with PSTs, and ask the PSTs to think about the cognitive demand of the lesson, the important mathematical idea and the connections to an important context (the Lavandería) and practices (making decisions about best purchases) in the community.

This launch can be a stand-alone component in which the math teacher educator reviews major points of lesson plan development using CME sample lessons to help guide the lesson design outside of class. Specifically, the presentation can highlight variations of CMEs lesson that show case strong connections to both children's mathematical thinking and cultural funds of knowledge (e.g. Las Socias) as well as lessons that gave strong attention to one construct but limited attention to the other (Dollar Store for strong attention to students mathematical thinking; Military time to strong attention to

Community based funds of knowledge). By presenting these examples, PSTs have models to strive for that attend to both students mathematical thinking and cultural funds of knowledge.

Alternatively, this can also launch an in-class activity in which PSTs engage in a lesson analysis that can also serve as a guide to their own CME lesson development. Below continues this in-class activity of analyzing CME lessons.

EXPLORE
As a small-group activity have PSTs explore key components of exemplar CME lesson plans such as cognitive demand; task structures and extensions; connections to funds of knowledge; student thinking strategies; teacher questions; participation structures; addressing status issues; attention to language (math; L1). Have PSTs summarize insights about the lesson on poster paper and prepare to share out with the whole class. If time allows, PSTs might review multiple example lesson plans that represent different ways of making meaningful or less meaningful connections to children's/community members community-based mathematical funds of knowledge.

SUMMARIZE
Have PSTs share out major points of small group discussion. Then use these insights as points for consideration in the final CME lesson plan design that occurs inside or outside of class.

Version B: Mathematics Task Development

PSTs participate in an in-class group activity in which they generate problem-based tasks that connect to what was learned in the Community Math Exploration (Activity 1). The task can be included as part of a lesson plan and/or part of the final presentation about the community math exploration.

Major considerations for task design:
- High cognitive demand tasks (Stein et al, 1998)
- Attention to student mathematical thinking (strategies; possible confusions; number justifications; task structures)
- Differentiation (task extensions for students who struggle or need extra challenge)
- Connections to contexts, practices, activities observed in CME
- Links to CCSS-M and/or state math standards

LAUNCH
Provide overview of task design using a prompt such as, "What makes a good problem-based task?" Generate a list that considers math ideas, connection to standards, student math thinking, math discourse, engagement etc.). If connections to funds of knowledge/community do not arise add to list.

Share with PSTs sample lessons/tasks (e.g. Lavandaría; Las Socias; Pizza Parlour lessons are included in the Tools and Handouts section).

In small groups/pair shares, ask PSTs to analyze the tasks using the criteria developed from the above prompt(s). It is a good idea to guide the discussion to include attention to the following: cognitive demand, student mathematical thinking, connections to cultural funds of knowledge; differentiation; mathematical discourse and language use (math, L1).

EXPLORE

• As a small-group activity PSTs engage in task design. Provide specific guiding questions to support problem-based tasks design: How does this task…

- promote problem solving
- connect to cultural funds of knowledge/authentic practices found in CME
- engage student mathematical thinking
- reflect multiple entry points (e.g. number choices; multiple strategies)
- foster math discourse including use of language (math, L1)

SUMMARIZE

• Share out progress on task design that will be incorporated in final presentation and/or lesson plan (via poster or ppt presentation).

Version C: Presentation of the Lesson Plans

Organize a whole class sharing session where each group of PSTs presents their lesson (task) to the class. These presentations could include the following components: a) PSTs explicitly state the central problems or task in the lesson (i.e., what is the mathematics problem that the lesson is built around), and explain why they chose that particular task, b) PSTs highlight the key mathematical ideas that the lesson address, and discuss how the lesson will support students' understanding of those key math ideas, and c) PSTs highlight how the lesson connects to and draws upon important settings, contexts, activities, issues and/or practices in students' communities. *In other words, PSTs' presentations should make it clear how they used what they learned in their community walks / community visits to inform the design of their lesson.*

See FAQ on website for TEACH Math ideas on Mathematics Lesson/Task Development