Assessment Task Design Principles and Procedure

One approach researchers have used to assess content knowledge for teaching is to have prospective and practicing teachers analyze and respond to children's thinking. For example, some assessments present common misconceptions and patterns of thinking from children and ask respondents to comment on children's work and describe ways to help their thinking develop (e.g., Hill, Ball, and Schilling 2008; McCrory et al. 2012; Saderholm et al. 2010). A well-known example of this sort of assessment item comes from the work of Liping Ma (1999). Ma presented a classroom scenario in which a child told a teacher "that she has discovered that as the perimeter of a closed figure increases, the area also increases" (p. 84). The child then presented a 4×4 rectangle and a 8×4 rectangle as support for the conjecture. Some of the teachers in Ma's study were uncertain how to respond to the child because they did not know for themselves if the conjecture was true or not. Others were able to blend their knowledge of content and pedagogy to ask probing questions to lead the student to discover a counterexample to the claim (e.g., a 12×1 rectangle has a greater perimeter, but less area). Hence, this type of item has the potential to reveal qualitative variability in individuals' content knowledge for teaching.

In order to design items that assess statistical knowledge for teaching, it is helpful to have access to children's work samples. One readily accessible source of such work samples is the National Assessment of Educational Progress (NAEP) Questions Tool website (http://nces.ed.gov/nationsreportcard/itmrlsx/search.aspx?subject=mathematics). Figure 1 is a screenshot from the website. It shows a search for constructed response items on NAEP tests taken by eighth-graders. Under the "Select Content Classifications" tab, "Data Analysis and Probability" is checked. Under the "Select Years" tab, the years 2009, 2011, and 2013 are selected. These filters produced a collection of 7 items. Clicking on the "Add All Questions" button on the screen put the items in the "My Workspace" area. From "My Workspace," one can request the questions, answers, student responses, and performance summary data by clicking the appropriate boxes (Figure 2). One can then download all of these materials in HTML or Word by clicking on the desired format.

Figure 1. NAEP Questions Tool Search Results Screen

Figure 2. NAEP Questions Tool Workspace Download Screen

After downloading NAEP tasks and accompanying work samples, the process of designing a statistical knowledge for teaching task involves initial considerations such as: (i) Which statistical content tends to be difficult to teach in grades K-12?; and (ii) Which questions have content that matches objectives of the course in which prospective teachers to be assessed are enrolled? Consideration (i) can be addressed by scanning the "Difficulty" column in "My Workspace" (Figure 2). It shows, at a glance, which items were "easy," "medium," and "hard" for a representative sample of U.S. students from the selected grade levels. If one includes

"Performance Summary Data" in the HTML or Word material download, more information about the difficulty of the items is provided. Users are given the percentage of students scoring at the different levels specified in each task rubric. The richest information about statistical knowledge for teaching is likely to be produced in connection with items containing content that is generally difficult for students to learn, since this content is also likely to be challenging to teach. Consideration (ii) must be addressed on a course-by-course basis. However, it is worth noting that looking at the statistical content that is generally difficult to teach may impact the goals one has set for the course. An instructor might decide, for example, to shift course goals so that difficult-to-teach statistics content receives greater emphasis. The opportunity to reflect on course goals in such a manner is a collateral benefit of engaging in this task design process.