A classroom data literacy intervention for pre-service teachers

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HIGHLIGHTS

- Investigated 6-h classroom data literacy intervention for pre-service teachers.
- Intervention was facilitated, procedural, technology-enhanced, and collaborative.
- Gains observed in attitudinal/belief and objective data literacy measures.
- Participants reported positive intervention impacts on 23 data literacy facets.
- Qualitative data imply favorable perceptions around tool use and faculty coaching.

ARTICLE INFO

ABSTRACT

This pretest-posttest study investigated 64 pre-service teachers' perceptions of the impact of a 6-h data literacy intervention, which involved scoring classroom assessments, and analyzing, interpreting, and making decisions based on the data. The study also examined changes in participants' self-reported attitudes and beliefs and objectively-measured data literacy during the intervention. Participant reports suggest that the intervention increased the pre-service teachers' knowledge and skills related to data literacy. Pretest-posttest changes were also observed in three attitudes/beliefs (ds ranged from .34 to .46) and data literacy ($d = .60$). Findings contribute to the small and nascent body of scholarship concerning pre-service data literacy interventions.

1. Introduction

Current professional standards and policies articulate high expectations for teacher data literacy (Council of Chief State School Officers, 2012; Interstate Teacher Assessment and Support Consortium, 2011; National Council for Accreditation of Teacher Education, 2008, 2010). Teachers are expected to analyze and interpret assessment data and make various inferences and/or decisions based on the data (e.g., student strengths and weaknesses, appropriate interventions to implement). The underlying theory is that by informing with data decisions related to instructional goals, methods, and time allocation, teachers can better target their instruction to students, ultimately resulting in higher levels of achievement (e.g., Hamilton et al., 2009; Means, Padilla, DeBarger, & Bakia, 2009). Much recent attention has been given

to teachers' data literacy and use in European nations as well (e.g., Schildkamp, Karbautzki, & Vanhoof, 2013; Vanhoof & Schildkamp, 2014).

Data literacy is not only required by educators in today's classrooms, it is helpful in addressing student needs. Students struggle for many reasons; being able to collect relevant data and interpret those data is a valuable tool in helping teachers understand student progress (Mandinach, 2012). Data literacy can assist teachers in moving from an intuitive, disorganized, undocumented, "in the head" process of assessing their students to a systematic, consistent way of monitoring student progress. Research suggests that data literacy has a positive impact on teachers' instructional practices (Falk & Ort, 1998; Gambell, 2004), allowing teachers to increase the specificity of instructional goals, refine their own assessments, and use assessment to try to improve instruction and increase student feedback (Gambell & Hunter, 2004; Gearhart & Osmundson, 2009). Moreover, interventions intended to promote teacher data literacy positively affect student math achievement (e.g., Carlson, Borman,

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& Robinson, 2011).

Despite the increased mandate for data literacy however, there is evidence that inservice teachers find the analysis, interpretation, and instructional use of data to be difficult. Some in-service teachers report low levels of confidence in their data-related knowledge/skills (Athanases, Wahleithner, & Bennett, 2012; DeLuca & Bellara, 2013; Marsh, 2012; Means et al., 2009; Wayman & Jimerson, 2013). A study by Means et al. (2009) found that teachers struggled with examining multiple data points simultaneously (i.e., school and district scores over time), distinguishing absolute values and proportions, and identifying patterns within data. At the same time, research underscores the need to provide teachers with professional development and support surrounding data use (Hamilton et al., 2009; Jacobs, Gregory, Hoppey, & Yendol-Hoppey, 2009; Kerr, Marsh, Ikemoto, Darilek, & Barney, 2006).

Pre-service teacher preparation has naturally been charged with developing teachers' data literacy prior to classroom entry (Mandinach & Gummer, 2013; National Council for Accreditation of Teacher Education, 2010). Recent analyses of U.S. pre-service coursework and syllabi, though, estimate minimal preparation around data analysis and interpretation and a lack of opportunities for pre-service teachers to collaborate around data use (Greenberg & Walsh, 2012; Mann & Simon, 2010, July). The Greenberg and Walsh review also noted a dearth of treatment research concerning pre-service data literacy interventions, which is problematic in light of evidence that this population finds analysis of student work (and assessment concepts in general) more challenging than other facets of practice such as planning (Athanases, Bennett, & Wahleithner, 2013; Stobaugh, Tassell, & Norman, 2010).

Many questions about data literacy remain then, including the following: What knowledge/skills are needed by teachers? What are the most effective pre-service and in-service mechanisms for building teacher capacity around data? And what conditions facilitate and constrain data use (DeLuca & Bellara, 2013; Greenberg & Walsh, 2012; Hamilton et al., 2009; Mandinach & Gummer, 2013; Marsh, 2012)? In response, the present study examined pre-service teacher involvement in a classroom data literacy intervention. The intervention engaged pre-service teachers in scoring traditional and performance classroom assessments, and analyzing, interpreting, and making decisions based on the data. In particular, the research centered on the following questions:

1. To what extent do pre-service teachers report that the data literacy intervention increased their knowledge/skills (e.g., data analysis skills)?
2. To what extent do pre-service teachers report changes in their attitudes toward and beliefs about data and assessment over the course of the intervention?
3. To what extent do pre-service teachers demonstrate changes in their data literacy over the course of the intervention?
4. What are pre-service teachers' perceptions of the intervention?

2. Literature review

Data literacy is "the ability to understand and use data effectively to inform decisions…composed of a specific skill set and knowledge base that enables educators to transform data into information and ultimately into actionable knowledge" (Mandinach & Gummer, 2013, p. 30). This domain of professional knowledge comprises the ability to analyze and interpret raw and statistically, tabularly, and graphically presented data, and to translate those interpretations to instructional decisions including the students/ content on which to focus, instructional method(s) to use, and how

to differentiate or modify instruction. Furthermore, data literacy involves specific analytical tasks such as examining student work for patterns (e.g., common errors or misconceptions) and item-level data, making data-based comparisons, and disaggregating data. Others have noted how data literacy comprises the ability to identify reasons for student failure and generate hypotheses about students and instruction.

Teacher analysis, interpretation, and use of data is not an entirely new concept. In recent decades, a prominent body of literature on teacher inquiry has developed, in which teacher inquiry is conceived of as a broader process involving asking questions about practice, collecting and analyzing data, and making instructional changes (e.g., Nelson & Slavit, 2008). Despite noted definitional and conceptual issues in this sphere, data literacy is understood here to subsume literacy related to assessment data specifically (i.e., assessment literacy) (e.g., DeLuca & Bellara, 2013; Mandinach & Gummer, 2013). With this study, we focused on pre-service teachers' literacy related to *classroom assessment* data in particular.

Data literacy is applied to practice during data-driven decision-making, or the data use process. Marsh's (2012, p. 5) outlined a model of the components of this process: 1) "accessing or collecting data," 2) "filtering, organizing, or analyzing data into information," 3) "combining information with expertise and understanding to build knowledge," 4) "knowing how to respond and taking action or adjusting one's practice," and 5) "assessing the effectiveness of these actions or outcomes that result." Other data use frameworks similarly treat data use as a procedural (and often cyclical) concept (e.g., Coburn & Turner, 2011; Hamilton et al., 2009; Means et al., 2009). It bears noting that data use practices invoke not only data literacy, but also content and pedagogical knowledge (Coburn & Turner, 2011; Young & Kim, 2010).

2.1. In-service teacher interventions

As data proliferate in schools and districts, so too have interventions aimed at promoting educators' use of data to support teaching and learning (Carlson et al., 2011; Gearhart & Osmundson, 2009; Marsh, 2012; Wayman & Jimerson, 2013; Young & Kim, 2010). There is some evidence for the effects of data use interventions (or interventions containing data use components) on student achievement. One large-scale district-randomized study offered evidence for the effects of a data-driven reform intervention on student mathematics achievement (Carlson et al., 2011). That one-year intervention focused on administrators' interpretation and use of benchmark assessment data but also involved educator training in data use. In another study, elementary schools implementing a particular reform model (Getting Results) involving data use as one component posted larger gains in core academic subjects than comparison schools (McDougall, Saunders, & Goldenberg, 2007).

Other evidence related to in-service interventions focuses on teachers' beliefs, knowledge, and practices. In one study, 23 science teachers completed a two-year intervention consisting of designing, implementing, and scoring portfolio assessment, and analysis and instructional use of data. Findings suggested increased teacher specificity of instructional goals, focus on instructional improvement, and provision of feedback to students as results of the intervention (Gearhart & Osmundson, 2009). A study by Mertler (2009) reported a shorter, two-week in-service workshop encompassing summarization of objective test results, interpretation of standardized test results, and item analysis; in this smaller-scale mixed methods study, teachers reported pretest-posttest increases in data use practices.

The literature also evidences uneven or limited effects of some