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Teachers learning how to use data: A synthesis of the issues and what is known

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ABSTRACT

This article provides a synthesis of the articles found in the special issue on data use. The synthetic piece contextualizes how the articles contribute to the knowledge base of how teachers use data. It synthesizes the findings by identifying key common themes. It then describes gaps in the current knowledge base and identifies the requisite steps needed to address those gaps.

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This special issue has provided an international perspective on research and theory on how teachers learn to use data to inform their practice. Using data in education is not new; it has been around for a long time. However, the emphases for education to become evidence-based have been increasing in many countries. Despite the emphases and the recognition that teachers must be equipped with data, little comprehensive effort has been made to improve the capacity of educators to use data effectively and responsibly through teacher preparation programs and explicit requirements for licensure. The articles included in this issue address studies that focus on preparing teachers through professional development, data teaming, coaching, courses, and laying out theories, frameworks, and models of data use. They largely focus on various aspects of data use, its effects on teacher performance, how learning happens after hire, and—in limited ways—address the need to begin preparation for data use earlier in teachers' careers, a point that Mandinach and Gummer (2013, 2016) have made.

For data use to be woven into day-to-day practice, rather than being perceived as an “add-on” to the hard work teachers already do, continuous learning must occur throughout one's career, beginning in teacher preparation programs through to the time of retirement or when one leaves the profession. This means that the

building blocks for data use must be laid in teacher preparation programs (Mandinach & Gummer, 2016; Reeves & Honig, 2015), and that this learning must be extended, reinforced, and fit-to-context throughout one's career if the aim is to deeply embed the use of data as an engrained tool in a teacher's repertoire. Leaving the acquisition of data literacy to traditional forms of professional development is risky at best. Schools of education would not allow the graduation of teacher candidates without appropriate exposure to content, pedagogy, and methods courses, and practical experiences. Data use is no less important. In-service training (e.g., in the event of a new data system) or workshop-style professional learning experiences may well be necessary at times, but even these must build on pre-service experiences. Funding is scarce for professional development and many schools may consider data use to be peripheral, opting instead to focus on topics that are considered more pressing. Learning how to use data must occur over the entire landscape of teachers' careers. Our objective here is to provide an overview of the articles in this special issue, focusing on issues that call for additional consideration as the field considers how to support teacher learning around data use.

1. Cross-cutting topics: what's important for learning about data

In this synthesis, we identify several cross-cutting topics

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addressed by the articles in this issue. We highlight findings from the individual articles, but raise issues that the field must continue to address. Topics include: (a) the need for continuous learning around data – the where and when; (b) the need to integrate data skills with content knowledge and pedagogical content knowledge and link the data skills to other aspects of effective teaching; (c) the sustainability of impact; (d) models of effective professional learning and the impact of collaborative inquiry and data teaming; and (e) the logic model on impact of data use. Our intent here is not to review all the literature on these topics. That is grist for other articles. Instead, we seek to highlight the topics both as keys to models for enhancing data literacy and creating a generation of data literate teachers and as catalysts for dialogue around the ways in which teacher capacity for data use is enabled or hindered by preparation and support efforts.

1.1. Continuous learning

Teachers must engage in lifelong learning that begins when they are teacher candidates. Learning about the ways in which data inform instructional planning, delivery, and intervention efforts when educators are already in practice is too late. Mandinach and Gummer (2013, 2016) lay out the rationale for why schools of education must step up to begin to address the lack of human capacity around data skills. Preparation programs must introduce data use to teacher candidates, who must then have data use-related knowledge, skills, and dispositions reinforced through in-service training and professional development throughout their respective careers. To this point, Van den Hurk, Houtveen, and Van De Grift (this issue) describe how one school of education is addressing data use, while Poortman and Schildkamp (this issue) also focus on the topic by examining how a formal structure (in their study, the data use procedure) can contribute to teacher data use capacity even as teachers collaborate around data to address localized problems of practice. The article from Lai and McNaughton (this issue) describes a three-phase model of professional development on data teaming that helps educators enculturate data use into their practice.

Preparation programs are but one side of the equation, as these articles point out. Jimerson, Cho, and Wayman (this issue) for example, highlight the ways in which in-service teachers may struggle to fit data to practice when data-related concepts have not been well-introduced in teacher preparation programs. They note that in the absence of solid mental models for data use (student-involved data use, in their particular study) teachers may intuit their own purposes. In a similar vein, Farrell and Marsh (this issue) note the moderating effect of teacher beliefs in the use of data and capacity building as they highlight the importance of improvement-oriented (rather than compliance-oriented) routines for using data. Teacher beliefs about data use matter, and so learning around data must address not only the technical aspects of data use (e.g., accessing systems or interpreting reports) but also the assumptions teachers make about what data “count” and whether or how data use benefits students. Continuous learning, then, means less that either side of the equation (i.e., teacher preparation or school district/organization) does a “better” job at supporting data use, than it does that *both* sides of that equation must collaborate to not only build capacity around data use, but also provide a continuum of ever-deepening learning experiences in using data to inform teaching and learning.

1.2. Data skills: an integrated approach

Effective data use, as pointed out by the Farrell and Marsh piece (this issue), is a complex and nuanced endeavor. Underscoring this

complexity, and the importance of aligned and structured supports, Hoogland et al. (this issue) note the importance of data literacy and beliefs in data use. Mandinach and Gummer (this issue) outline a construct, data literacy for teachers, that contains some 53 skills and sources of knowledge teachers need to use data effectively and responsibly. This construct is grounded in Shulman’s (1986, 1987) knowledge needed for teaching. Fundamental to the conceptual framework is that data skills for teaching must be surrounded by several forms of knowledge, most specifically content knowledge and pedagogical content knowledge (Gummer & Mandinach, 2015). Many educators may have the skill set to understand data, but as the pieces from Lai and McNaughton (this issue) and Mandinach and Gummer (this issue) make clear, teachers must move beyond that understanding to put their interpretations to work in the form of transformed instruction. That Farrell and Marsh (this issue) as well as Van Gasse, Vanlommel, Vanhoof, and Van Petegem (this issue) find few instances of transformed instruction as a result of data use suggests that a gap exists in how the field supports teachers to develop just this capacity. Most commercial professional development providers of data use admit that they do not go far enough to connect to the pedagogy (Mandinach & Gummer, 2013). In contrast, Lai and McNaughton (this issue) refer to pedagogy and Poortman and Schildkamp (this issue) address curriculum, assessment, and instruction. There may well be a difference in the level of integration provided by academics such as Lai and McNaughton (this issue) and Poortman and Schildkamp (this issue) in contrast to the commercial professional development models, with the former providing more of an integrated approach whereas the commercial models focusing more on just the data skills. Preparation and training around data skills must be integrated with both content knowledge and pedagogical content knowledge. These activities must incorporate the skills that Mandinach and Gummer (this issue) outline and are mentioned in passing in several of the other articles.

A question we must raise is what is the base level of each type of knowledge (e.g., data skills, content knowledge, and pedagogical content knowledge) required to serve as a starting place for effective data use? The field needs to explore the relationships among these skill sets. Not everyone needs to be a data nerd, but every educator must have some passing knowledge of inquiry, data collection, data interpretation, and application to instructional planning and delivery. Some educators may only need to be good consumers of information. Clearly some teachers lack a deep understanding of data, using only the most cursory data to inform their practice, and even making interpretive errors based on misunderstanding of the data. (To be certain, this is problematic among many school leaders as well, but as this issue focuses on teacher learning for data use. That is our focus here as well.) As Means, Chen, DeBarger, and Padilla (2011) found, teachers with good data skills who work in collaborative teams can compensate and backfill for other teachers who lack such skills. But as van Gasse et al. (this issue) note, collaboration does not occur automatically, having found little collaboration among teachers on data use. For teachers, they also must rely on their knowledge of content and pedagogy: this knowledge is not negotiable. Teachers without content knowledge and pedagogical content knowledge and who possess only data skills, may well be considered data nerds, but not effective teachers; these teachers will not be able to transform information into instructional steps. Teachers without content knowledge will be unable to diagnose student misconceptions, strengths, and weaknesses. Therefore, efforts to support teacher learning around data use must contribute to a solid operating foundation in each of these areas of knowledge. As there must be some minimum acceptable levels for all of these areas of knowledge, no facet of data literacy should be neglected.

1.3. What is effective teaching and how are we measuring it?

Most of the articles in this issue address student performance as intended outcomes of effective teaching. Van den Hurk, Houtveen, and Van de Grift (this issue) discuss effective teaching. What is interesting about this article is that it outlines an instrument that contains 24 items related to effective teaching, yet not one item explicitly pertains to data use. This reflects a hole in the current literature where there still is no recognition of the importance of data use in teachers' practice, or where exists only a surface recognition of data use as merely tangential to other components of practice (e.g., feedback, assessment, or planning for remediation). It also may reflect the circular issue that data use may be both a component of effective teaching and can lead to more effective teaching. Data use must become an integral and integrated component of educators' work, just like any other method. Further, data must be deeply enculturated into the school so it can be sustained and nurtured despite mobility, leadership changes, and other possible impediments. Educators must recognize the utility of data use and its possible impact. But the data must be useful, informative, and actionable. The disconnect may be a measurement issue, or it may be about the having the right data for a given educational issue or question. For example, Lai and McNaughton (this issue) note that at the heart of measuring effective teaching is the need to have aligned and diagnostic data that can help teachers do their jobs more effectively. In the same way that summative test scores are not sufficiently sensitive to instructional modifications, teachers need data that provide sufficiently diagnostic data that can help them modify their practices.

Together, several of these articles provide different peeks into how data are woven into professional learning experiences—implicitly or explicitly. The Van den Hurk et al (this issue) piece provides an in-depth look at a process in which teachers use structured and reflective data on a number of teaching behaviors vis-à-vis video observations and feedback loops. Through this piece, we see how innovative professional learning structures can model data-using cycles to improve teacher capacity broadly writ. Still, in this model, data use is woven into the process for teachers-as-learners; it is not identified as an explicit component of instruction that teachers should necessarily weave into their practice. The Poortman and Schildkamp (this issue) piece provides another interesting twist by employing a methodology that allows for effectiveness to be measured specific to the problems-to-be-solved among data teams. In the model described by this article, teachers not only use data to explore and address problems of local import, but learn about data use in context as they do so. The Farrell and Marsh (this issue) piece also suggests that classroom change happens—most likely—as collaborative groups of teachers work toward instructional improvements, supported by external and internal data; again, we see a different take on teacher learning that still highlights a learning-by-doing orientation when it comes to using data.

Together, these articles suggest ways in which data may be used to foster and further reflective practice among preservice and practicing teachers. Instead of leaders using trend data to determine professional learning needs for schools or groups of teachers, we get to see what it might be like if data-capable teachers were able to collaborate around very localized problems of practice—engaged in inquiry cycles to steer their own learning. Taken together, these articles demonstrate the symbiosis between data-enabled professional learning and how practice unfolds in everyday contexts.

The Jimerson et al (this issue) article takes the need for data literacy a step beyond teachers to include students themselves as primary data users; teachers in this study were attempting to

facilitate reflective data collection and analysis by even fairly young students, which necessitated working with students in a range of data use-related tasks. One of the five essential recommendations posed by Hamilton et al. (2009), based on an extensive literature review, was for students to become their own data-driven decision makers. But for students to be data literate, teachers first need to have the necessary skills, knowledge, and dispositions that are part of data literacy. They must then be able to facilitate the development of these skills and dispositions among their students in appropriate ways; this is a lofty goal, and one not without challenges.

1.4. Sustainability of impact

The Van den Hurk et al (this issue) article mentions studies that show that it takes teachers 15–20 years to learn some of the most challenging aspects of the profession. The field does not have that luxury. Most teachers have left the profession well before that time. They have either exited the profession in search of greener pastures or retired. The Poortman and Schildkamp (this issue) article raises the issue of sustainability by noting the need for continued support. Jimerson et al (this issue) point out that even “true believers” in student-involved data use note frustrations and challenges that, unless addressed, may dissuade others from even trying to adopt such practices; depending on teachers to cobble together their own resources from disparate (and perhaps inconsistent) online sources also points to sustainability concerns. Lai and McNaughton (this issue) have outlined a three-year model that tests the limits of feasibility. How many school districts can afford three years of professional development in terms of practical and financial constraints? How many school districts have the same educators after three years, given high rates of mobility? As noted above, Means, Padilla, and Gallagher (2010) found the importance of sustained support around data use. Somehow, the field must find a balance between what is recommended and what is feasible and practical.

Also of importance here is a finding that Mandinach and Friedman (2015) noted in case studies of exemplary data-oriented teacher preparation programs. A study was conducted in one of the programs and other local schools of education. It found that the unique impacts of what teacher candidates learn in their teacher preparation programs washes out after two years because of the strength of cultures in the schools where they have been placed (Schallock, Schallock, & Ayres, 2006). This causes us to ask if there is any hope of sustained impact from teacher preparation or professional development if school cultures are so strong. Farrell and Marsh (this issue) raise a similar issue about embedding data use in a strong school culture; their findings raise questions about how useful changes in preparation programs will be if early career teachers—excited or at least hopeful about using data to inform practice—subsequently find themselves placed in compliance-driven contexts where they must do “solo work” on a day-in, day-out basis.

1.5. Models of effective professional learning

Underlying many of the models of data use is the notion of inquiry cycles, and the role of these cycles in enabling reflective practice. Several of the articles note the cyclical (and sometimes messy) nature of data use. Poortman and Schildkamp (this issue) describe an eight-step cyclic model of data use, noting that the process is not necessarily linear. An implied model can be found in the Lai and McNaughton (this issue) article. These two articles can be tied back to the components, skills, and knowledge that Mandinach and Gummer (2016; also this issue) outline as parts of the data literacy for teachers construct. Van den Hurk et al (this

issue) use a cyclic model of feedback for teacher improvement. A common thread throughout the pieces is that, by building capacity for data use, teachers can be empowered to drive their own learning in ways that are sensitive to the specific needs of the local context—they need not always wait on a school or system leader to determine professional development needs.

Means et al. (2010) made clear that professional development must be an ongoing enterprise, not isolated events for impact to be achieved. The article by Lai and McNaughton (this issue) article is an exemplar, creating a long-term model of professional development. Van den Hurk et al (this issue) cite work by Wayman and Jimerson (2014) on the characteristics needed for effective professional learning. They include: collaboration, engagement, context, embedding in the job circumstances, intensity, and coherence. Job-embedded implies that professional learning occurs in in-service settings. The Van den Hurk et al (this issue) article embeds professional learning in a Master Course. Lai and McNaughton (this issue) embed professional learning in a three-phase, three-year sequence of professional development. These articles not only provide some models for how professional learning might play out in post-hire contexts, but suggest a roadmap for how colleges of education might be more intentional about structuring reflective practice and norming, using video, ratings/observation instruments, and structured cycles of inquiry. Certainly, the first time teachers encounter these processes should not be when they land in a “PLC” in a school as full-time teachers; preparation programs can introduce these structures so that they are familiar learning vehicles for teachers as they enter the workforce.

1.6. Collaborative inquiry and data teaming

One promising model for professional learning is collaborative inquiry through interactions in data teams. Like with most models, there are challenges and opportunities. Collaborative inquiry means that teachers no longer have to go it alone in the isolation of their own classrooms. They can come together to examine data, interpret results, and discuss possible actionable steps and implications for their practice. In order for data teaming to function effectively, there must be certain structures and process in place. School leadership must provide the needed resources and time for teams to meet. Leadership must create an open, trusting, and non-evaluative environment in which team members can discuss issues and feel free to dissent or even admit their challenges.

Means et al. (2011) found that data teams can compensate for the lack of teachers’ individual data skills. This finding is a double-edged sword. Though it is somewhat frightening that the study highlights existing weaknesses in the areas of data literacy among teachers, it is also encouraging that the process of collaborative, data-informed inquiry can shore up skills and still result in learning that improves practice. Still, why shouldn’t all teachers have at least firm foundational knowledge on which to build? Collaborative groups need a critical mass of members who bring balanced knowledge (again, data skills, pedagogical content knowledge, and content knowledge) to the table; though they may be able to support individuals in skill-building related to data use, they do not benefit from an abundance of individuals who lack these skills, unless the objective is solely for there to be mentoring and modeling.

Collaboration underlies the Lai and McNaughton (this issue) and Van Gasse et al (this issue) articles. Yet collaboration looks different in each of the articles. Van Gasse et al (this issue) use collaborative exercises around student learning outcomes. An interesting study would be a replication with a group of existing teachers to examine the impact as in-service training over time. Lai and McNaughton (this issue) focus on building leaders for data teaming, using a

“hybrid cascading” model to subsequently train teachers. Lai and McNaughton (this issue) cite realistic funding restrictions for not including teachers in their study. Indeed, conducting large-scale professional development is expensive, but there are trade-offs to using a turnkey model for collaborative inquiry. One question is, can we realistically expect building leaders to be able to train their teachers? Love, Stiles, Mundry, and DiRanna (2008), in their coach’s guide for data teams make clear that having building leaders in teaming environments may not be a good idea because it introduces possible constrained discussions when having an authority figure present. There needs to be an open and trusting environment in which teachers feel comfortable discussing successes and challenges without fear of repercussions.

1.7. Logic model on impact of data use

Underlying data use is the expectation that data-driven decision making will improve student performance. The logic model is multi-part: (a) train teachers to use data; (b) there will be an impact on classroom practice; and (c) those practices will lead to improved student performance. Poortman and Schildkamp (this issue) and Lai and McNaughton (this issue) mention part of this logic model and raise questions about it, but perhaps we should all question the seductive nature of such a simple logic model for how data use works. Berliner (2006), in an article based on a rousing keynote address at AERA in 2005, noted that there are many things beyond the control of teachers, such as childhood health issues, poverty, hunger, and lack of parental support. Teachers impact what their students do, but there are many things that impede student learning; data use, no less than teaching in general, can be a complex, messy affair. It is therefore of little surprise that the rigorous studies (Carlson, Borman, & Robinson, 2011; Konstantopoulos, Miller, & van der Ploeg, 2013) found mixed results on the impact of data use on student achievement. Desimone (2009), in her review of the professional development literature, noted the lack of consistent results on impact on student performance. Establishing a straightforward logic model for data use is challenging. And, as Jimerson et al (this issue) note in their article, the lack of a clear logic model for practice (in the context of that study, for student-involved data use), may influence how the practice is enacted in the classroom.

Still, what we should not dissuade us from doing what we *can* do to support student learning, supported by data. We would therefore suggest talking about the logic model and focusing on the linkages between preparation on data use or using data on what happens in the classroom. These conversations can and should be seeded by grounding in school improvement processes, but should also explore connections to motivation theory, developmental psychology, and other theoretical bases that may influence how data use plays out in classroom and in organizations. As Senge (2006), and, more recently, Sinek (2015) point out, people have to understand *why* they are engaging in a process. They also need to know *why* that process—if implemented—may reasonably be expected to result in improvements. When that noise in the system is settled—when people are on the same page about why they are using data, and how they are using it—then the field can get a better read on how data use affects teachers’ actually classroom practices.

2. Concluding thoughts

The papers in this special issue provide an international perspective on data use by teachers, the preparation of teachers to use data, and the effects of data use. The articles highlight the fact that there are real differences in how schooling is structured and teachers are prepared. Yet the countries represented in the issue

share similar challenges related to appropriate data use. Across contexts, we see data use not as a clear, linear process of neatly sorting students into tutoring groups by areas of need, but as a messy, iterative process that requires critical thinking skills, innovation, a dogged determination to inspect ourselves and our contexts, and to play the role of educational detectives to seek out root contributors to student (and system) underperformance. We see echoes of reflective practice (recognized, if not always realized). We see the importance of broad collaboration, and what happens when work is “solo” and unsupported through the structures of time, policy, or professional learning. We also see a concern for appropriate use of data by teachers—a recognition that data use is not an inherent good, but that it must be implemented in ways that are ethical and which treat data use as a means to an end, rather than an end in and of itself. Even though the field is still teasing out when and under what conditions data use best serves the needs of all students, we find that—like educators in these studies—voices from multiple contexts inform better action and decision-making on multiple fronts.

The papers in this issue demonstrate how far research on data use has come as well as how far it yet needs to go. While they are a good start, and demonstrate methodological diversity, they are by no means comprehensive. They also highlight some emerging gaps in the field. For instance, the field must begin to talk about the extent to which research on “data use” is representative of the broader existing literature. For example, the [Lai and McNaughton \(this issue\)](#) piece demonstrates data use as woven into a reading intervention. Because the intervention is placed in the foreground (and the data use processes placed in the background), how many literature searches on “data use” would end up including this study? And yet, if we are serious about data use being woven into practice, and being used in conjunction with pedagogical content knowledge as well as content knowledge, we must challenge the field to push beyond studies that use “data use” as a keyword to see whether and how elements of data use appear in studies in the content areas. Similarly, what relevant literature might we miss because the research appears in a publication that may not be easily available in other countries? This highlights the importance of forging more international and interdisciplinary collaborations to strengthen and broaden our knowledge of the field.

There are both methodological and practical issues to overcome. As [Farrell and Marsh \(this issue\)](#) note, there are some real challenges and data use is a very complex enterprise. The field seems to have moved well beyond simply imploring educators to use data in the service of learning, and of identifying barriers to data use. Though important these paths have been well-trod. To make the necessary progress, several key challenges must be overcome. One challenge is to ensure that all educators know how to use data effectively and responsibly. This barrier requires action by educator preparation programs, professional development providers, school systems, and other relevant stakeholders. This means that educators must be exposed to data literacy as early as possible and then have data literacy reinforced throughout their careers ([Mandinach & Gummer, 2016](#); also [this issue](#)).

Second, there still needs to be a common and accepted language of what it means for educators to be data literate. This has been the goal of the work of Mandinach and Gummer and the [Data Quality Campaign \(2014\)](#) in positing definitions. Correspondingly, it is essential for the field of education to understand and recognize the distinctions between data literacy and assessment literacy. Because of the emphasis on testing and accountability results, people tend to think of data as only quantitative test results. Even [Reeves and Honig \(2015\)](#) who explored data literacy in pre-service teachers, focused solely on assessment data, and failed to take a broader view of what constitutes data literacy. We cannot say strongly enough

that the field must consider data more broadly, beyond assessment data. Other sources of data must be considered, including motivation, self-efficacy, attitudes, wellbeing, career paths, attendance, behavior, health, among others. Student performance may loom large but these other sources provide essential information to educators. Therefore, the terminology must be about data literacy, not just assessment literacy.

Third, with increasing problems with data security in many venues, it is essential for educators to understand how to use data responsibly. This means protecting student privacy and confidentiality. This is no small task as new technologies emerge and threaten security. Learning how to use data responsibly must begin early and be reinforced. A looming question though, is what agencies should take responsibility for such training. Should it be schools of education? Professional development providers? School districts? Or some other agency? We posit that data security is the responsibility of everyone at every level. It may be possible for schools of education to introduce the concept of data security, reinforced through professional development, and with required training and certification by school districts. The only way to avoid the majority of data breaches is to have an educated and data literate workforce.

In this collection of papers we see increased attention devoted to examining how data informs not only teaching, but how it informs teachers themselves in terms of reflective practice. We are introduced to studies that seek to reach across silos to embed data use in literacy interventions, and to connect to knowledge in fields related to, but not limited to, school leadership. And, we see a broadened perspective that asserts that equipping teachers to use data well and ethically is not solely the job of preparation programs or school districts, but is a responsibility that ought be borne by all who prepare and support teachers and teachers-to-be. The field needs more work that looks across the preparation-support-professional learning pipeline. Because of the distinction between data literacy and assessment literacy ([Mandinach & Gummer, 2016](#); also [this issue](#)), the field must look beyond student achievement and test results as a primary indicator of impact of data use. Thus, the field also needs more work that measures diverse outcomes of data use in action; this meaning including not just typical achievement-oriented student outcomes, but also affective, conative, behavioral, and other metrics. This collection of papers is a step in that direction.

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