The Complexities of Integrating Data-Driven Decision Making into Professional Preparation in Schools of Education: It's Harder Than You Think

Report from an Invitational Meeting

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Introduction

Data-driven decision making has become a national education priority, and Education Secretary Arne Duncan (2009a, 2009b) has commented about the pressing need for educators to gain knowledge and skills in data use to inform practice. John Easton (2009), Director of the Institute of Education Sciences (IES), has also acknowledged that data use and data analysis are fundamental elements for the improvement of schools and districts. Further, the American Recovery and Reinvestment Act (2009) specified the use of data to inform educational practice as one of its four pillars. Data are to be used for continuous improvement (of students, schools, and districts), not just for compliance and accountability purposes.

Nearly $516 million of federal funding has been expended on developing states' technological infrastructure to support data-driven decision making through the Statewide Longitudinal Data System (SLDS) Grants Program (National Center for Educational Statistics, 2010). Districts' information technology infrastructures are also evolving (Means, Padilla, & Gallagher, 2010). This technological infrastructure is a necessary component of support for educator use of data to inform decisions. Yet without improving educators' capacity to use and understand data, the potential of those investments will not be maximized (Mandinach, 2009a, 2010) and educators will not use data effectively to advance educational practice.

Schools of education play an important role in developing the capacity of educators to understand, analyze, and use data. Recognizing this role, a National Council for the Accreditation of Teacher Education (NCATE) Blue Ribbon Panel (2010) published recommendations for schools of education that included training on data-driven decision making. According to the NCATE report, teacher preparation must provide "the opportunity to make decisions and to develop skills to analyze student needs and adjust practices using student performance data while receiving continuous monitoring and feedback from mentors" (p. 10). The recommendations of the Panel, including the need to require training to promote data literacy, received the endorsement of Secretary Duncan (2010b).

To date, two sets of standards address using data in teacher and administrator preparation: the Interstate Teacher Assessment and Support Consortium Model Core Teaching standards (Council of Chief State School Officers [CCSSO], 2011) and the Interstate School Leaders Licensure Consortium (ISLLC) principal standards (CCSSO, 2008). The National Board for Professional Teaching Standards (NBPTS; 2010) provides information on what experienced teachers should know and be able to do. Together with the new NCATE recommendations, these standards may stimulate progress. However, evidence of implementation in teacher preparation in measuring educator knowledge and skills and in accountability has remained elusive (Aguerrebere, 2009). States are making slow progress in requiring data preparation as part of certification. A recent survey of state data directors (Data Quality Campaign, 2011a) indicated that 14 states currently require data skills as part of certification for superintendents, 15 for principals,

and 14 for teachers. These figures are slightly higher than in the 2010 survey (Data Quality Campaign, 2010), where 11, 12, and 13 states had requirements for superintendents, principals, and teachers, respectively. The 2010 survey also indicated that over half the states have plans to include such requirements for 2012 and beyond (these data are incomplete due to limitations in self-reporting and did not examine state licensing and certification documents.)

The literature on data-driven decision making supports the need to build educators' capacity to use data effectively and appropriately (Choppin, 2002; Feldman & Tung, 2001; Ikemoto & Marsh, 2007: Mandinach, 2009a; Mandinach & Honey, 2008; Mason, 2002; Miller, 2009; Wayman & Stringfield, 2006). This entails building data literacy so that data are transformed into actionable knowledge (Herman & Gribbons, 2001; Knapp, Copland, & Swinnerton, 2007; Knapp, Swinnerton, Copland, & Monpas-Huber, 2006; Long, Rivas, Light, & Mandinach, 2008; Mandinach, Honey, Light, & Brunner, 2008). Educators are not traditionally trained in how to use externally validated data (such as state and national achievement tests) or how to become data literate.

Schools of education have yet to provide quality and sustained training on data-driven decision making (Mandinach, 2009a, 2009b, 2010). Early findings indicate that there is a dearth of formal courses on educational data-driven decision making (Mann & Simon, 2009). Researchers and policymakers know very little about the nature of the training in understanding and using data received by pre-service teachers and administrators in their preparation programs

Further, researchers, teacher educators, and policymakers know relatively little about what training educators are receiving in the field. Means and colleagues (2010) found in their national survey of school districts that over 90 percent of the districts provided professional development on data use for at least some of their administrators and teachers, but that such training is generally not systemic. Principals receive more training than teachers. The study also notes that districts report that ongoing support is more important than formal professional development. The train–the-trainer model in which principals are trained first, assumes that those trained are capable of training their colleagues.

Researchers, teacher educators, and policymakers must be able to define data-driven decision making and data literacy. They must be able to identify and operationalize the knowledge and skills that comprise data literacy at different levels across the education system. Once those questions are addressed, then the issue of impact can be examined. Building educators' capacity to use data is a complex enterprise. This fundamental knowledge is required before a comprehensive approach to formal coursework, in-service activities, professional development, and continuing education around data-driven decision making can be developed.

The Spencer Foundation Initiative on Data Use and Educational Improvement and the Genesis of the Conference

The Spencer Foundation recognizes the importance of effective data collection, analysis, and use to educational improvement. The Foundation has launched its Initiative on Data Use and Educational Improvement to support scholarship on the environmental conditions and factors that influence the use of data and information by educational organizations. The Initiative funds research that examines the conditions, contexts, and underlying factors and processes that affect how educational organizations use data and information for improvement. These efforts are intended to connect the fragmented nature of the research base and focus on an analytic framework of the conditions under which data-driven decision making is successful rather than a normative framework that espouses data use in general or a particular data use practice.

The Initiative's goals are to:

> ...create new knowledge about the conditions, contexts, and other factors that affect how data are used; stimulate additional attention to what happens after data are gathered and shared; and advance theory about data use, all as part of an effort to ensure that the promise of data use for educational improvement does not go unfulfilled (Spencer Foundation, 2011).

The Spencer Foundation recognizes that efforts to establish data-driven decision making frequently are in response to accountability pressures rather than being a systemic effort to learn from data to inform improvement. The research funded under the Initiative is intended to examine the why, in what contexts, and how of effective use of data at both the K-12 and higher education levels:

> We are interested in research that goes beneath the undifferentiated demand for more data, that challenges the uncritical embrace of the effectiveness of data use, and that promotes the efficacy of using and understanding data to make actual improvements in K-12 and higher education (Spencer Foundation, 2011).

The conference on which this paper is based was designed to examine the issues that undergird educator preparation in data use for decision making. Throughout the design and implementation of the conference ran the concern expressed in the Spencer Initiative (2011) that the ways in which data use are being defined is problematic for the field. The following Spencer Foundation Initiative questions formed the basis for the conference summarized in this paper:

- How do the kinds of data and the forms in which they are presented affect how data are used?
- What skills and dispositions are needed for professionals in elementary and secondary education, and in higher education, to interpret, understand and use data to enable improvement in practice and outcomes?
- What sorts of training or professional development and workplace norms are needed to help education practitioners use data and information more effectively?
- What organizational cultures or structures influence how people make sense of data/information in their particular professional contexts?

- How do principals, deans, and teachers take data and then apply this information in decision making about instruction, resource allocation, course design, and other pertinent concerns? (Spencer Foundation, 2011)

The Role of Schools of Education: An Important Convening Opportunity

On February 7, 2011, CNA Education, Education Northwest, and WestEd convened a symposium to discuss what role schools of education might play in helping to build educators' capacity to use data effectively. The meeting brought together representatives from schools of education, researchers, policy makers from professional credentialing organizations, and individuals who currently provide professional development around data-driven decision making. The authors identified experts in research and professional development in the area of data-driven decision making. The conveners sought representation from a diverse set of schools of education, ranging from large research-focused institutions to more traditional teacher colleges, as well as the three most salient professional accrediting and policy organizations. Based on availability, the meeting was scheduled for a time that would accommodate the largest number of key contributors, thus providing a sample of convenience. A list of participants is provided in the Appendix B.

Conference convener, Robert Muller, set the stage for the meeting by describing some of the complexities and the highly systemic nature of the issue of implementing data-driven courses into schools of education.

> I suggest to you that it might be a good idea to push the envelope a little bit about how to infuse data into teacher preparation. For example, course taking is a necessary but not sufficient component of learning about data. This challenge can be thought about as a systems problem, where there are other ways of leveraging higher education beyond just the course catalog – its not about adding a course to what institutions of higher education and those who train teachers and administrators offer – there are many other ways to bring the expertise and resources of higher education to bear on this problem.

The objective of the conference was to gain an understanding of the needs, challenges, and differing perspectives of the efforts needed to develop, introduce, and offer learning experiences on data-driven decision making to students at the undergraduate and graduate level, and for teacher and administrator candidates. It also sought to identify different perspectives on the multiple meanings of data-driven decision making and characterize the skills involved in educational decision making.

The meeting attempted to implement a data-driven process to help the group better understand the issue of building educators' capacity to use data; that is, it applied the cyclical components of data-driven decision making to collect, analyze, and synthesize data and information from the conference participants about how schools of education can respond to the need to train educators to become data literate. The meeting also sought to link the diverse perspectives represented by the attendees into a cohesive set of findings that could be shared with schools of education and relevant stakeholders to stimulate further discussion and identify the action steps needed that would embed data-

driven decision making content more firmly into programs at institutions of higher education.

Key Themes

Several themes emerged from the conference discussion. They include the following:

- Lack of clarity in terminology around data-driven decision making whereby multiple definitions create the potential for confusion;
- Multiple knowledge and skill sets (depending on one's role in the education system) shape perspectives regarding data-driven decision making;
- Standards for data-driven decision making are complex and integrated throughout multiple areas of educator expertise;
- The knowledge and skills that teachers and administrators need to learn form a developmental continuum rather than a set body of knowledge;
- The context in which data-related content can be provided to educators can be structured in multiple ways;
- Organizational capacity to teach data-driven decision making is not widely established; and
- Integrating and implementing preparation in data use content across the contexts in which educators work present a highly systemic set of challenges.

Other issues emerged from the meeting as well. A number of areas lack strong research and adequate information. Successful examples of effective data-driven decision making and successful training in data literacy skills need to be identified, disseminated, generalized, and scaled to other venues and situations. Finally, there is a need for additional policy and practice work that enables the field to differentiate how expert and novice educators use data to inform their practice.

The conference engaged participants in a spirited discussion of how schools of education can respond to the need to build human capacity around data-driven decision making. It also explored the knowledge and skills educators need to best use data in their educational practices. Given the time available and complexity of these questions, the group did not identify specific course components in detail. It is hoped that the issues discussed here will provide a sound basis for schools of education to revisit and investigate the degree to which data-driven decision making is infused across their programs. The following summarizes the discussion around the seven key themes and concludes with recommendations and next steps. Recommendations focus on the additional research needed, changes to educational practice, the need to conceptualize the developmental continuum of educators' knowledge and use of data-driven decision making, and the need for follow-up discussions.

Key Themes: Detailed Proceedings

Key Theme 1: Multiple Definitions of Data-Driven Decision Making

Two guiding questions started the conversation among the conference participants.

- What is the landscape of the need for educators to become data literate?
- What do pre-service education students, teachers, and administrators need to know about data use?

As each participant addressed those two questions, the multiplicity in the ways that they were defining data and data-driven decision making became evident. The definitions are not straightforward and the authors have had difficulty finding an acceptable and broad definition because data-driven decision making means different things to different people.

Data-driven decision making is seen as a continuum in which data must be transformed into information and, ultimately, actionable knowledge through a set of cognitive skills and processes (Mandinach, et al., 2008). It is an iterative or cyclical process. Data are virtually meaningless in their raw state as they are simply numbers. Context enables data to be transformed into information and imposes or provides meaning to the numbers. The information then is transformed into knowledge on which a decision can be based and implemented, and the outcome monitored. The iterative nature comes into play when users determine the need to return to an earlier part of the process to collect more data or and reanalyze the results. Data-driven decision making focuses on the identification of a problem, seeking a solution through the use of data or evidence, monitoring the ramifications of the decision, and determining what to do next (Easton, 2009).

Issues around the definition are multifaceted. The conference discussion began with a generic, but limited, definition for the purposes of the meeting. That definition came from the Institute of Education Sciences (IES) practice guide on data-driven decision making (Hamilton, Halverson, Jackson, Mandinach, Supovitz, & Wayman, 2009):

> Data-based decision making in education refers to teachers, principals, and administrators systematically collecting and analyzing various types of data, including demographic, administrative, process, perceptual, and achievement data, to guide a range of decisions to help improve the success of students and schools. (p. 46)

This definition was intended to focus on data use at the classroom, school, and district level for the purpose of improving student achievement. It was to serve as a starting point for discussion from which the group could elaborate. The conference participants recognized early in the discussion that the definition must be broadened to encompass a wide range of data use across all levels of the education system for all forms of decision making. Multiple participants commented on this issue.

> There are so many different groups of people with their own specific vocabularies trying to talk with the other groups of people and those vocabularies don't match, whether it's data vs. math. (Patrick Sherrill)

> We could start right now, in pre-service, to simply integrate this language that 'data' is not a four-letter word; it is not a test score, its information to inform professional judgment (Paige Kowalski).
>
> [It's a] topic that sounds great, particularly among researchers, but the situation of practitioners in schools is a whole different reality. (Gary Natriello)

But there was a wider concern if the definition is broadened too far. Many believe that the term 'data' is interchangeable with 'assessment.' That is, when people discuss data-driven decision making, many confuse the concepts and believe that data are solely assessments for the purpose of educational decision making. For instance, when the authors have put queries to deans and faculty in schools of education about their course offerings around data use, most often the response was that there are courses and they are assessment courses. Assessments are a subset of data that can and must be used to inform educational practice. But data are much broader. Educational data include demographics, behavioral, transportation, student performance, school improvement, financial, administrative, personnel, process, perceptual, welfare, health, and many other forms of informative that help educators make decisions.

An additional caveat concerns the meanings and utilities of data. Data needs are role based; that is, different people need different data depending on their role within the education system. Teachers need different data from their principals, who need different data from their superintendents. Further, the same data may have different uses and interpretations based on an educator's role. For example, consider student assessment data from the state summative measures. A teacher may or may not choose to use those test scores because of their level of alignment to the curriculum and their instructional relevance. Principals may examine those scores to provide a broad-scope picture of how their schools are doing with respect to achieving their state's content standards. Superintendents may look at those same data to determine the extent to which their districts are meeting accountability standards. Thus, the same data are being examined at different levels of specificity for different kinds of decisions.

A further confusion occurs around different kinds of assessment data, their level of utility, and the validity of interpretation around those data. State summative assessment data are the most contentious. The overarching question remains about the extent to which they are a valid indictor for instructional decision making. Classroom educators often express the perception that the results from the state tests are too far removed from classroom practice, arrive far too late, and often lack curricular alignment to be of use in informing instructional practice. The tests are not sufficiently aligned to curricula and the resulting data are not well aligned to provide for instructional validity. The state data can provide a cursory and high-level view of student performance, but do not provide the capability for drilling down to a level of diagnostic feedback. The state data may, however, be informative to district administrators to determine the need to revise the curriculum, make higher-level modifications to instructional delivery, or make even higher-level decisions about educational offerings.

The use of formative assessment data are often confused with other types data-driven decision making (Black & Wiliam, 1998; Heritage, 2007, 2010; Stiggins, 2002, 2005). As Stiggins (2005) notes, formative assessment is assessment *for* learning. The objective is to provide teachers with data that can be used to modify instruction. The results are delivered in a manner that is both timely and sufficiently aligned to the instruction so that classroom practices can be adapted in a tight feedback loop between assessment and instruction. Formative assessment forms part of a cycle of inquiry (Wiliam & Leahy, 2006). Indeed, the use of formative assessment can be one form of data-driven decision making, but again, it is a limited form that informs instruction based on data about student performance. Data for driving decision making may include, but must be broader than, formative assessment.

The above mentioned definitional issues have implications for course offerings on data use for institutions of higher education. Data-driven decision making is a generic tool that all educators must use. It is not just about assessment data. It is much broader. But it is different for different occupational roles within the education system, whether a teacher, a school, a district administrator, a policy maker, or even a researcher. How courses on data-driven decision making are delivered must reflect the differences in focus and data use. Further, there are apparent differences for novice versus experienced educators. Beginning or pre-service teachers lack real-world experience in which to contextualize data use. Thus, training on data use may be very different from what might be appropriate and effective for experienced educators. Participants expressed general agreement with the following observation:

> It seems to me that there are three levels, at least three levels, of analyzing this data and that each of these groups in using this data have significantly different reasons for using it. If we train superintendents and we train principals to use data in their jobs, we're still a long way from training teachers to use data in their job. (Patrick Sherrill)

Further, there is a concern among schools of education about how such courses may be integrated into their curricula and whether courses can sufficiently capture the complexities in which teachers and administrators must function. Inquiry-based practices are seen as a mode of professional practice for educators and provide a focus on data in educator preparation programs. As one participant noted:

> I know we have entire programs that are focused on inquiry as a mode of professional practice, and those extend for both administrators and teachers. They've been in place for decades. They've evolved over a period of time, started with lots of fanfare and lots of optimism. I think they've settled into a different kind of realty that we can prepare people to a certain extent, we can equip them, but then we send them into very complicated organizations. (Gary Natriello)

Schools of education can prepare practitioners only to some extent to deal with the complexities and realities of schools and districts. They are unable to capture the full range of challenges found in the educational system.

A final challenge around terminology is a cultural issue. There is a need to develop an understanding within the field of what data-driven decision making is and how data can

and should be used to inform practice. The extent to which educators in general have dispositions that are focused on data use is a concern. Multiple participants agreed on this issue as expressed by one person.

> The other thing is so much of this is cultural, and I think when we talk about courses and skills, it doesn't get at the cultural aspect of this. For the most part, people, and educators in particular, when they hear the word "data", they hear the word "test", so we've lost them already when we start this conversation. There is so much advocacy still to be done and culture change (Paige Kowalski).

Schools of education may have difficulty engaging in data-driven decision making in their own practices. All of the school of education participants agreed with the following observation:

> The thought experiment I always run when I try to get people to think about this is our own experience. The question [raised in this conference] is can we get schools of education to prepare people to base educational practice on data and make data-driven decision making part of their life. A prior question is can we get schools of education to do that themselves. I would say my experience in a number of schools of education is that's really difficult. It's incredibly difficult to find the time within one's course of activity and in the culture in which one is working, both the practical culture and the political culture, to actually get the right kind of data at the time you need it, have the resources and the capacity to act on that data, and to see improved practice come about. (Gary Natriello)

One cultural issue that was raised by participants focused on the complexity of the way that data use is embedded in schools of education. One participant indicated:

> If I were to stand up at our faculty meeting and say, "who of you would like to move to data-driven decision making as a theme of your course?" the response would overwhelmingly be, "we all do that." So, one of the issues of getting schools of education to adopt courses in data-driven decision making is to sort of get beyond the idea that, in fact, that's all we do already. I think we do try to do a lot of it, but I'm not sure it's exactly the way you're [the conference] thinking about it here. (Gary Natriello)
>
> I'm now to the point where I think overall data-driven decision making as kind of a general way of life is probably not within our capacity, but are there a certain set of things, a certain set of practices, that could be guided by data. Could we start in a very focused and small way around certain key things and train both ourselves and the students we have in our classes who become teachers and administrators to actually do this? (Gary Natriello)

The cultural challenge comes at a time when educators are very concerned about how data are going to be used for evaluative purposes; that is, they are deeply concerned about the emphasis on linking student performance to teacher evaluations. Emphasizing data-driven decision making at a time when educators perceive data use as a means by which they will be evaluated and even fired is not just a cultural issue. One participant observed:

> ...what happened in DC public schools, DCPS administrators excelled in data driven decision making, and they ultimately lost their jobs. They didn't build an understanding

about what we mean by the word "data" and, therefore lost the communications battle. They didn't communicate to parents and the public that poor test scores don't equal poor ratings and firing of teachers.... there is the human process and professional judgment that comes into data driven decision making and that's sort of the battle we're losing. I think all this absolutely has to happen (Paige Kowalski).

Key Theme 2: The Integration of Multiple Knowledge and Skill Sets

The literature on data-driven decision making indicates that there is a fundamental set of skills and knowledge, although different conceptual frameworks espouse slightly different skills. Most of the frameworks, in fact, describe general processes, rather than skills. For example, Easton (2009) describes the need to identify problems, seek solutions, define research, and monitor progress. Means and colleagues (2010) describe a cycle that includes planning, implementing, assessing, analyzing data, and reflecting on outcomes. Hamilton and colleagues (2009) present a cycle that includes collecting and preparing multiple sources of data, interpreting data and developing hypotheses, and finally modifying instruction to test the hypotheses. Mandinach and colleagues (2008) focus on cognitive skills, not just processes and outline six skills: collecting data, organizing data, analyzing information, summarizing information, synthesizing knowledge, and prioritizing knowledge. Mandinach (2010) also refers to pedagogical data literacy that involves taking the data and transforming them into actionable instruction, using pedagogical content knowledge (Shulman, 1986). Means, Chen, DeBarger, and Padilla (2011) term this skill instructional decision making. They also identify four other skills: finding relevant data, or data location; understanding data, or data comprehension; determining what the data mean, or data interpretation; and the ability to ask instructionally relevant questions, or question posing. Further, they note that while teachers may lack many of these skills, working collaboratively helps compensate for individual deficits.

The research and professional development literature also speaks to specific components or strategies that educators should use when examining data. The following are some of the strategies and associated references:

- Differentiate instruction to meet the needs of all students (Long, et al., 2008; Love, Stiles, Mundry, & DiRanna, 2008);
- Formulate hypotheses about students' learning needs and instructional strategies (Boudett, City, & Murnane, 2007; Halverson, Pritchett, & Watson, 2007; Herman & Gribbons, 2001; Love, et al., 2008: Mandinach, et al., 2008);
- Collect and use multiple sources of data (Bernhardt, 2008; Goldring & Berends, 2009; Kerr, Marsh, Ikemoto, Darilek, & Barney, 2006; Love, et al., 2008; White, 2005);
- Use formative, summative, interim, benchmark, and common assessments to make decisions, as well as student classroom work products (Boudett, et al., 2007; Goldring & Berends, 2009; Love, et al., 2008; White, 2005);
- Modify instructional practice according to the data collected (Abbott, 2008; Bernhardt, 2008; Mandinach, et al., 2008);

- Drill down to the item level to gain a deeper understanding of performance (Boudett, et al., 2007; Love, et al., 2008);
- Use student work, not just tests, and other sources of data (Bernhardt, 2008; Boudett, et al., 2007; Halverson, et al., 2007; Supovitz & Klein, 2003; Wayman & Stringfield, 2006);
- Monitor outcomes (Easton, 2009; Love, et al., 2008; Mandinach, et al., 2008);
- Focus on all children, not just the "bubble kids" (Booher-Jennings, 2005; Brunner, Fasca, Heinze, Honey, Light, Mandinach, & Wexler., 2005; Love, et al., 2008);
- Look for causes of failure that can be remediated (Boudett, et al. 2007; Love, et al., 2008); and
- Work in data teams to examine data (Halverson, et al., 2007; Long, et al., 2008).

A key thread across these documents is the concept of making data actionable, whether this is done by a teacher or an administrator. For teachers, this is what is referred to as pedagogical data literacy or instructional decision making. The researchers see these as a skill set and a process that must be integrated into practice or made part of educator culture. Pedagogical data literacy requires teachers to combine their knowledge of data with their knowledge of the content area and the associated instructional methods in what Shulman (1986) referred to as pedagogical content knowledge. Pedagogical data literacy is the fundamental component in teachers using data to inform practice. Data use is not simply about the numbers, otherwise it would be more statistically oriented. It is about taking the numbers and making them actionable for teachers in terms of instruction. It is the link between the data and their transformation into actionable knowledge that is essential, yet difficult to teach. Even professional development programs like *Using Data* do not focus on this transformation process (Love et al., 2008). Parallels can be drawn for administrators who need to make actionable their relevant data for the purposes of administrative, personnel, finance, programmatic, or other decisions.

The literature also recognizes assessment literacy (Brookhart, 2011; Heritage & Yeagley, 2005; Herman & Gribbons, 2001; Popham, 1999; Shaw, 2005) and statistical literacy for educators (Confrey & Makar, 2002, 2005). Assessment literacy is seen as an educator's ability to understand fundamental concepts of measurement such as reliability and validity and apply knowledge to various forms of instrument development, implementation, and analysis. Statistical literacy is understanding fundamental statistical concepts such as central tendency and distribution. Confrey and Makar (2002, 2005) describe some of the misconceptions around issues of central tendency and distribution with which educators need to be familiar. Yet having assessment and statistical literacy is different and only part of data literacy (Mandinach, 2010). Educators need to understand assessment and they need to understand fundamental statistics such as central tendency and distribution, but the actual use of data goes beyond those concepts. As noted above, pedagogical data literacy is about taking the numbers or statistics, making sense of them, and translating them into knowledge about instructional action.

Conference participants were asked directly what knowledge and skills pre-service teachers and administrators need to know to be able to use data. The meeting participants noted that the issue here is not only about the requisite skills and knowledge, but also about the culture in which data use is implemented. It is about changing the culture to make data use a fundamental part of educators' everyday work. As one participant stated:

> [D]ata-driven decision making is not an end in itself, and rather than a separate course or a set of skills, it's process that really needs to be threaded throughout teaching and learning and throughout school improvement and, therefore, throughout teacher education and administrator training. (Joan Herman)

The discussion raised an important set of questions about the determination of appropriate courses at institutions of higher education for data literacy.

The list of knowledge and skills is daunting; including technical measurement/statistical skills, understanding of how to use statistical knowledge and skills in particular contexts, understanding school and district contexts and issues (Copland, Knapp, & Swinnerton, 2009; Heritage & Yeagley, 2005), understanding how to associate assessment findings with instructional strategies, understanding the developmental status of students and the development of content knowledge, and understanding culturally competent pedagogy (Shaw, 2005). This issue was addressed multiple times during the conference by the majority of the participants.

> [O]bviously it's not just a set of skills, it's a culture and a belief system. It's not only knowing what the goals are and how to get to the goals, it's a belief system that I as a teacher, I as an administrator, I as a school community, am responsible for getting kids there. (Joan Herman)

> So, we talk a lot about triangulating. Though I may have compared the skills needed by teachers to triangulate data, in our professional development, triangulation refers to the use of multiple sources of student learning data - rather than the triangulation of teachers' skill sets. Effective use of data by teachers requires more than the technical or statistical background needed to understand the data itself. We typically assume that all teachers have the necessary background as a result of their undergraduate course in measurement or statistics 101. Making connections between the statistical implications of data to teaching and learning is a different skill set. It requires a deeper understanding of the context of different types of assessments, the content being taught and the opportunity for teachers to apply that understanding to their own students' context (Diana Nunnaley).

> Districts could impart skills to teachers about how to read the data, interpret the data, but then "what do I do in my classroom as a result of that data" was something that many teachers were still needing support, and I think probably one of the bigger challenges of data use. That also suggests that when you're teaching folks how to use data that it be contextualized, not necessarily in a separate specific course (Chris Padilla).

Little is known about the extent to which teacher education programs require a course in statistics or a course that focuses solely on assessment for their students. Even the meeting

participants expressed concern that so little is known about this issue. A common theme from multiple conference participants was that traditional statistics or measurement courses do not prepare teacher or administrator candidates to use data effectively in the complexity of educational contexts. As one participant stated:

> For me, maybe a way to approach it is that when we're talking with teachers and one of the sort of effective practices that we work with them about, is to always use multiple measures, never base any single decision on any one piece of data. So, we talk a lot about triangulating. To me, this is a problem where it's going to take a real triangulation of a lot of different pieces of it because there are the data skills themselves, just the technical skills of being able to read and the facility to understand the data and to be able at a technical level to interpret it. And we take it for granted that teachers of all levels are able to do that because they've taken the statistics and measurement class as undergraduates or in their graduate programs. But there is a separation between that type of statistical analyses and then being able to apply it to student learning data and other types of data. But even when they get beyond the technical aspects of it and begin to feel confident that they can interpret what their FCAT[1] says or their MCAS[2] says, beyond that, it's then not just interpreting the data factually, but it's the making meaning of it and what does that say for student learning and where are kids and where the deficits are and how we need to respond to that. (Diana Nunnaley)

A major concern of the participants was the need for educators to understand the nature of diverse learners and the disciplinary areas in which they teach. Multiple participants agreed with the following articulation of the issues:

> The real learning that needs to take place for practitioners comes at that level. And that generally happens when they begin to really understand more about the different kinds of learners that they're working with and when they begin to examine a lot of their own assumptions, and that usually happens, we find it best, in the context of really taking the content apart. So there are two pieces here. It's all my belief structures about teaching and learning and then there is the strength or the lack thereof of my own content knowledge, and my ability to take that content knowledge apart in ways that I can translate that into interventions and solutions and improving my own skills, my pedagogy that is in response to that. (Diana Nunnaley)

> We could address partly there, but if it doesn't somehow happen in the content areas and in really looking at how we design formative assessments and how we improve our content knowledge in ways that we do really finally have tuned up formative assessments, then I'm not sure that it's going to get down where it needs to go. (Diana Nunnaley)

At the heart of data-driven decision making are the knowledge, skills, and dispositions necessary to examine data. These are the technical skills to be able to read and understand the data and, at a technical level, to be able to interpret them. However, there is a gap between those technical elements of data-driven decision making and the ability to apply data to inform different kinds of decisions. *Using Data* does not connect the pedagogical content knowledge and the instructional methods needed to transform data into actionable instruction. It only teaches the data literacy skills.

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[1] Florida Comprehensive Assessment Test.

[2] Massachusetts Comprehensive Assessment System.

The fundamental connection between data and pedagogy was raised by a faculty member who has taught courses on data-driven decision making and has worked with projects such as *Data Wise*. As one participant noted:

> [We] can teach people how to be able to disaggregate, look at data, use Excel, but if individuals who are looking at data don't know how to interpret it to determine what to do next to improve instruction, and what they need to do differently in the classroom, that's where the work kind of stops (Rebecca Thessin).

Another barrier to the development of knowledge and skills in data-driven decision making is a wide-spread skepticism about the utility of the sorts of data, including state testing data, that are available to educators. One participant indicated:

> There are faculty, and I would say that they are the majority in most schools of education, that are deeply skeptical about the role of norm-referenced testing and state testing. I think they are [a] substantial majority right now. I think they don't need to be, but they are. It isn't just the technical learning, it's the attitude about the use of quantitative data that is a very large problem. (Samuel Stringfield)

Other participants who teach or have taught measurement courses reiterated the concern.

> I really agree with what Sam [Stringfield] said about sort of a general resistance on the part of a lot of educators to quantitative data analysis in general, and so I think that is an obstacle that has to be overcome. (Rebecca Zwick)

Technical Measurement/Statistical Skills

Most professional development guides or manuals do not substantively deal with the technical measurement and statistical skills that are addressed in the multiple measurements and assessment texts that are pertinent to data-driven decision making. For example, one chapter in the *Data Wise* book (Price & Koretz, 2007) introduces the following:

- Sample principle of testing
- Discrimination
- Measurement error
- Reliability – tradeoffs with detail
- Validity – consequences of testing practices
- Score inflation
- Accounting for sampling error and measurement error
- Keeping test scores in perspective
- Norm-referenced tests
- Criterion-referenced tests
- Standards-referenced tests
- Developmental scales
- Use of school to district and district to state, cohort-to-cohort, and value-added models of longitudinal analysis
- Measures of central tendency

- Distribution
- Statistical significance

These topics are not covered in sufficient detail to promote understanding. An additional difference of such a book from typical assessment texts for educators is the focus on data sources to inform decisions and the focus on building a culture of data use at the school or district level rather than a focus on the development of different types of summative and formative assessments. Participants clearly indicated that these technical measurement and statistical skills are only one aspect of what educators need to know and be able to do. Yet take for example one "how to" book for educators on the use of data (Creighton, 2007). The book is statistical manual for the examination of data, written by a former teacher, principal, and superintendent who is now a professor. Topics in this book include:

- Regression
- T-tests
- Analysis of variance
- Analysis of variance: repeated measures
- Two-way analysis of variance
- Chi-square
- The use of statistical packages such as SPSS

A book such as this, although billed as a guide to teach educators how to use data, is a statistics manual, not a book on data-driven decision making. It illustrates the overlap and confusion by an individual who was an educator and is now teaching educators how to use data.

One example of the necessary distinction between knowledge and skills in measurement and statistics and data use in decision making was provided by a former assessment professor who taught courses in measurement and statistics. This participant indicated:

> I think they need to have some understanding of measurement error, which I think of very broadly. I'm not talking about [whether] they know how to compute a standard error of measurement at all. I'm talking about the fact that they need to understand which data are more and less trustworthy. In order to do that, they have to have some understanding about error and test scores. For example, I think that most educators, if anything, make the error of relying too heavily on test scores rather than not heavily enough because of a lack of understanding about measurement error. I consider that to be an important issue (Rebecca Zwick).

She described the lack of educator knowledge about measurement and statistics from her own research.

> In the research that I did while at UC Santa Barbara on trying to develop some modules to teach teachers more about measurement and statistics, I found out some disturbing things about the level of knowledge and background. For example we had a total of 250 educators participate in the project and one of the background questions we asked them was how many college level or above courses in measurement and statistics they had had. Our thought was that when we would analyze the results of our study, we would look the relationship between their past background and their ability to comprehend our

> materials. It was a shock to find that the modal number of courses was zero. In some pilot research, we did, we found that about half of the respondents thought that test reliability was the correlation between test score and grades. So even such a basic concept as reliability is not one that I believe is generally understood by educators, and it's hard to see how data could be used competently without some understanding of that concept (Rebecca Zwick).

All of the conference participants who have taught either statistics or data-driven decision making courses for educators emphasized that most statistics courses provide educators with a basic awareness of the methodological aspects of various statistical concepts and tests. However, educators do not leave such courses with ways to use their developing understanding to interpret data in an educational context.

Specialized Knowledge for Administrators

It is unclear from the literature and from professional development experts just how different data-driven decision making is for teachers versus administrators. Certainly the kinds of decisions that must be made and the level of examination of data differ, but there is little guidance on the how skills and knowledge differ across the groups. Knapp and colleagues (2006) examined issues around data-informed leadership. One of their enduring findings can be found among their unanswered questions and issues. First, there really is not an understanding of how data literacy for educational leaders is defined. That is, the field has not adequately addressed the skills, knowledge, and beliefs around administrative data-driven decision making. Second, the authors note that it is unclear how administrators acquire data literacy. Third, they note that it is unclear what impact there is on teaching and learning from data-informed leadership. Finally, the relationship between data-informed leadership and other aspects of educational leadership is unclear. Much has been written on data-informed leadership, yet there is little agreement and clarity about what exactly the construct entails (Goldring & Berends, 2009; Kowalski, Lasley, & Mahoney, 2008; Ontario Principals' Council, 2009; Preuss, 2007). These are fundamental issues that the field must address. At the heart of these questions is an understanding of school and district contexts and issues (Copland, et al., 2009; Heritage & Yeagley, 2005).

The *Data Wise Project* at Harvard focuses on helping administrators to gain data literacy and help to manage the data process. Only recently, the *Using Data Project* at TERC has been developing a Principals' Academy as an enhancement to their traditional professional development model, recognizing the importance of leadership in creating data cultures in schools. Researchers and professional development providers have been working together to identify the skills and knowledge that principals need to create a data-informed building. They have identified data skills that are not unlike those needed by teachers, as well as leadership and management skills:

Data Literacy	**Leadership/Management**
Knowing what data	Planning for data use
Knowing where to get the data	What data are where
Access to what data	Grouping structures
Knowing how to get the data	Communication skills
What do the data look like	Collaboration skills
What is the decision making process	Distributed leadership
How to identify the right data	Establishing a vision (data teams/ data mentors)
Knowledge of alignment of data elements	Alignment of learning goals with data
Monitor implementation	Structure and organizational functions
Understand what data say about impact	

Conference participants also struggled with two distinctions. The first distinction was between the knowledge and skills administrators need to know versus what teachers need to know; that is, if data literacy for teachers differs from data literacy for administrators. The second distinction was data skills versus leadership skills for administrators, similar to the issue the *Using Data Project* is trying to distinguish. One participant indicated:

> I'm teaching the principals and superintendents courses. A couple of pieces about that: my courses deal almost exclusively with leadership skills because I tell my students I teach them what they need me for and they need me a lot more for trying to create learning organizations, the data informed district, and things like that. They can learn the skills from a lot of other places so we actually don't teach any statistics or numeric stuff in my classes. (Jeff Wayman)
>
> To me, the absolute key to this is to get all educators using this in the course of their everyday work every now and then. In our work right now, we're really pressing on this everyday work thing. To that end, we need to take advantage of professional judgment. The data support professional judgment, right? We don't want to take the professional judgment out of it. In fact, the whole reason we're getting more information and more data is to feed this into their professional judgment and help them make better decisions. Professional judgment is the glue that holds it together. (Jeff Wayman)

This comment is particularly salient for several reasons. Dr. Wayman is one of the foremost researchers in the area of data-driven decision making. He teaches courses for administrators, superintendents, and policy makers, but not teachers, because of the structure of the University of Texas (they are taught in the Department of Curriculum and Instruction). He recognizes the need for the quantitative skills (statistics), but firmly emphasizes the management, organizational, and judgment skills. Because educators, can take statistics in a variety of courses, his courses focus on the set of skills that they cannot get elsewhere. He does believe that all educators, including administrators, need data literacy skills. Other conference participants agreed with the importance of administrators acquiring other skills beyond statistics.

> For administrators, and I believe that for administrators, Jeff, you're right on target, that it's not about the statistics. It's about the leadership skills and about transforming leadership roles in the schools as you move toward more shared leadership forms and how

> that communication is kept robust in all areas and throughout the district. (Diana Nunnaley)

Specialized Knowledge and Skills for Teachers

More research has focused on the skills and knowledge that teachers need to use assessment information and other data effectively. Mandinach and Jackson (in press) examined various conceptual frameworks for data-driven decision making and excerpted the skills that research has identified as necessary for data use (Abbott, 2008; Easton, 2009: Hamilton, et al., 2009; Mandinach, et al., 2008; Means, et al., 2010). As noted above, Means and colleagues (2011) identified five processes: data location, data comprehension, data interpretation, instructional decision making, and question posing. As can be seen from these lists, different researchers are identifying different skills or using different names for similar skills.

Teachers need strong models of disciplinary knowledge, misconceptions, and learning progressions that they use as the bridges between information about student performance and the instructional strategies they will implement based on an analysis of student data.

The specific skills for data-driven decision making writ large may have commonalities across disciplines. But it was made clear from the conference attendees that the key to educational decision making, and instructional decisions more specifically, is the ability to transform the data into meaningful instructional actions. This is a key aspect of pedagogical data literacy, or as Means and colleagues (2011) refer to it, instructional decision making. Multiple participants spoke clearly about this issue.

> The piece where everyone got stuck was on the examining instruction part of the process. The [*Data Wise*] process had been designed with the idea that yes, we need some steps to figure out how to even tackle data use; for instance, what should schools do with these mounds of state assessment data that they get at the beginning of every year? But then once a school team created the data overview, built some assessment literacy among staff and disaggregated some of the data, the question was then "what do we do about it?" Most schools were not prepared to initiate classroom observations to build their own understanding of the instruction that was leading to the data results they had examined. That's where every single school team got stuck (Rebecca Thessin).

> Interpreting data is more difficult. Content pedagogical knowledge has been mentioned, but it's the next steps, what to do based on the data, as other have mentioned, that is the real stumbling block. Numbers are not destiny. We can do something to change how kids are performing, but the reality is, in most cases, teachers in schools have already done their best and what to do differently is a challenge. (Joan Herman)

This issue of pedagogical data literacy has direct connections to teacher knowledge and skill in instructional design. Teacher's use of data is predicated on their abilities to plan instruction adequately. One participant indicated:

> First, for teachers, is formulating learning goals. They can't fundamentally, in my view, use assessment to improve learning until and unless they know where they're trying to get kids. So, knowing what the goals are at a detailed, more than superficial level and knowing

> sort of the trajectory over which kids have to travel to get there is fundamental to being able to use assessment evidence to improvement their learning. So, knowing what the goal [is] number one. (Joan Herman)

Good data for teachers comes from, among other places, good assessment instruments, and this is also an area of knowledge and skills development.

> Number two, having available or being able to select assessment evidence or evidence from their ongoing teaching that tells them how kids are doing are fundamental skills that, in general, teachers don't have. That, to me, is the number one problem for teachers in classrooms, use of data to improve learning. (Joan Herman)

Collaboration

Participants also indicated that both administrators and teachers need to develop the knowledge and skills required to engage collaboratively with each other. They also recognized the need for the development of creativity in conceptualizing the appropriate data lenses to identify which data sources might apply to which decisions that need to be informed.

Researchers have identified the importance of collaboration around data-driven decision making processes (Lachat & Smith, 2005; Wayman & Cho, 2009; Wayman & Stringfield, 2006).

- Bringing focus, a sense of purpose and a common language to collaborative efforts (Wayman, Midgley, & Stringfield, 2006).
- Data efforts that are collaborative are more likely to be successful (Chen, Heritage, & Lee, 2005; Lachat & Smith, 2005; Wayman, 2005; Wayman, et al., 2006, Wayman & Stringfield, 2006).
- Data systems support collaboration (Wayman, Stringfield, & Yakimowski, 2004 Chen, Heritage, & Lee, 2005; Lachat & Smith, 2005; Wayman, 2005; Wayman, et al., 2006; Young, 2006).
- Collaboration around data systems should proceed with small steps and iteratively (Wayman, Cho, & Johnston, 2007; Wayman, et al., 2006).
- Collaborative examination of data can address inequities in student opportunities (Symonds, 2004).
- Collaborative interactions support administrator dissemination of data use practices (Supovitz & Klein, 2003; Young, 2006).
- Multiple types of informed decisions can be made using data systems in a collaborative process (Halverson Gregg, Prichett, & Thomas, 2005).

Multiple participants raised the issue for the need the development of collaboration, especially in the context of leadership skills.

> But another thing when we think about project based learning is that if we organize the setting in collaborative groups so that it's not individual teachers who are going out with their data set and analyzing it, but they're working with a group of teachers, we start to infuse the idea that it's a good thing to work together. It's a good thing to brainstorm together, and you make an exciting social experience out of the learning and that's something that can carry over into the classroom space where we know isolation, the

> traditional isolated teacher, is one of the problems and one of the cultural changes that we'd like to see. Teachers can't do everything on their own and in isolation, but that if they work collectively and recognize that they have organizational goals that all the children and the school can benefit from, that there's synergy there (Chris Padilla).

Collaboration needs to be considered a whole school process, with models of distributed leadership as a means by which to make possible the acquisition of data literacy and data use (Lachat & Smith, 2005; Park & Datnow, 2009). This issue was articulately addressed by one participant.

> I tell you that collaboration is absolutely critical. It's the only way we're seeing effective data use happen right now. We need to look at ways to involve faculties fully, not just a handful of teachers. (Jeff Wayman)

> We're really pressing on this collaboration thing. The more I'm in this, the more I see that everything around data use happens around collaboration. I talked earlier about leaders being able to form structures and that the teachers need to get used to this. Collaboration is where teacher reflection really happens. This collaboration is if where they are thoughtful about their data use, we don't see any sort of teacher reflection on data happening individually. It's happens every now and then, but not in any real scalable substance. Collaboration for teachers facilitates so many things. It's where time is found, it's where time is saved. It helps them learn. Professional learning and collaboration are all the same thing in my mind. It's where they figure out how to change their practice based on data because they're talking to other pros, other teachers. That's where they identify and start to use common definitions. (Jeff Wayman)

Collaborative interactions were seen by the participants as one of the ways that teachers could come to publicly own the data that came from the classrooms. As indicated by one participant:

> One of the things we heard about one school that was kind of interesting was when they first started the collaboration around data, they brought in real data that they had at the classroom level, but they took the teachers' names off of it so that no teacher would feel that her students' data were being shown to her colleagues and that she could be judged negatively based on that. Then, after a couple of sessions, the teacher said to the administrator, "You know, we want to find out who did best on this so we can find out how they taught it. Could you please put the names on?" So, it was kind of interesting making them ask for it, and it seemed to work really well. (Barbara Means)

Collaboration was seen as a way that teachers could develop questioning skills in order to initiate substantive data use. Multiple participants raised this issue.

> For example, project based instruction tends to get to a much deeper level of understanding and allows for "a-ha" moments if teachers are looking at their own data... That works a lot better than, for example, going through a book and learning definitions for mean, median, etc. If we organize the setting in collaborative groups so that individual teachers are not alone facing their data set and analyzing it, but working in groups, we start to infuse the idea that it's a good thing to work together. It's a good thing to brainstorm together, and you make an exciting social experience out of the learning and that's something that can carry over into the classroom space where we know

> isolation [of] teachers is one of the problems we need to address. This is a cultural change that we'd like to see. (Linda Cavalluzzo)

> The parallel is educators not knowing what questions they're trying to answer as they assemble and attempt to analyze their data. The data become a confusing and overwhelming mix of "stuff." It's helpful to start with clear questions that the data can help answer and then to organize available data – hopefully from multiple kinds of measures – and to target their analyses to specifically address those questions. Knowing what questions to ask; how to identify, analyze and interpret data to address those questions; and what to do based on the answers are all crucial skills in data use. As other speakers and participants have said, learning communities can be really helpful in sharing existing expertise and in helping teachers and administrators to build these skills. (Joan Herman)

> A skill that teachers need is how do you figure out how to pose questions to get useful data. I think that's also a skill that needs to be developed collaboratively. How do I query a system in order to get more data to find out, get beyond just what is given to me in terms of test data, things like that. (Chris Padilla)

Finally, research is emerging that shows that when teachers work together collaboratively on data use, they perform better. One participant described her recently published findings.

> Teachers really struggled when trying to pose questions relevant to improving student outcomes that could be investigated using data in a typical electronic data system. That was something they were just not very good at doing. Teachers and other school staff responding in small groups on an average did better on these questions than did individual teachers. You can see in the dialog that someone in the group was likely, sometimes there were just errors in their, you know, they might have been looking at the wrong number or they miscomputed two differences and therefore were making a wrong inference or their reasoning was faulty, so it was more likely that someone in the group would catch that a kind of get the group back on track. They did do better collaboratively; we found empirical support for that. (Barbara Means)

Summary of Knowledge and Skills

There is no question that identifying the knowledge and skills that are the components of data literacy and their acquisition is no easy task. The attendees at the conference not only struggled to identify the specific skills that comprise data literacy, but they also labored to describe the most effective means by which data literacy can be acquired. As noted in the title of this paper, it's harder than the field thinks and it is complicated. Several participants commented on the complexity of the knowledge and skills required for effective use of data in educational settings.

> I would certainly agree that we're talking about technical skills, professional judgment, and the culture of the environment in which we're operating. (Joseph Aguerrebere)

Identifying the skills may be the simpler task. Determining how best to educate future practitioners and train current educators is the more challenging task. The key for subsequent work in this area is to determine the skill acquisition process by answering some fundamental yet unanswered questions.

- Does the acquisition process differ for pre-service versus in-service educators?
- What role does authentic activity and data experience play in the acquisition of data literacy?
- How do schools of education structure and integrate practica that will enable pre-service candidates to acquire at least fundamental data literacy skills?
- At the graduate, in-service, or continuing education levels, are courses or is more traditional professional development the best method of skills acquisition?
- Is professional development sufficient for acquiring and sustaining knowledge and skills, or does the training need to be done in a more continuous manner, as found by Means and colleagues (2010)?
- Should there be stand-alone courses?
- Should the principles of data-driven decision making be integrated into existing courses?

Until researchers have the answers to these questions, we will continue to seek effective methods for addressing the need to improve human capacity around data-driven decision making.

Key Theme 3: Role of Standards to Support Preparation in Data-driven Decision Making

Participants recognized the importance of standards as a lever to emphasize educator preparation in data-driven decision making. The standards were seen as a vision to inform schools of education about what should be included about data use. Conference attendees agreed with this issue as raised by two of the participants.

> What the National Board has been about over the years is trying to identify those standards of practice or habits of mind that yield better results. (Joseph Aguerrebere)

> As a profession, part of what I hope we'd be able to get to is some agreement around what constitutes good professional practice. In fact, that's what we're trying to do with the National Board in coming to some professional agreement around a set of standards for what constitutes good practice, whether you're teaching kindergarten or teaching high school biology and everything in between at different developmental levels. (Joseph Aguerrebere)

> First of all, we can and we will set higher standards for those who are entering the profession and for those who are getting advanced degrees in the profession. This will be a much stronger set of clinical standards, and it will be a much stronger focus on doing this through partnerships with practitioners. One of the things that we will very much need help on in the next two years as we set the new standards is what exactly are the expectations for candidate performance in this area of using data? What precisely do you (schools of education faculty and researchers) believe we should require the programs to demonstrate that their candidates are able to do in this area? We have some influence on then trying to align that with licensure standards because there is a growing interest in reforming licensure so that it reflects more than just a minimal sort of expectations. (James Cibulka)

Standards are also seen as a way to hold schools of education accountable for the outcomes of educator knowledge and skills of data-driven decision making.

> I very much agree with the remarks that have been made about the need for a new regulatory environment at the state, and really the federal level that can help move us in the direction we need to go. The whole focus needs to be upon an accountability system for colleges of education that focuses on K–12 student outcomes, multiple measures of teaching effectiveness that address quality of instruction and student outcomes, and a focus on program performance. (James Cibulka)

> Accessing that skill set and getting folks in touch with it is an internal management challenge maybe that could be leveraged with state licensing and accreditation standards that could take us in a pretty good direction. (Gary Natriello)

The notion that programs change as standards are enforced is not a straightforward process. One participant indicated:

> One place where you do sense that people do respond. When those standards change, we all hear about it. We know about it. People's actions change. Although the following-up inspections are usually not very detailed and so people change at a certain level, but maybe not at a very deep level. So, if you actually did want to change what was being taught, I think there is a mechanism, but I think the mechanism would require greater follow through and greater follow-up. (Gary Natriello)

One barrier to standards for educators as a lever to change what and how educators are prepared is the variability across programs with their focus on standards.

> As you go from program area to program area, I think I would also echo the comment that there is big variability. In some certification areas, there's a real embedded sense or assessment is a real embedded part of how they do business. It gets back to how tightly they are connected to a research literature, how reflective practice is of standards, as opposed to other areas in teacher preparation where there is a very heavy ideological bent and the connections there are just as deep and just as tight. (Gary Natriello).

Both the new version of standards for teachers from the Interstate Teacher Assessment and Support Consortium [InTASC](CCSSO, 2011) and the new *Educational Leadership Policy Standards: Interstate School Leaders Licensure Consortium (ISLLC) 2008* (CCSSO, 2008) adopted by the National Policy Board for Educational Administration (NPBEA) contain references to educator use of data. The InTASC standards do not directly refer to data use or data-driven decision making. It is seen as a key cross-cutting theme, woven throughout multiple standards. The updated standards indicate nine knowledge statements, nine disposition statements, and 20 performance statements that reference the use of data to support learning, demonstrating how the theme of data use has been integrated across the document. Data use is one of fifteen themes that can be inferred from the standards rather than being explicitly stated.

The new draft InTASC standards' first reference to data use is in Standard 5: Innovative Applications of Content, which addresses teachers' use of interdisciplinary and cross-disciplinary themes to provide students with opportunities for critical and creative thinking and problem solving. This first association with data use focuses on the

information-gathering knowledge and skills of teachers in a way that emphasizes an instructional focus on data-driven decision making identified by conference participants.

The strongest focus on data use is in Standard 6: Assessment that describes teachers' understanding and use of multiple methods of assessment. Here the focus is on the use of data to document student growth and to inform planning and instruction. All but one of the teachers' assessment performance, essential knowledge, and critical disposition standards are associated with data use except one that addresses teacher and student metacognition, according to the InTASC draft standards document. The language of what teachers need to know and do around assessment reflects the data-driven decision making knowledge and skills identified by the participants above.

Data use is also referenced in Standard 7: Planning for Instruction, Standard 8: Instructional Strategies, Standard 9: Reflection and Continuous Growth, and Standard 10: Collaboration. The larger discussion of the standards focus on data use addresses many of the aspects of data-driven decision making identified in the definitions in theme 1 and the knowledge and skills in theme 2. Teachers' performances, essential knowledge and critical dispositions are clustered around the use of data to inform multiple types of decision making at the classroom level using different formats of achievement data. Only in the final standard does the "data use" indicated in the InTASC standards broaden to refer to the way that data-driven decision making was identified by the participants of the conference. Appendix A includes all of the InTASC standards that are associated with data use.

The new *Educational Leadership Policy Standards: ISLLC 2008* (CCSSO, 2008) adopted by the national Policy Board for Educational Administration (NPBEA) updates the previous *Interstate School Leaders Licensure Consortium (ISLLC) Standards for School Leaders* first articulated in 1996 (CCSSO, 1996). The new standards address data-driven decision making more directly than do the InTASC teacher standards. Standard 1 identifies how administrators "Collect and use data to identify goals, assess organization effectiveness, and promote organizational learning" (CCSSO, 2008, p. 14). Standard 4 reiterates the function of data collection and analysis, while Standard 6 refers to an administrator function of "Assess, analyze, and anticipate emerging trends and initiatives in order to adapt leadership strategies" (CCSSO, 2008, p.15).

In both sets of standards, data-driven decision making elements are identified as a crucial determinate of effective teaching and educational leadership. The distributed nature of the data-driven decision making elements across the standards emphasizes the multifaceted nature of the essential knowledge and skills required of teachers and administrators to engage in data-driven decision making. At the same time, this distributed nature makes the evident inclusion of data-driven decision making into the structure of the teacher and administrator programs difficult to plan for, to measure effectively, and to track.

Key Theme 4: Developmental Continuum of Educator Practices

A theme that conference participants at the conference emphasized is the developmental nature of the acquisition of knowledge and skills leading to expertise in data-driven decision making. A general consensus of the participants in the conference was that expertise does not come until the practitioner has the opportunity to engage in data-driven decision making within the context in which he or she works. The questions this raised for the participants were where and when do educators need professional development in data-driven decision making, as indicated by one participant.

> Is the best time to instill these habits well before people are in practice – or is the best time to instill [them] when the people are in practice? (Gary Natriello)

Several conference participants indicated that new teachers may be better informed about data-driven decision making than some of the more experienced teachers in the schools, having engaged in the elements of data-driven decision making in their pre-service preparation.

> On the one hand, I have to say that in our experience in the last few years as there have been more retirements and new teachers coming in, we see an enthusiasm and less resistance in terms of being able to use the data and jump into it. But if they've been in their school very long, they get steeped so quickly in the culture of that school and the practice of that school that the enthusiasm disappears in very short order. (Diana Nunnaley).

The other perspective indicates that data-driven decision making is not so much a pre-service issue as it is an issue of continuing professional development, especially of teachers in the classroom. Data-driven decision making needs to be taught in courses at all levels, including the pre-service level. This perspective is based on the complexity of knowledge and skills needed to think coherently about data use. Without a toolkit of instructional strategies, a deep understanding of students and their developmental status, and an experienced understanding of schools, new teachers do not have sufficient background to effectively engage in data-driven decision making.

> I will say in terms of that a couple of people have mentioned that their younger teachers seem to take better to this, and we find contrary results in our work. We've only had one piece of one study that ever showed a difference based on experience. In fact, what we're finding is across the board it's not experience that predicts whether you take to this, it's your teaching toolkit, your abilities to do this. And, in fact, often the younger teachers are not as good at using data to inform their decisions because they're worried about things like getting to 3:30 and making sure that they can survive today so they can show up tomorrow. (Jeff Wayman)

Clearly, teachers and administrators with different preparation experiences will emerge from pre-service and leadership training programs with varying levels of knowledge and skills. As one participant noted:

> Through the tens of thousands of teachers that have gone through the process, it's quite obvious that there's a lot of variation among professionals in the system in terms of their ability to use information. (Joseph Aguerrebere)

Without clear research findings on the status of teacher and administrator preparation, the developmental nature of expertise in data-driven decision making is not certain.

Key Theme 5: Multiple Venues of Educator Development

Schools of education have multiple programmatic structures into which educator preparation in data-driven decision making will need to be integrated. Pre-service teachers are prepared in four-year undergraduate programs and in fifth-year programs where teacher certification and licensing are added to an undergraduate degree. Pre-service teachers are also prepared in graduate-level programs where they receive a master's degree in addition to certification and licensing. Most pre-service teacher preparation programs are delivered in face-to-face instructional environments, though some courses may be available online. Few pre-service programs are offered largely online. Alternative pathways into the teaching field must also be examined to flesh out the venues in which data-driven decision making preparation should be considered. Programs like Teach for America do not prepare teachers through a traditional course-based program, but embed training in actual teaching practice.

Master and doctoral degree programs are offered for in-service teachers who are full time teachers as well as graduate students. Administrator preparation programs are typically offered at the master or doctoral program levels. Participants in the conference saw these programs as being the venue in which data-driven decision making courses might be most applicable, particularly for administrator preparation. Colleges and universities also offer in-service preparation for educators that are independent of degree programs, both face-to-face and through online environments. Anecdotal evidence suggests that data-driven decision making courses are frequently taught by adjuncts who are school-based personnel with experience in data use at the school or district level

A question remains how schools of education can best prepare practitioners in a way that reflects actual teaching to deal with the complexities of learning to use data.. Related issues concern how such preparation is delivered. Will traditional courses work? Is there a need for more authentic preparation such as practica and embedded learning experiences? How much experience do educators need in order to concretize and understand the complexities? Should, and how should, courses or training differ for teachers, administrators, and superintendents? When is the best time to introduce authentic activities to minimize the abstractness of data-driven decision making? One participant indicated:

> For me, courses have the appeal of being, well, that's what we do, so that's a kind of delivery mechanism we understand, but the dilemma, sort of the question is, is the best time to instill these habits well before people are into practice, or is the time to instill these habits when people are in practice. The dilemma for courses always is, of course, a time when you don't actually get to try this out unless you're in an in-service capacity, and even there it's kind of difficult. I think that's a real limitation of the course model for sort of transferring habits of performance. (Gary Natriello)

Several of the conference participants raised the issue of whether or not typical education coursework was the proper venue in which data-driven decision making preparation should be addressed.

> [It is] an integrated approach to the work that we're talking about makes the most sense. This isn't an issue of the universities adding a course or figuring out how this course best fits into the course listings that they already have, but rather the notion that Sam [Stringfield] brought up of top-down, bottom-up. (Mickey Garrison)

Participants indicated that for teachers, the best preparation was integration throughout the pre-service program.

> What Alverno College is doing is really pretty remarkable. They don't have a course on assessment; they don't have a course on data. They have an integrated approach around the importance that assessment plays in learning, and all of their instructors actually use a meta-cognitive approach to help their students understand what they're assessing, how they're assessing, and how they then use that information to guide their instruction. In looking at, again, my role as a teacher and my role as an administrator, that is the richest design that I've at least seen to date where instead of teaching a class and figuring out what other courses are needed, you actually get faculty to look at the connection between assessment and instruction help have them model that. (Mickey Garrison)

The difference between the venue in which administrators might be prepared to use data and the venue that best suited teachers was clearly important to participants.

> I'm not fortunate enough right now to teach a teacher class because that happens in a different department in our college, but Mickey's [Garrison] thoughts about Alverno's not teaching a course on data use for teachers, but integrating it is dead on. I think administrators need a course, but I think teachers need it integrated in all their work. The critical thing, absolutely critical thing that our pre-service teachers need to learn is changing practice based on data. When we're in the field we see a lot of teachers, almost all teachers, using data, but very rarely do we see some who are adept at changing their practice based on data. Their intersection of content knowledge and data use; Jon Supovitz at Penn is doing some good thinking on this. As we go through this, we need to remember a couple of things about teachers. One, teachers use everything formatively. You give them a state test, they will turn it around and try to use it formatively. The other thing is a lot of data use that we're seeing in the schools doesn't tell teachers something that they don't already know. We need to get them some things that actually make this worthwhile to them. (Jeff Wayman)

A representative from a state-supported professional development project for administrators and teachers described how she worked with universities in partnership to develop her program. The Oregon Department of Education (ODE) has used funding from the SLDS Grants Program to develop a data-driven decision making program that they provide to multiple audiences including district administrators and teachers and educators from the regional Educational Services Districts. They started with a grass-roots approach to identify what educators felt they needed to learn. The ODE project director described the process.

> We went to the field and asked them what they wanted as far as really helping them take some next steps to close the achievement gap. And the response was resoundingly," We don't know how to use data, and we don't even know where to start." I think that it has

> to be a multitiered approach that needs to have some field-based opportunities to really help teachers and administrators at an in-service level. (Mickey Garrison)

A multistage process provides professional development in both data systems and in the use of data to inform decisions. A certification process was developed so that the capacity to disseminate training could be facilitated across the state.

> We took our trainers from Direct Access to Achievement, which was our first SLDS grant, and we had them work with university partners so that the university staff could really understand what was happening in K–12. (Mickey Garrison)

This process provided university faculty with experiences in using data that matched what educators in the schools needed to know and be able to do. In turn, the universities have partnered with ODE to incorporate elements of the training into their own programs.

> Then, also to complement the work that we've started, we're also working with universities in continuing education opportunities for administrators and teachers that are already in the field, and that's been a really wonderful partnership so that they are, the universities are, providing field-based opportunities that have again really strengthened what we've started within the work through our SLDS opportunities. (Mickey Garrison)

Key Theme 6: Schools of Education Capacity to Teach Data-Driven Decision Making

The research is clear about the need to improve educators' capacity to use data. The literature consistently discusses the lack of human capacity around data use (Choppin, 2002; Feldman & Tung, 2001; Hamilton et al., 2009; Herman & Gribbons, 2001; Ikemoto & Marsh, 2007: Mandinach, 2009; Mandinach & Honey, 2008; Mason, 2002; Miller, 2009; Wayman & Stringfield, 2006), but to date there is no empirical evidence about the prevalence of course offerings in schools of education or professional development opportunities offered by independent providers that can address the need to develop data literacy in education. One initial, limited study employing a non-representative sample of selected teacher preparation institutions suggests that they include only limited coursework for pre-service teachers on data use (Mann & Simon, 2010). Anecdotal evidence indicates that there is a lack of formal courses around data-driven decision making. However, courses are only now beginning to emerge, such as those taught by some of the conference participants. Some courses are limited to graduate-level seminars for administrators (such as Jeff Wayman), often taught by professors who are conducting research in the field. Such courses are often small in size and highly focused. Some courses have broad reach by using a virtual portal, such as one course at Wilkes University. Some courses work with current educators to directly impact their instruction (such as Rebecca Thessin). Undergraduate courses for teacher candidates seem to be sporadic, most often with instruction on data-driven practices subsumed in existing offerings such as measurement, statistics, instruction, or methods. The Mann and Simon (2010) survey was preliminary, limited, and flawed in its sampling. Their sample failed to include the institutions that produce the majority of the teaching corps within and across states. They focused primarily on a small number of the flagship state and top-ten universities.

Simply put, existing courses do not meet the growing need for training on data-driven decision making. Further, there is little reliable evidence regarding the extensiveness of courses on data-driven decision making and what schools of education are doing to respond to the new federal emphasis on this practice.

With this as a foundation, the participants questioned whether or not faculty were, themselves, sufficiently data literate to support their teaching courses on the topic.

> That partnership has really worked very well for us, and many of our universities partners have gone through a certification process within our project work to help them really, again, understand, honestly, where to find the data because they aren't that familiar with what those data are. (Mickey Garrison)

> A lot of faculty members, I think, just do not know enough about the use of data so that they might then prepare candidates who can do this effectively. They need to, of course, feel sufficiently comfortable doing that in their work so that they can model this for the candidates they're preparing, (James Cibulka)

> We really do not have the knowledge base in our field about how to prepare candidates effectively in the use of data and in a variety of other areas, and, I guess, hence the need for this conference. (James Cibulka)

Participants also questioned whether or not data-driven decision making was sufficiently important for deans of a school of education to use valuable faculty slots for a teaching position solely devoted to the topic.

> Change has been correspondingly slow, and what people look for, I think, for example, what do they always tell you when you go for an administrative job in one of these places? They always tell you how many people you can hire. I think that's because that's portrayed as the major avenue of change. You now have nine slots or six slots or three slots and during your X number of years as being associate dean, provost, whatever you are; that's how you make your mark, and it's slow going. (Gary Natriello)

Across the participant group, the conclusion was that devoting a slot solely to data-driven decision making is not in the near future for schools of education because there are too many other priority needs.

Additional questions about school of education capacity to teach data-driven decision making were not addressed by the participants. These include the following:

- Can professors who teach related topics, such as measurement, pedagogy, or statistics, satisfactorily integrate data-driven practices and concepts into their courses?
- More specifically, would statistics or measurement professors understand pedagogy or instruction in a way that would allow them to describe competently how teachers should translate the hard numbers (the data) into actionable instructional knowledge?
- Conversely, would professors who teach methods or instruction know enough statistics or measurement to make the reverse integration?

- Would schools of education be better served by hiring adjunct faculty who are knowledgeable about data-driven decision making to teach courses?
- Could schools of education look to successful models of professional development, such as the *Using Data Project* at TERC (http://usingdata.terc.edu/) or the *Data Wise Project* at Harvard (http://www.gse.harvard.edu/ppe/programs/prek-12/portfolio/data-wise.html) to inform their course offerings?
- Could these professional development specialists provide virtual course offerings for pre-service candidates because the *Using Data Project* provides both face-to-face and virtual courses for in-service educators?

There are no easy answers to these questions. The questions are complex and they address multiple levels of the systems of educator preparation.

Key Theme 7: The Systemic Nature of Data-Driven Decision Making

Simply from the brief discussion about the capacity to teach data courses, one can extrapolate how interconnected all of these key themes are. It is impossible to find a solution to the problem of how schools of education can build human capacity by examining and solving each of the issues independently. The authors encouraged the participants to consider a systems perspective beyond just considering what courses might be necessary. One participant described how other countries are addressing the issue of capacity building in the preparation of educators to use data as a systems approach.

> They prefer to use the term collective responsibility, that we are all in this together. It's the institutions, it's the schools, and if you look at how they've put together a system, it's definitely a systems approach. There's a high bar for entry into the profession. (Samuel Stringfield)

He also addressed the centrality of data as a systems approach to the complexity of education. Referring to education in systems diagram language, one participant noted:

> What data has that is so beautiful about it is that if you stop and try to say what is the education system of the U.S., [if you] create all these boxes and arrows and all that kind of stuff, there's about 20 boxes. How do you get something from the policy level to where there's a kid? What are the things that can go through that system? Goals and data are two of the very few things that you can follow through that system in a coherent pattern. I feel a sense of urgency on the part of all these ideas that we've talked about around the table to get our act together and begin to come up with some systems, to come to some professional agreement on what constitutes good practice, and to figure out mechanisms and levers for making good practice standard practice because it's not right now. (Samuel Stringfield)

The themes described above are systemic. They are interrelated in complex ways. Confusion about terminology abounds. The construct of data-driven decision making is multifaceted. Many people think that data-driven decision making in education is a synonym for assessment or, more specifically, formative assessment. Formative assessment may well be an integrated component of data-driven practice for teachers as the

interrogation of data merges with instructional design, but the InTASC (CCSSO, 2010) standards indicate the need for teachers to also become practiced in the use of data to support school improvement. For administrators, the components may differ. As indicated above, the authors have asked deans if they offer a course on data-driven decision making. The responses vary. They include a shrug – with a translation – what is that? They also include very specific responses: "Oh yes, we have courses on formative assessment or value-added modeling." The field needs to reach a common understanding of what is data-driven decision making before courses can be developed and implemented. No single course can address all of the facets of data-driven decision making and institutions of higher education need to be specific about which facets they are addressing and which they are not.

There is also confusion about what constitutes data. For example, most educators immediately gravitate to assessment and achievement data but educational data are much broader than that. They include demographics, process, perceptions, programmatic, financial, behavioral, welfare, medical, transportation, administrative, personnel, and other data sources. Data sources relate to the purpose of data use, the role of the user, and the decision being made. Different data mean different things for different users; they are role dependent. Even the same data mean different things for different users, depending on their purposes. The participants encourage schools of education to think broadly about sources of data as this will impact how courses on data-driven decision making will be conceptualized. Administrators need certain data that teachers do not need, and vice versa. These issues are likely to impact the course content for teachers, principals, superintendents, and policy makers.

The developmental continuum of pre-service teacher to graduate-level and continuing education programs also points to the systems nature of the capacity building in data-driven decision making. Questions abound here:

- When in the pre-service curriculum it is best to introduce candidates to data-driven decision making?
- Is it best to introduce the concepts later so that candidates have more knowledge into which they can contextualize the data-driven practices?
- Should the data use be subsumed within existing courses or should it be done in a stand-alone manner?
- Should data use be integrated into practica where candidates must deal with authentic data?
- How do these decisions differ for the current population of teachers who are seeking continuing education credits or pursuing a graduate degree?
- How do these decisions differ for administrative candidates?

These questions relate to other themes and issues in complex ways. In particular, they raise the issue of the best venue for educator preparation in data use. As one participant stated:

> The culture of colleges of education, not unlike higher education, is very individualistic. It's not one that brings a systemic perspective to the preparation of practitioners. (James Cibulka)

It is possible that schools of education may not be the appropriate venue for training educators in how to use data. That role may best reside with the professional development providers for current educators, not future educators. But here, too, is a systems issue. The professional development providers can only reach a small subset of current teachers, and this is dependent on interest by individual school districts and their willingness to expend valued resources to purchase such services. In order for human capacity to improve, as broadly construed by Secretary Duncan (2009a, 2009b, 2009c, 2010a, 2010b) and as defined in the NCATE recommendations (Blue Ribbon Panel, 2010), the broadest population of current and future teacher must become data literate. This cannot be left solely in the hands of the professional development providers because their scope is far too limited.

Systems Thinking and Data-Driven Decision Making

As can be extrapolated from the content of the conference, the issue of introducing courses on data-driven decision making into schools of education is not straightforward. Just because policy makers recognize the importance of building human capacity around data use, it is not a sufficient condition to affect change, although it is a necessary condition. The issue of developing, implementing, and entrenching such courses is steeped in the complexities of institutions of higher education. It is also embedded within a complex system of interrelated components that influence change and affect policy.

Because of the complexity and interrelatedness, the authors recognized the importance of adopting a systems perspective as a way by which to examine the issues around building human capacity among educators. They envision schools of education as playing an essential role in this capacity-building process, but they are not alone in this process. There are many other players that can either contribute to or impede progress. These include state and federal departments of education, professional organizations, accreditation organizations, testing companies, school districts, and even the universities in which the schools of education reside. Schools of education are complex organizations embedded in the larger context of universities. Some schools train only graduate-level students; pre-service teachers may be trained in other silos within a university. Continuing education courses that can reach current educators may be located in yet a different silo within the institution. Further, different universities are structured in different ways, allowing for limited generalizations. Identifying the leverage points to affect change is just one of the many challenges.

Schools of education do not act alone, yet they are frequently silos in institutions of higher education. They are part of a complex system with many interrelated components

that form higher education in this country. The policies of the related components or organizations will influence the actions taken by these schools and vice versa. Schools of education are also viewed as learning organizations that should evolve in response to emerging needs in the field of education and, more generally, in society. Additionally, the authors recognize the complexity of the issue at hand. To paraphrase one meeting attendee, the issue is steeped in interdependencies where the foci must be on theories of action for data use, for using data to improve teaching and learning, for school improvement, and for improving teaching practice. This is a complex enterprise. This paper therefore is grounded in the principles of systems thinking to help gain a more comprehensive understanding of a complex issue.

Schools of Education as Learning Organizations

Fundamental to an understanding of the issue is that schools of education must act as learning organizations. They are also silos within larger organizations. They must adapt to new ideas by introducing new course offerings. They can no longer stagnate in the status quo of providing the same products and services that they have for the past decades. They must respond to emerging trends and needs identified by policy makers, professional organizations, researchers, and current practitioners. Just as the institutions must adapt, so must the curricula and the faculty. The identification of an emerging field provides the opportunity for schools of education to become learning organizations in response to an established need. This is the opportunity provided by data-driven driven decision making. The field of data-driven decision making falls between the cracks of traditional courses. It is not introductory statistics or measurement; it is not instruction, pedagogy, or methods. Data-driven decision making lies at the intersection of those courses. Course offerings need to be modified and/or supplemented. Faculty must be identified who can teach new courses or existing courses with new content. This requires a process of organizational introspection on how to affect such changes.

Senge (1990) identifies five necessary components of a learning organization: personal mastery, mental models, shared vision, team learning, and systems thinking. Four of the components are especially relevant here. First, there must be a shared vision for the desired direction of the organization. Therefore, integrating a new course such as data-driven decision making requires a level of commitment from the relevant faculty and administrators. Second, there needs to be a mental model or vision for what the course might look like. Third, there is a need for team learning. In this instance, that may translate into collaboration among faculty and administrators to develop a stand-alone course, a suite of courses, or embed data-driven concepts into existing courses. It may also translate into the use of emerging technologies such as virtual courses to reach broader audiences.

Fourth, systems thinking serves an integrative function for the other four components. It allows organizations to focus on the whole, rather than individual components. With systems thinking, organizations examine the structure or the interrelationships and interactions among components that influence behavior over time. It captures the dynamic nature of phenomena as they evolve. It recognizes the hierarchical nature of

phenomena and their multiple levels, such as school districts (Mandinach & Cline; 1994; Mandinach, Rivas, Light, & Heinze, 2006; Senge, 1990; Senge, Cambron-McCabe, Lucas, Smith, Dutton, & Kleiner, 2000; Williams & Hummelbrunner, 2011). There are events, patterns of behavior, and systemic structure, the most generative level of explanation. Systems thinking looks for the underlying causes of behavior that can be changed. It helps organizations to identify leverage points and determine where and when actions can be taken at the right time and place to affect change. It focuses on the examination of processes, rather than snapshots; looking at the dynamic, rather than the static. Senge's framework examines wholes with respect to change, and looks at the complexity, identifying underlying structures and causes. Systems thinking also relies on the systematic collection and analysis of data for self-reflection: data-driven decision making turned on its side. Systems thinking considers the consequences of decisions, so it is like turning data-driven decision making back on itself

Through the discipline of systems thinking, organizations and people can examine complex phenomena and diagnose patterns of behavior to understand the underlying causes by organizing the complexity into a coherent depiction. It helps organizations and people to understand their assumptions and challenge their thinking about why things are the way they are (Senge, Ross, Kleiner, Roberts, & Roth, 1999). The tools of systems thinking enable people to wade through the plethora of information, understand what is important, and identify the leverage points to change. This is precisely the issue of this conference: the leverage point to change for schools of education with respect to data-driven decision making.

One might argue that heretofore schools of education have not been learning organizations. They are not data-driven institutions. They have not used data to inform their practice. They have not formally been held accountable by data and hard evidence about their effectiveness and performance. Only recently have there been discussions and activities to hold schools of education accountable. The U.S. Department of Education is seeking to link student and teacher performance and then tie those results back to the teacher preparation programs. Such linking of data for evaluative purposes is part of the Race To the Top program (U. S. Department of Education, 2010). U. S. News & World Report and the National Council on Teacher Quality (2011) are conducting a study that will rank and evaluate teacher preparation programs and schools of education. One can safely say that both of these efforts are contentious at best and have stimulated substantial outcry and attention (Gabriel, 2011). In order for schools of education to be true learning organizations, however, they must become data-driven institutions in which they use data to inform and improve practice.

> If we want colleges of education to operate as high-performing organizations, and we want schools to be high-performing organizations, then the accreditor needs to embrace the principles of continuous improvement, and it needs to move away from a compliance model that assumes that it has all of the answers and instead uses a model focused upon continuous improvement in research and development. (James Cibulka)

It is through this change process and this lens that conference participants contextualized the systemic nature of introducing data-driven decision making into the curricula offered by schools of education.

Application of Systems Thinking to the Identified Complexities

The authors have emphasized two fundamental premises that this paper has explicated. First, data-driven decision making must become part of an educator's preparation. Educators must receive systemic training in how to use data, preferably beginning in their pre-service years, but continuing throughout their careers. Second, schools of education are the appropriate venue in which the needed educational experiences must occur. Whether in pre-service, graduate, or continuing education programs, schools of education must find ways to integrate data-driven practices and principals into the training of educators.

As this document has noted, because of the complexity of the issue of integrating data-driven decision making courses into institutions of higher education and the interrelatedness of relevant other organizations, it is necessary to examine the topic through the lens of systems thinking. Further, schools of education need to be considered learning organizations, although they are frequently silos within a larger organization. As such, there is a need for organizational introspection and the examination of data to determine how to respond to the emerging need to provide data-driven courses. The schools of education are just one component among many that can and must play a fundamental role in developing and delivering courses to build educators' capacity around data use.

A first major player in the system is government agencies, both at the state and federal levels. To date, federal policy makers have spoken widely about the importance of data to improve education (Duncan, 2009a, 2009b, 2009c; Easton, 2009) and the need for all educators to use data effectively to inform their practice (Duncan, 2010a, 2010b). The discourse at the federal level has yet to move beyond rhetoric to mandates. Nor has there been any federal programs implemented that focus on the development of educators' capacity to use data. There is a need for such a next step.

States have leverage in terms of requiring educators to be trained to use data as part of standards or licensing and certification requirements. The Data Quality Campaign (2011a) released its Data for Action 2010 survey of the directors of the statewide longitudinal data systems. Action 9 focuses on how states are promoting professional development and credentialing. Only one state, Florida, has attained the Action. All other states are slowly making progress. As noted above, data-driven decision making is part of the certification/licensure process for teachers in 14 states, for principals in 15 states, and for superintendents in 14 states. The state education agency (SEA) encourages training for teachers in 29 states, for principals in 26 states, and for superintendents in 22 states. The SEA provides on-site training in data (as defined by data that reside in the SLDS) in slightly more states (32, 27, and 23 respectively). Only four states provide funding for training on data. The Data Quality Campaign highlights

three states (Oregon, Louisiana, and New Hampshire) for their models of training educators. The Louisiana model focuses on value-added assessments. The Oregon and New Hampshire models are more generic to build capacity to use data. The New Hampshire Department of Education is even reaching out to universities to work with them in training pre-service candidates (Data Quality Campaign, 2011b). The authors know other states are doing similar training with slightly different models and foci (e.g., Arkansas training on formative assessment and has even integrated these data into their SLDS; Kansas using some of their SLDS funds to send a professional development expert to districts to train on data generically).

The authors note missed opportunities for states to have an impact on the issue. Although states are progressing, the progress is slow and is hindered by lack of resources. Further, the capacity building is around data that reside in the SLDS. Those data are, admittedly, limited and serve more for the purpose of accountability than for continuous improvement. Training is not broadly construed, but limited to a small subset of data elements. Additionally, the training, however limited, is for the current cohort of teachers, not for pre-service candidates. Most important, states have missed the opportunity to require data-driven competency as part of the licensure and certification processes. That is perhaps the most critical leverage point they can use.

Professional organizations such as NCATE, NBPTS, and American Association of Colleges for Teacher Education (AACTE) play a key role in promoting the need for all educators to become data literate. NCATE's Blue Ribbon Panel (2010) has taken a major step by putting forth two recommendations around data use. They released a comprehensive set of recommendations about what teacher preparation should look like in the future. The recommendations are far-reaching and have a direct impact on training educators to use data. The approach, termed clinical preparation, is modeled after medical training. The Panel states that teacher candidates "need to have opportunities to reflect upon and think about what they do, how they make decisions, and how they 'theorize' their work, and how they integrate their content knowledge and pedagogical knowledge into what they do" (p. 9). As noted earlier, the report further espouses the notion that teacher preparation must provide "the opportunity to make decisions and to develop skills to analyze student needs and adjust practices using student performance data while receiving continuous monitoring and feedback from mentors" (p. 10). These are the principles of data-driven decision making and continuous improvement applied to teacher preparation and to practice.

Two of the Panel's 10 design principles relate directly to data-driven practice. The first principle speaks to skills and knowledge teachers need to obtain.

> Candidates must develop a base of knowledge, a broad range of effective teaching practices, and the ability to integrate the two to support professional decision making. To be successful teachers in challenging and changing environments, candidates must learn to use multiple assessment processes to advance learning and inform their practice with data to differentiate their teaching to match their students' progress. Further, effective teachers are innovators and problem solvers, working with colleagues constantly seeking new and different ways of teaching students who are struggling. (p. 5)

The second principle espouses the role schools of education.

> Those who lead the next generation of teacher throughout their preparation and induction must themselves be effective practitioners, skilled in differentiating instruction, proficient in using assessment to monitor learning and provide feedback, persistent searchers for data to guide and adjust practice, and exhibitors of the skills of clinical education. (p. 6)

It is recommendations like these that can serve as important levers to affect change in what schools of education do to address the capacity issue for current and future teachers. The changes required in schools of education are complex and systemic, as noted by one participant:

> What we have in place at the present time as a delivery system is just too variable as Sam [Stringfield] was saying. It's unacceptably variable. As we've thought about this challenge at NCATE and CAEP [Council for Accreditation of Teacher Preparation] as we move forward, it's our perspective that it's more than a matter of just course redesign. I think we have to really look at a redesign of the entire way that we prepare teachers. It needs to be a much more clinical model that weaves together opportunities to practice along with theoretical instruction. It needs to focus much more on preparing people to operate in teams, in differentiated kinds of roles and responsibilities, and it needs to be done in much stronger partnership with schools, drawing on the expertise that is in the schools, sharing authority between higher education and the schools, new working relationships, new ways of developing the qualifications of clinical educators whether they come from higher education or from the schools. There are a whole series of things that are implied by this partnership model that we believe is necessary. The ability to use data effectively on the part of the candidates I don't think is going to occur without this more fundamental transformation that has to occur. (James Cibulka).

But perhaps recommendations are not sufficient. It is possible that recommendations must be transformed into requirements, and that necessitates collaboration with and action from the SEA. Thus, there is another critical link in the systems model. The requirements put emphasis on the development of assessments of educator candidates and evaluation of teacher education programs. As one participant indicated:

> It is a challenge to change the cultural as well as the skill sets both in higher education and in the schools. These are mutually reinforcing problems. Just looking at schools of education first, NCATE, for some time, has tried to change the culture of colleges of education by getting them to focus on assessment data on their candidates. It shifted our accreditation system beginning in 2000, to a performance-based one. I think NCATE has changed the culture of the schools it accredits to some degree. There is now recognition that individual faculty members do not entirely own courses, that there is some responsibility for the development of the skills, knowledge, dispositions of the candidates that is shared, but we're far from where we need to be in that regard. (James Cibulka)

> What can the accreditor do in the face of the need to fundamentally transform preparatory systems? Certainly, it can set higher expectations through its standards, and that's what we intend to do. That's really what the Blue Ribbon Panel report was very much about, trying to set the expectations for that without using a sledgehammer. (James Cibulka)

> Accreditation can play its part by allowing colleges of education that have the research capacity to develop research and development projects that demonstrate how to effectively prepare educators in this manner. The other side of the coin is the continuous improvement in this new redesign system has to move all of the programs toward excellence and away from a definition of adequacy, which is really what accreditation has been about in the past, protecting the public from violations of practice which is an adequacy standard, and I don't think that really is sufficient any longer. (James Cibulka)

Preparation in data-driven decision making is not just an issue at the beginning of a teacher's career. The lever of assessment of teachers' knowledge and skill also calls for the development of capacity in data-driven decision making. As one participant noted:

> I think there are a lot of things that can be done right now. Certainly, we've seen from teachers that go through the National Board Certification process and have to have a minimum of three years of teaching before they are eligible, the achievement rate has historically been around 40%. It's an evidenced-based, standards-based process, so what it tells us, to a certain degree, is that the majority of teachers, have a difficult time trying to identify the evidence that is appropriate to support the fact that they have met particular standards. What we've been thinking about at the National Board is developing an e-portfolio, something that actually stays with teachers throughout their career that might start at the pre-service stage, but gets added on to over time. (Joseph Aguerrebere)

At the pre-service level, inclusion of data-driven decision making across the program provides the opportunity to examine how teachers' knowledge and skills develop. The portfolio assessment of teacher candidates is a process that AACTE is currently developing in partnership with a number of states. As one participant reported:

> We're experimenting with something that I think has the potential to be a powerful lever of change: performance assessment inside the program for the candidates. But using performance assessment is not a plug-in tool. It has to be something that is integrated across the program. Initiating use of performance assessment is the occasion for collaboration and discussion involving all those who participate in program delivery. I hear from the programs that are involved in this work that performance assessment of candidate practice provides data that are very informative regarding program improvements. (Sharon Robinson).

Developing mechanisms to demonstrate expertise in data use is not just an issue for teachers. The NBPTS is currently developing ways to examine how board-certified principals might document their knowledge and skills in an e-portfolio, as was indicated by one participant.

> In fact, with our principal certification, field test, they are starting that way from scratch. We're asking principals to do certain kinds of things, like surveys of parents, surveys of teachers and students, etc.. All of it is done electronically and scored electronically. The idea is to take advantage of the technology that is available. (Joseph Aguerrebere)

Coupled with the development of new ways to document teacher and principal knowledge and skills is the identification of professional development that educators need.

> The other thing that we're trying to do, and that is to start to look in the aggregate at how teachers are performing through the assessment experiences that we're asking them to go through, and, based on that, trying to develop certain kinds of PD experiences that will help address particular issues. (Joseph Aguerrebere)

Another key link is the testing organizations that develop examinations that educators must take in order to practice. To date, data-driven decision making is not part of the *PRAXIS* tests administered by Educational Testing Service (ETS). There is, however, the *School Leaders Licensure Assessment* that requires the analysis of information and decision making. This component is one of three two-hour modules. Interestingly, the data presented in them are varied, including assessments, school improvement plans, budgets, schedules, resource allocation, staff evaluations, and curriculum information (ETS, 2005). The authors maintain that if data-driven decision making is required on tests for teachers and administrators, schools of education will be forced to respond by teaching to the test. ETS will build such assessments if professional organizations and state departments of education require such skills and knowledge.

Yet another component in the system is the school districts and their educators. They are the stakeholders in the trenches actually carrying out the requirements. They are the educators who are lacking the skills and knowledge around data use, but who must quickly acquire the capacity to use data effectively. They can pressure schools of education to help them address the capacity issue. Many districts do not have the resources or the internal capacity to implement broad-scale professional development on data-driven decision making. Districts can look to schools of education for continuing education courses and graduate courses for their current staff. They can look to the schools of education to produce new teachers who have data skills. They can hold institutions of higher education accountable for delivering to them graduates who show competence in data use. Districts can require candidates for positions to demonstrate data literacy as a requirement of the hiring process (Long et al., 2008).

Schools of education play the essential role in building the capacity of educators to use data. But they are influenced and affected by the state and federal governments and the professional organizations, as well as the testing companies, and the school districts that employ their students as new teachers and administrators. It is clear that schools of education cannot and will not make the needed changes on their own. Change comes slowly and painstakingly. It requires the necessary stimuli and motivation that come from all of the identified components. And even with identified need, there are still hurdles to be overcome. These may include funding for a faculty position, finding qualified individuals to teach the course, finding a place within the course offerings for data, making decisions about stand-alone courses versus embedded courses, and other challenges. Schools of education may choose to look to the professional development providers for assistance. They may look to adjunct faculty or to existing or new faculty. They may consider virtual courses, hybrids, or more traditional courses. Schools of education need to consider the developmental continuum and design courses that are appropriate for educators at all phases of their careers and for different roles. These are

all complex issues that require thought about the appropriate development, implementation, and integration. It requires a systems perspective.

Recommendations and Next Steps

Recommendations and take-away messages from the meeting focused on four topics:
(a) the research needed to support the building of human capacity;
(b) the changes to educational practice that need to occur;
(c) the need for the field to conceptualize the developmental continuum of educators at various stages of their careers; and
(d) what can be accomplished through a more focused conference as a follow-up to this meeting.

Needed Research

The meeting identified gaps in the field's knowledge about data-driven decision making. There were no surprises. The identified research needs were consistent with the authors' knowledge of the field. First and foremost, there is no credible evidence about the pervasiveness of courses on data-driven decision making in institutions of higher education. The field simply does not know what courses exist and if and how schools of education are attempting to address the growing need to build human capacity around data use. Mann and Simon (2010), two graduate students at the George Washington University, conducted a small-scale survey of a limited and unsystematic sample of institutions. Because of the limits of the sampling, the results from that survey are quite suspect.

It was clear from discussion at the meeting that there is a need for a scientific and comprehensive survey and inventory of the existence of courses and the extent to which data-driven practices are integrated into existing courses is needed. Additionally, it is necessary to understand how SEAs are dealing with the issue. The field needs to know if there are accreditation and licensure requirements issued by the SEAs, how those requirements are being implemented, and how institutions of higher education are responding. Multiple participants agreed with the following description of what research needs to be done.

> I would suggest that there are a few things we can do. We can inventory. We can look around among our colleagues and find out who is doing this even though 'this' isn't well defined. Who is teaching at any level, at any level of specificity teachers... to go into the classroom and use data? Who's doing it, whether it's inservice that's coming after the fact or pre-service? We can also then take a look at the curriculum that those people...are using, what is the curriculum they're using? What is the combination of statistics and educational theory? What is the blend of technology vs. just pen and paper? Then, it seems once we have those sorts of things in hand, we can begin to bring some people into the room who understand these things, get some robust discussion and debate about, maybe not the very best way of doing it, but what are the best ways, plural, of teaching the subject? (Patrick Sherrill)
>
> What I'd like to suggest is that the reason you need an inventory is because you need to find those few programs that are out there, those few professors that are out there, that

> are actually helping students to become prepared to deal with data in the classroom and that then, when those students go out, they are making a difference. If a first-year student is able to perform more effectively because they are able to use data more effectively in finding each of their charges, meeting the needs of the individuals they are charged in teaching, then I think you're going to create the demand for replicating that curricula, that program. Until that happens, it's going to continue on as it is or what they're used to. (Patrick Sherrill)

The information from such a comprehensive survey and inventory will provide fundamental data from which policy organizations and schools of education can build and respond. Currently, the field has only anecdotal information that is insufficient and even inappropriate, given that this document is emphasizing the importance of data-driven practice.

There is a need for hard evidence that can provide the stimulus and impetus for action on the development and implementation of courses on data-driven decision making.

> There is no reason why institutions like the University of Memphis, Teachers College, the University of Louisville should not have an opportunity to engage in research-based interventions to demonstrate how they are preparing the new generation of candidates who can use data to improve student performance. That type of project can lead to tremendous advances in our knowledge of best practices and can then be used to leverage further changes in our standards as our knowledge base increases. We have transformation initiatives that are part of our reaccreditation process, and I see these as increasingly important drivers as we move ahead. (James Cibulka)

Educators also need to understand the theories of action that impact the use of data. As one attendee commented at the end of the conference:

> I think my title [for the report] would be... from data use to theories of action for using data to improve ... theories of action for improving teaching and learning, theories of action for using data for school improvement, theories of action using data collectively to change and teaching practices [many voices]. We should try and use today's conversation to spin out what those different theories really are because, as I said, I hear people using the term "data use," but really talking about different things. They're all "data use," they all involve use of evidence, but what the goal is, what the most relevant evidence is, what the skills you need to use that evidence, and the context of use are really are different (Joan Herman).

In parallel to the need to understand the theories of action, another related line of research that is needed is to understand the impact of training teachers to use data. In all the studies examined during the IES Practice Guide process, there was a dearth of evidence about the impact of providing professional development or training on data-driven practice on teacher behavior and student performance. The field assumes that training teachers to use data will impact what they do in their practice and classrooms and ultimately improve student performance. But this logic model has not yet been tested and evidence is needed to address this issue.

Issues Around Practice

There are several issues that impact practice that need to be addressed and better understood. First and foremost, there needs to be an alignment between what districts, schools, and educators actually do and need and the actions that schools of education might take to integrate data-driven practices into educator preparation programs. It would be remiss to make changes without consulting the ultimate stakeholders and end users – the local education agencies (LEAs). Schools of education must be responsive to those needs, whether adapting their course offerings or providing outreach through continuing education opportunities.

Practice is influenced by many components within the education system. The field needs to explore what role the federal government might play beyond making public policy statements about the need for educators to be data literate. Might there be provisions for helping to train the current cohort of educators, rather than placing the onus on already overburdened LEA budgets? What else can the U.S. Department of Education do? The field needs to explore the role that the SEAs can play in setting policy and developing and mandating licensure and certification requirements for all educators. Can and will the SEAs require that educator preparation programs offer training on data use? Will schools of education be held accountable for their graduates to show evidence of data literacy? Can and will testing organizations introduce components of assessments that measure data use and data literacy? Will such requirements stimulate change throughout the education system and impact practice?

Understanding Developmental Needs of Educators

Much of the discussion during the meeting revolved around trying to understand the differing needs of diverse groups of educators in terms of preparation for data-driven practice. Pre-service teacher candidates have different needs from masters' level students. Administrators have different needs from teachers. It is possible that administrators at the school, district, and state levels also have different needs. Course offerings, therefore, need to accommodate the diversity of needs around the learning progressions in the field. It is clear that there is no one-size-fits-all model for data-driven decision making. For example, it may be preferable to integrate data use into existing courses for undergraduates and provide it as part of the practica in the last years of coursework. For graduate students and administrators, stand-alone courses may be more viable. In fact, the issue is far more complex that the authors originally imagined and there is a need for greater understanding of the specific needs and how those translate into the types of courses best aligned for particular segments of the education population.

Thus, there is a need for further discussion and investigation about how the needs along the developmental continuum translate into potential course offerings. This was clearly an issue for the representative of one of the accrediting agencies:

> One of the things that we will very much need help on in the next two years as we set the new standards is what exactly are the expectations for candidate performance in this area of using data? What precisely do you believe we should require the programs to demonstrate that their candidates are able to do in this area? We have some influence on

> then trying to align that with licensure standards because there is a growing interest in reforming licensure so that it reflects more than just a minimal sort of expectations. Another thing you can help us do [as] we set these standards is articulate exactly [what] these standards and expectations ought to be for clinical educators, those in the academy, in schools of education as well as those coming from the schools, who are to work in collaboration with the higher-education providers in this new partnership model. (James Cibulka)

Those responsible for educator preparation need to talk to professors who specialize in pre-service curricula to understand how data-driven practices can best be integrated into coursework. Faculty need to understand how authentic activities can be infused with data-driven decision making. Educators need to determine if stand-alone courses or integrated courses are the best option for graduate-level teacher and administrator preparation, as well as understanding the content and nature of the courses. They also need to understand how data-driven decision making can be infused into continuing education offerings in a division of institutions of higher education that are not within the jurisdiction of schools of education. It is perhaps the continuing education area that provides the biggest opportunity for universities because the existing teacher and administrator cohorts need to be trained to use data effectively. The possibility for virtual courses presents a very real opportunity for universities, with broad outreach and potentially smaller costs than face-to-face courses.

Strengthen the Discourse Around Educator Preparation

One clear message that can be extracted from the brainstorming meeting is just how complex an issue it is to try and introduce data-driven courses into educators' preparation. First, there was no agreement where and how data-driven courses can and should be integrated into course work. This is, in part, because of the developmental continuum across pre-service to in-service, and teachers to administrators. Second, the location and venue for such courses will differ, depending on the student. In many institutions of higher education, pre-service teacher preparation occurs in a department outside of a school of education, as does continuing education courses. There is no one model for where in a university the focus must be. It must be multifocal. Third, there is no empirical base for understanding the current state of the field. That is, there was a direct mandate to survey or catalogue current practices in institutions of higher education to determine if there are courses or not, if there are requirements, and what role the SEAs are playing in stimulating universities to respond to requirements. Fourth, schools of education are autonomous, thereby making it almost impossible to introduce a new line of courses unless there is a perceived pressing need and certain systemic changes occur. Fifth and foremost, because of the complexity of the issue, nothing is going to happen until there is a mandate that requires educators to demonstrate data literacy for which schools of education are held accountable.

The February 7 meeting provided a surface view of the issues. It is clear that another meeting is needed. This meeting should bring together some of the same attendees, but extend beyond to SEAs. The meeting should provide an opportunity to dig deeper to understand the specific constraints that challenge the development and integration of

data-driven coursework. It should engage the SEA staff in a discussion of the need for requiring data literacy among the states' educators at all levels, from teacher to principal, to superintendent, as well as leveraging SEA power to affect change in schools of education. It also needs engagement from the U.S. Department of Education, beyond the public statements made by high-ranking officials. The meeting must further explore the implications of the developmental continuum, trying to determine how best to introduce data concepts to pre-service candidates while concretizing data literacy in administrative candidates.

One possible venue for such a meeting is to convene a Wingspread Conference. The Spencer Foundation underwrote part of the cost of a Wingspread meeting in 2005 and its concept papers that became *Data-Driven School Improvement: Linking Data and Learning* (Mandinach & Honey, 2008). Such a meeting would provide an intensive and uninterrupted venue in which a select group of participants could devote two-three days in which all aspects of the issue could be explored in an in-depth manner, with the outcome being concrete action steps from which progress can be made. Bringing together stakeholders who can make action happen is not inexpensive. The outcome would be the development, engagement, and implementation of a systemic and strategic plan, rather than haphazard, tactical, and reactive action. If the field is left to a piecemeal approach to action, nothing is going to happen and little, if any, progress will be realized. This issue requires buy-in from many, at different levels, and from varied organizations. Obtaining that agreement requires leveraging at the appropriate sources of influence. It will not be easy because of the interdependencies and complexities, but it is possible.

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Appendix A: Appendix A: InTASC Standards Associated with Data Use

Standard 6: Application of Content

The teacher understands how to connect concepts and use differing perspectives to engage learners in critical/creative thinking and collaborative problem solving related to authentic local and global issues.

Performances

(c) The teacher develops and implements relevant learning experiences and authentic assessments incorporating contemporary tools and resources to maximize content learning in varied contexts.
(f) The teacher consciously builds student capacity to collaborate in face-to-face and virtual environments through applying effective interpersonal communication skills.
(g) The teacher engages students in generating and evaluating new ideas and novel approaches, seeking inventive solutions to problems, and developing original work.
(h) The teacher facilitates students' ability to develop diverse social and cultural perspectives that expand their understanding of local and global issues and create novel inclusive approaches to solving problems.

Essential Knowledge.

(l) The teacher understands the demands of accessing and managing information as well as how to evaluate issues of ethics and quality related to information and its use.
(r) The teacher knows how to seek information about social and cultural diversity and how to teach students how to access this information and evaluate its accuracy. (CCSSO, 2011 p.14)

Standard 6: Assessment

The teacher understands and uses multiple methods of assessment to engage learners in their own growth, to document learner progress, and to inform the teacher's ongoing planning and instruction.

Performances

(a) The teacher designs formative assessments that match learning objectives with assessment formats to engage learners in demonstrating knowledge and skills.
(b) The teacher works independently and collaboratively to examine test and other performance data to understand students' progress and to guide planning.
(c) The teacher engages students in understanding and identifying quality work and provides them with effective descriptive feedback to guide their progress toward that work.
(d) The teacher models and structures processes that guide students in examining their own thinking and learning as well as the performance of others.

(e) The teacher effectively uses multiple and appropriate types of assessment data to identify student learning needs and to develop differentiated learning experiences.
(f) The teacher prepares all students for the demands of particular assessment formats and appropriately modifies assessments or testing conditions for English language learners, students with disabilities, and students who are above grade level.
(g) The teacher continually seeks innovative ways to employ technology to support assessment practice both to engage students more fully and to assess and address student needs.

Essential Knowledge

(h) The teacher understands the range of types and multiple purposes of assessment and how to design, adapt, or select appropriate assessments to address specific learning goals and individual differences.
(i) The teacher knows how to analyze and interpret various kinds of student data to guide planning and instruction and to provide meaningful feedback to each learner.
(j) The teacher understands the positive impact of effective descriptive feedback for learners and knows a variety of strategies for communicating this feedback.
(k) The teacher understands how examining one's own thinking deepens learning, and knows how to engage students in this metacognitive process.
(l) The teacher understands how to prepare students for assessments and how to modify assessments and testing conditions for students with exceptionalities and English language learner needs.

Critical Dispositions

(m) The teacher is committed to engaging students actively in assessment processes and in reviewing their own progress and learning.
(n) The teacher takes professional responsibility for aligning learning goals with instruction and assessment.
(o) The teacher is committed to providing timely and effective descriptive feedback to students on their progress.
(p) The teacher is committed to using multiple types of assessment processes to support and document learning.
(q) The teacher is committed to modifying assessments and testing conditions for English language learners and students with exceptional learning needs.
(r) The teacher is committed to the ethical use of various assessments and assessment data to identify student strengths and needs to promote student growth. (CCSSO, 2011 p.15)

Standard 7: Planning for Instruction

The teacher draws upon knowledge of content areas, cross-disciplinary skills, learners, the community, and pedagogy to plan instruction that supports every student in meeting rigorous learning goals.

Performances

c) The teacher evaluates plans in relation to short- and long-range goals and systematically adjusts plans to meet each student's needs and enhance learning.

Essential Knowledge

(n) The teacher believes that plans must always be open to adjustment and revision based on student needs and changing circumstances. (CCSSO, 2011 p.16)

Standard 8: Instructional Strategies

The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to access and appropriately apply information.

Performances

(b) The teacher continuously monitors student learning, engages students in assessing their progress, and adjusts instruction in response to student learning needs.

(d) The teacher varies his or her role in the instructional process (e.g., instructor, facilitator, coach, audience) in relation to the content and purposes of instruction and the needs of students.

(i) The teacher listens effectively to decipher meaning, including knowledge, values, attitudes and intentions and responds appropriately.

Essential Knowledge

(n) The teacher knows when and how to use appropriate strategies to differentiate instruction and engage all students in complex thinking and meaningful tasks.

Critical Dispositions

(w) The teacher values flexibility and reciprocity in the teaching process as necessary for adapting instruction to student responses, ideas, and needs. (CCSSO, 2011 p.17)

Standard 9: Reflection and Continuous Growth

The teacher is a reflective practitioner who uses evidence to continually evaluate his/her practice, particularly the effects of his/her choices and actions on others (students, families, and other professionals in the learning community), and adapts practice to meet the needs of each learner.

Performances

(a) Independently and in collaboration with colleagues, the teacher uses a variety of data (e.g., systematic observation, information about students, and research) to evaluate the outcomes of teaching and learning and to reflect on and adapt planning and practice.

(d) The teacher advocates, models and teaches safe, legal, and ethical use of information and technology including respect for intellectual property, and the appropriate documentation of sources, and the appropriate management of ethical boundaries with students.

Essential Knowledge

(g) The teacher understands and knows how to use a variety of self-assessment and problem-solving strategies to reflect on his/her practice, its influences on students' growth and learning, and the complex interactions between them.

(h) The teacher knows how to analyze his/her practice based on research and student data and how to adapt and differentiate instruction based on thoughtful reflection. (CCSSO, 2011 p.18)

Standard 10: Collaboration

The teacher collaborates with students, families, colleagues, other professionals, and community members to share responsibility for student growth and development, learning, and well-being.

Performances

b) The teacher engages collaboratively in the schoolwide effort to build a shared vision and supportive culture, identify common goals, and monitor and evaluate progress toward those goals.

(c) The teacher participates actively as part of an instructional team, giving and receiving feedback on practice, examining student work, analyzing data from multiple sources, and sharing responsibility for decision making and accountability for each student's learning. (CCSSO, 2011 p.19)

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Appendix B: Participants, February 7, 2011

Joseph Aguerrebere	President	The National Board of Professional Teaching Standards (NBPTS)
Linda Cavalluzzo	Research Director	CNA Education
James Cibulka	President	National Council for Accreditation of Teacher Education (NCATE)
Mickey Garrison	Director of School Improvement	Oregon Education Enterprise Steering Committee
Edith Gummer	Director, Classroom-Focused Research and Evaluation Program	Education Northwest
Joan Herman	Director	National Center for Research on Evaluation, Standards, and Student Testing (CRESST), University of California at Los Angeles
Laura Holian	Research Analyst	CNA Education
Paige Kowalski	Director, Policy Initiatives	Data Quality Campaign (DQC)
Ellen Mandinach	Senior Research Scientist	WestEd
Barbara Means	Co-Director	Center for Technology in Learning, SRI International
Robert Muller	Vice President	CNA Education
Gary Natriello	Gottesman Professor of Educational Research and Professor of Sociology and Education	Department of Human Development, Teachers College, Columbia University
Diana Nunnaley,	Project Director, *Using Data Project*	TERC
Chris Padilla	Senior Policy Analyst	Center for Education Policy, SRI International
Ernest Rakow	Associate Dean for Administration & Graduate Studies	College of Education, University of Memphis
Sharon Robinson	President	American Association of Colleges of Teacher Education (AACTE)
Terri Duggan Schwartzbeck	Program Manager	CNA Education
Patrick Sherrill	Project Manager, EDFacts	U.S. Department of Education
Samuel Stringfield	Professor and Distinguished University Scholar	College of Education, University of Louisville
Rebecca Thessin	Assistant Professor of Educational Administration	Graduate School of Education and Human Development, The George Washington University
Jeff Wayman	Assistant Professor, Educational Administration	College of Education, University of Texas at Austin
Brandi Weiss	Assistant Professor of Quantitative Research Methods	Department of Educational Leadership, Graduate School of Education and Human Development, The George Washington University
Rebecca Zwick	Distinguished Presidential Appointee	Educational Testing Service

Appendix C: Participant Information, February 7, 2011

Joseph Aguerrebere, President, The National Board of Professional Teaching Standards (NBPTS). NBPTS is an independent, nonprofit organization that advances the quality of teaching and learning by establishing a rigorous national system for certifying teachers who meet high standards of accomplished teaching. Dr. Aguerrebere has spoken on the topic of helping educators to become data literate.

Dr. Linda Cavalluzzo is Research Director of CNA Education, a senior economist with extensive experience in the design, execution and management of research studies in K-12 education, one of which is a randomized controlled trial to examine the impact of training teachers to use data on classroom practices and student performance. Her work focuses on teacher effectiveness and the collection, analysis and use of data to inform education policy and practice.

James Cibulka, President, National Council for Accreditation of Teacher Education (NCATE). NCATE is the profession's mechanism to help establish high-quality teacher preparation. NCATE's performance-based system of accreditation fosters competent classroom teachers and other educators who work to improve the education of all P-12 students. Dr. Cibulka has recently released a set of recommendations for the clinical training of educators that includes data-driven decision making as an essential component.

Mickey Garrison, Director of School Improvement, Oregon Education Enterprise Steering Committee. The OEESC is a partnership between the Oregon Governor's Office, the Oregon Department of Education, the Oregon University System, K-12 education and the Oregon Association of Education Service Districts in an effort to increase statewide capacity for school improvement where Garrison supports the state's Direct Access to Achievement (DATA) Project.

Edith Gummer, Meeting Facilitator and Director, Classroom-Focused Research and Evaluation Program, Education Northwest. Dr. Gummer is an expert on the use of formative assessments to inform classroom practice. She also has been working in the area of state-level, data-driven decision making as part of her work at the Regional Laboratory Northwest.

Joan Herman, Director of the National Center for Research on Evaluation, Standards, and Student Testing (CRESST), University of California at Los Angeles. Dr. Herman is one of the foremost experts in educational measurement in the country. She has written on educators' use of data.

Laura Holian, Research Analyst, CNA Education. Dr. Holian is working on CNA's randomized controlled trial to examine the impact of training teachers to use data on classroom practices and student performance.

Paige Kowalski, Director, Policy Initiatives, Data Quality Campaign. The Data Quality Campaign (DQC) is a national, collaborative effort to encourage and support state policymakers to improve the availability and use of high-quality education data to

improve student achievement. Ms. Kowalski oversees the DQC's annual survey that contains one component focusing on the capacity to use data for decision making.

Ellen Mandinach, Meeting Facilitator and Senior Research Scientist, WestEd. Dr. Mandinach is one of the foremost experts in the area of data-driven decision making, working at the state, district, and classroom level. She is an author of the IES Practice Guide on data-driven decision making and has published widely on the topic. She is the co-Principal Investigator on an IES-funded study to examine the impact of training teachers to use data.

Barbara Means, Co-Director, Center for Technology in Learning, SRI International. Dr. Means has conducted a national project on the technologies to support data-driven decision making and has published two widely cited and seminal US Department of Education reports on the topic.

Robert Muller, project director, is Vice President of CNA Education and Director of the Regional Educational Laboratory, Appalachia. CNA works with clients and stakeholders at the federal, state and local levels to use data to improve the quality of public education. Among numerous other projects, Muller was a contributor to "A Byte at the Apple: Rethinking Education Data for the Post-NCLB Era" (Fordham Institute, 2009), teaches at Georgetown University, and has had a long career in education reform and policy.

Gary Natriello, Gottesman Professor of Educational Research and Professor of Sociology and Education in the Department of Human Development, Teachers College, Columbia University. Dr. Natriello teaches graduate courses in the social organization of schools and classrooms, the social dimensions of assessment processes, the sociology of online learning, and research methods, and is the Director of the Teachers College EdLab, a design and development unit devoted to creating new educational possibilities for the information age.

Diana Nunnaley, Project Director, *Using Data Project*, TERC. The *Using Data Project* builds the capacity of educational leaders to lead a process of collaborative inquiry with school-based data teams and to influence the culture of schools to be one in which data are used continuously, collaboratively, and effectively to improve teaching and learning. Ms. Nunnaley is one of the foremost experts in helping to prepare educators to use data.

Chris Padilla, Senior Policy Analyst, Center for Education Policy, SRI International. Ms. Padilla has conducted a national project on the technologies to support data-driven decision making and has published two widely cited and seminal US Department of Education reports on the topic.

Ernest Rakow, Associate Dean for Administration & Graduate Studies, College of Education, University of Memphis. Dr, Rakow teaches measurement courses that pertain to aspects of data literacy.

Sharon Robinson, President, American Association of Colleges of Teacher Education (AACTE.) AACTE is a national alliance of educator preparation programs dedicated to the highest quality professional development of teachers and school leaders in order to enhance PK-12 student learning.

Terri Duggan Schwartzbeck, Program Manager, CNA Education. Ms. Schwartzbeck provides experience in policy implementation, teacher quality, and school reform and has worked closely with district superintendents in education reform efforts.

Patrick Sherrill, Project Manager, EDFacts, U.S. Department of Education. EDFacts is a U.S. Department of Education initiative to put performance data at the center of policy, management, and budget decisions for all K-12 educational programs. Mr. Sherrill participated in a small survey of schools of education around their implementation of courses on data use.

Samuel Stringfield, Professor and Distinguished University Scholar, Educational and Counseling Psychology (ECPY) and Educational Leadership, Foundations, and Human Resource Education (ELFH), College of Education, University of Louisville. Dr. Stringfield is a pioneer in the area of educational data-driven decision making, having written widely on the topic and having taught courses on data use. He also has been a school board member, using data from the practice side.

Rebecca Thessin, Assistant Professor of Educational Administration, Graduate School of Education and Human Development, The George Washington University. Dr. Thessin teaches courses on data-driven decision making and has also participated in the *Data Wise Project* at Harvard University.

Jeff Wayman, Assistant Professor, Educational Administration, College of Education, University of Texas at Austin. Dr. Wayman's teaching and research interests focus on the use of data for school improvements. He has written one of the most important works on educational technology to support data use and was an author on the IES Practice Guide on data-driven decision making and numerous other articles on the topic.

Brandi Weiss, Assistant Professor of Quantitative Research Methods, Department of Educational Leadership, Graduate School of Education and Human Development, The George Washington University. Dr. Weiss teaches courses on assessment and statistics as they pertain to data literacy.

Rebecca Zwick, Distinguished Presidential Appointee, Educational Testing Service. Dr. Zwick is an expert in educational measurement. She taught measurement and statistics courses at the University of California, Santa Barbara, and conducted research on teachers' understanding of measurement constructs.

Appendix D: Conference Agenda

Building Capacity with Data-Driven Decision Making Courses:
A Conference to Discuss Course Content
Sponsored by the Spencer Foundation
Produced by CNA Education, Education Northwest, and WestEd
February 7, 2011

Agenda

9:30 – 10:00 a.m.	Welcome Introductions Objectives Common Definitions	Robert Muller, Edith Gummer, & Ellen Mandinach
10:00 – 11:00 a.m.	Guided Brainstorming Describe individual perspectives	All attendees
11:00 a.m. – 12:00 p.m.	Defining and Structuring • What is data-driven decision making? • How does data-driven decision making differ from existing courses? • What are different kinds of data use? • What different kinds of data are used? • Why is data-driven decision making not Statistics 101 or Measurement 101?	Gummer & Mandinach with Wayman, Stringfield, Nunnaley, Herman & Zwick
12:00 – 12:30 p.m.	Break for lunch	
12:30 – 1:45 p.m.	The Role of Research • What do educators need to know about data-driven decision making? • What does the research say?	Mandinach, Wayman, others
1:45 – 2:15 p.m.	The Challenges	Practitioners and leaders of schools of education
2:15 – 3:15 p.m.	The Role of Schools of Education • What can schools of education do? • What must schools of education do to contribute to building human capacity? • Who will teach the courses? • What might the courses look like? • What are the challenges?	Leaders of schools of education
3:15 – 4:00 p.m.	Perception from Professional Development Providers	Nunnaley, Garrison and others
4:00 – 4:20 p.m.	The Role of Associations and Policy Makers in Building Capacity	AACTE, NCATE, NBPTS, ED
4:20 – 4:30 p.m.	Wrap Up, Next Steps, Thank You	Gummer, Mandinach
4:30 p.m.	Adjourn	