Student-involved data use: Teacher practices and considerations for professional learning

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HIGHLIGHTS

- Beliefs about SIDU appeared to influence how teachers implemented SIDU in their respective classrooms.
- Understandings stemmed from the different ways teachers were introduced to and supported in the practice of SIDU.
- Preparation and hiring entities have important roles to play in how SIDU is introduced, implemented, and sustained.

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ABSTRACT

In student-involved data use (SIDU), students are guided in the tracking and analysis of their own learning data. Research, however, is scarce when it comes to the outcomes of this practice as well as to the knowledge and skills teachers need to productively engage students in this kind of data use. This study adds to the knowledge on SIDU by exploring the ways in which 11 teachers across five districts learned how to involve their students with data. Teachers' descriptions of practice and roots of learning specific to SIDU suggest considerations for the ways in which preparation and hiring entities might support teachers to engage in constructive data use.

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1. Introduction

Around the world, educational leaders are occupied with promoting the use of data to support student learning (see Anderson, Leithwood, & Louis, 2012; Earl & Fullan, 2003; Lai & Hsiao, 2014; Lingard & Sellar, 2013; Schildkamp, Karbautzki, Breiter, Marciniak, & Ronka, 2013; and; Schildkamp & Poortman, 2015). Although adults using educational data is commonplace, engaging students in using their own data is a more recent trend. In what we term student-involved data use (SIDU), teachers work to purposefully and directly engage students in the tracking and analysis of their own learning data (Jimerson & Reames, 2015; Kennedy & Datnow,

2011; Marsh, Farrell, & Bertrand, 2016). These practices share aspects with, but move beyond the strategies described in the literature on formative assessment (e.g., Black & Wiliam, 1998; Van der Kleij, Vermeulen, Schildkamp, & Eggen, 2015; Wiliam, 2011a, b). They also move beyond recommendations to clarify learning goals and to engage students in reflective thinking (e.g., Marzano, Pickering, & Pollock, 2001). SIDU could include such strategies, but typically also includes a slate of practices that includes individual student "data binders", quasi-public displays of data, and "data chats" aimed at spurring improvement practices at the student level (Jimerson & Reames, 2015; Marsh et al., 2016).

The thinking behind such practices seems to be that involving students in these ways may lead to improvements in instructional practices while catalyzing student motivation (see Marsh et al., 2016). The field, however, has yet to thoroughly document such practices or to develop consensus about their effects. Thus, while the practice may extend beyond the United States (the context for

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this particular study), little research exists documenting how SIDU unfolds in classrooms across the globe. At present, we do know that teachers across the United States are embracing these practices—either of their own accord or at the behest of school leaders (e.g., Jimerson & Reames, 2015; Kennedy & Datnow, 2011; Marsh et al., 2016). Therefore, it behooves the field to explore how teachers understand and implement these practices, and what forces influence the scope and shape of SIDU. As we learn more about these issues, we are able to consider how preservice programs and school districts might shape learning experiences so that teachers engage in SIDU in ways that are well-aligned with broader evidence on data use, assessment, feedback, and learning.

This study contributes to the evidence base around SIDU by exploring the practices and perspectives of a group of veteran teachers. Our efforts were guided by three broad but intersecting questions:

(1) What learning supports (preservice or post-hire) influenced the ways in which these teachers implemented SIDU?
(2) How did these teachers understand the practice of SIDU?
(3) How did these teachers work to fit SIDU to practice?

2. Teacher capacity for student-involved data use

In this section, we lay out the context for SIDU. We touch on the evidence for data use broadly writ, then outline the components of data literacy considered essential for teacher practice. We connect research on teacher data use to the practice of SIDU, and highlight the gap between the increasingly popular practice and the scant research on supporting teacher learning for involving students with data. We also briefly clarify how SIDU (in its present iteration) diverges from seemingly similar practices.

2.1. Classroom-based data use

Educators have known for some time that day-to-day classroom practice that makes use of formative assessment data, combined with specific, timely, standards-or content-specific feedback, results in improved learning for students (see Black & Wiliam, 1998; Shute, 2008; Wiliam, 2011a,b). The literature also suggests that systematic data use can contribute to a sense of collective responsibility for student achievement (Datnow & Park, 2014); enable inquiry around issues of student equity (Park, Daly, & Guerra, 2013); and—when well-structured and supported—contribute to student achievement gains (Carlson, Borman, & Robinson, 2011; Lai & McNaughton, 2013; Louis et al., 2010).

Research suggests that when implemented well and within a nonthreatening culture of inquiry, certain forms of data use can make a positive difference for student learning (e.g., Anderson et al., 2012; Datnow, Park, & Wohlstetter, 2007; Hamilton et al., 2009; Lai & Schildkamp, 2013). For these promises to be fulfilled, however, teachers and school leaders must be adept at using data to inform instructional decisions. This raises questions related to educator data use capacity and how systems can support improved data use among teachers.

2.2. The challenge of improving teacher data use capacity

In response to the need to support the data-using skills of educators, recent work has focused on building capacity for data use among preservice teachers (e.g., Mandinach, Friedman, & Gummer, 2015) and veteran teachers (e.g., Farley-Ripple & Buttram, 2015; Jimerson & Wayman, 2015; Mandinach, Parton, Gummer, & Anderson, 2015; Wayman & Jimerson, 2014). These studies

underscore that to use data well in the service of instruction, teachers need a set of skills and dispositions that help them turn data into action.

Specifically, teachers must be able to formulate questions related to instruction and to situate their data use within a relevant driving purpose (Jimerson & Wayman, 2015; Lai & Schildkamp, 2013). They need to be able to identify (or collect) multiple data relevant to those questions, and to engage in interpretation and sensemaking around their findings (Cho & Wayman, 2014; Jimerson & Wayman, 2015; Lai & Schildkamp, 2013; Mandinach, Parton et al., 2015). Perhaps most important, they must be able to connect data analysis with effective interventions, monitoring processes, and instruction (Jimerson & Wayman, 2015; Mandinach, Parton et al., 2015; Mandinach & Friedman, 2015; Van der Kleij et al., 2015).

2.3. The SIDU-data use intersection

SIDU presents a novel challenge for preparation and professional development systems: Beyond ensuring that teachers themselves have the capacity to engage in data use (from question setting through the identification of action steps), they must also consider whether teachers are able to develop similar capacity in students. To consider what it is educators are preparing students to *do* within SIDU, it is important to clarify what SIDU is and what it is not. As described in the limited literature available, SIDU is a process in which teachers facilitate student use of their own data to set goals, monitor progress toward those goals, and engage in reflection to inform learning (see Jimerson & Reames, 2015; Marsh et al., 2016). Thus, a visitor to a classroom implementing SIDU might see students accessing individual "data binders" in which they track data from a variety of assessments (perhaps with bar charts or scatterplots) and may observe "data walls" on which evidence of student progress (by group or individual, in terms of absolute achievement or in terms of growth) is displayed. "Student-led conferences," wherein students talk classroom visitors or parents through progress checks using their binders as artifacts may also be evident.

Though SIDU shares characteristics with well-researched strategies related to special education and formative assessment, SIDU is not simply an offshoot of these practices. For example, SIDU diverges from the self-tracking/token economies as described in special education literature (see Sugai et al., 2000), as such strategies are designed to help students establish new patterns of behavior, and then be extinguished. Rather, SIDU aligns more with continuous improvement strategies (e.g., Langley, et al., 2009) in that it aims at forming lifelong data using habits.

Neither is SIDU synonymous with the strategies described in the literature on formative assessment (Shute, 2008; Van der Kleij et al., 2015; Wiliam, 2011b). In formative assessment, teachers work with students to establish learning goals and then provide timely and specific feedback to help students make learning adjustments (Wiliam, 2011a). Formative assessment practices also focus on facilitating student reflection (Marzano et al., 2001; Wiliam, 2011a). Yet the practices described in the limited work documenting SIDU do not always align with these characteristics (see Jimerson & Reames, 2015; Marsh et al., 2016). Goals tracked are sometimes vague, aimed at test scores more than specific skills or knowledge (see Jimerson & Reames, 2015; for examples). And, SIDU often involves quasi-public displays of data, the presence of which is expected to motivate students (Marsh et al., 2016). Yet such displays are absent from recommendations in the literature on formative assessment practices (e.g., Black & Wiliam, 1998; Shute, 2008; Wiliam, 2011a,b).

These are important distinctions: If SIDU were synonymous

with formative assessment, or were simply one strategy under the broader umbrella of formative assessment, then we could conclude that the field had already amassed a wealth of supporting evidence. However, if SIDU unfolds in ways that diverge from tenets of these well-evidenced practices, then an open question remains as to the present and potential value of SIDU. Thus, the field needs research that fleshes out this particular strain of data use and how it might unfold in ways beneficial to students.

3. Theoretical lens

To better understand the origins and development of teachers' SIDU practices, we framed our approach to this study through a lens informed by Guskey's work (1989; 2002) on the reasons teachers adopt, retain, or reject changes in practice. This lens is itself nested within a broader context of social and situated learning (Bandura, 1977; Lave & Wenger, 1991; Putnam & Borko, 2000). Fig. 1 illustrates this perspective, which we describe in more detail in the following sections.

The external space (in Fig. 1, the area in grey), denotes the social context in which teachers operate; it also reflects the important role collegial relationships play in whether and how teachers adopt new practices. This layer of our perspective draws from both situated learning and social learning theories (e.g., Bandura, 1977; Lave & Wenger, 1991; Putnam & Borko, 2000; Smylie, 1995). From this, we take that teachers learn about new practices through an iterative process of pooling knowledge and comparing perspectives about the fit and nature of those practices. We therefore expected that teachers would report learning about SIDU practices from a variety of experiences, though all would involve some kind of social interaction.

The interior space (represented in Fig. 1 by the area in white), drills down beyond the fact *that* teachers adopt certain practices, and draws on Guskey's work (1989; 2002) to explain *why* and *in what measure* they do so. Guskey asserts that teachers generally will try new strategies if they believe that the adoption and implementation will result in some benefit. Further, he clarifies that this benefit may or may not be academic in nature; that is, the improvement may be academic performance of students, but it could also be something along the lines of greater student engagement or a more manageable classroom. Finally, upon trying the strategy in question, teachers will either retain the practice (if expectations of benefit are borne out) or reject the practice and return to established methods (if expectations of benefit are unmet). Thus, teachers' theories-of-action—their beliefs that a strategy will, in some way, work to effect positive change—influence their adoption and retention or rejection of a practice.

3.1. Interactions of social learning and personal theories-of-action

We expected that teachers would come to SIDU via socially-based learning experiences; we also wondered whether those

Fig. 1. How and why teachers adopt SIDU practices.

experiences might influence how teachers thought SIDU "works". Thus, teachers might learn about SIDU in similar ways (for instance, through a formal workshop), but end up with differing theories-of-action for why the practice benefits students. One teacher might assume SIDU encourages students to work harder (catalyzing existing capacity), whereas another might assume that it helps students engage in metacognitive reflection and subsequently adjust learning strategies (building capacity).

Further complicating this line of thinking, personal theories-of-action may or may not align with evidence. A teacher who expects SIDU to serve as a motivator may not be familiar with research related to intrinsic and extrinsic motivators and how these intersect with student self-concept (e.g., Duckworth & Gross, 2014; Dweck, 2006, 2015). Or, a teacher who implements SIDU in line with a personal theory-of-action that involves empowering students through goal-setting and reflection may understand that such practice builds on formative assessment and requires timely and specific feedback (e.g., Wiliam, 2011a). Thus, teachers may articulate personal theories-of-action for enacting SIDU that fit well (or not at all) with broader research on supporting student development.

3.2. Determining value of SIDU

A second consideration borne of this perspective involves how teachers determine whether SIDU is beneficial to them (and subsequently retain or reject the practice). Guskey's work suggests that if teachers perceive SIDU to confer benefit, they will retain the practice. This seems rather straightforward, but is complicated when we consider work in the area of continuous improvement, wherein we learn that early trials in any improvement endeavor will be imperfect, and take time to hone and perfect (see Langley et al., 2009). Thus, as teachers explore and implement elements of SIDU, they could work to gradually refine the ways in which SIDU fits with classroom practice. However, if teachers are not afforded appropriate time or supports, or lack data literacy, efforts to implement SIDU in ways that align with the literature on data use (e.g., Hamilton et al., 2009; Kerr, Marsh, Ikemoto, Darilek, & Barney, 2006; Lai & Hsiao, 2014) may prove frustrating and be prematurely discarded. This could lead to situations where SIDU, never fully tried, is found wanting due to factors beyond the practice itself.

Even with adequate supports, coming to understand the purposes and benefits of new practices is not easy. Some teachers may experience dissonance or conflict (Bredeson, 2002; Putnam & Borko, 2000). The adoption of new practices involves both learning and unlearning the how and why of getting things done. In reconciling these demands, teachers may seek out "dynamic sameness" (Bredeson, 2002, p. 66). In such a case, adopted practices can be "new", but not so new that they no longer fit with local norms, expectations, or routines. In trying to maintain enough familiar practice to achieve comfort with the "new," SIDU may never reach a stage of implementation robust enough that benefit is achieved, leading to premature rejection.

4. Methods

In line with the exploratory nature of this study, we employed a qualitative research design. In this section, we describe the study's sample, data collection procedures, and approach to analysis.

4.1. Study sample

Eleven teachers (across five districts and six campuses) participated in this study (see Tables 1 and 2 for information on the participants and districts, respectively). Data were collected during
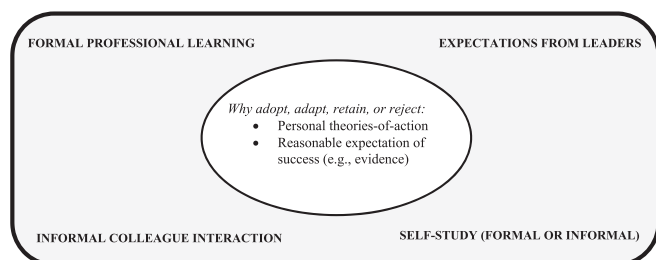
the 2014–15 school year, beginning with meetings and conversations with district-level leaders in the north central Texas region in winter 2014; data collection ended in May 2015. For the purposes of this study, we aimed to observe and interview teachers who: (1) had already begun to implement SIDU practices on a regular basis; and (2) were considered "exemplars" by district and/or campus staff. Therefore, sampling began by asking leaders for recommendations of teachers considered "exemplars" in implementing SIDU. We defined SIDU for these leaders as "practices that involve students in tracking and analyzing their own data for learning purposes."

4.2. Data collection

Each teacher completed a brief email questionnaire designed to gauge practices and attitudes related to SIDU. Questions included open-ended items that focused on the ways in which these teachers learned about SIDU practices, how they worked to engage students in data use, and what advice they would give to other teachers or leaders considering the implementation of SIDU in their own contexts.

Classroom observations were conducted four to six weeks after the questionnaires were completed. Observations were aimed at teachers' classroom practices, their intersection with data use, and classroom structures (e.g., data walls, binders). Lasting entire school days, observations captured a range of subjects and activities. This resulted in a total of 55 instructional hours observed.

During observations, rich scripting (see Yin, 2010) was employed to capture the sights, sounds, and interactions of a typical school day. Phenomena observed included: classroom layout and setup; data-related dialogues; SIDU practices in action; and SIDU-related materials. See Table 3 for samples of scripting excerpts.

Teachers also participated in individual interviews. Interviews ranged from 25 to 45 min and pressed on topics set into relief by the questionnaires and observations. Lines of inquiry addressed perceived benefits of SIDU, reasons for adoption/implementation, student responses to using data, and challenges to classroom implementation. We also asked participants to describe any training or professional learning they attended or were provided related to SIDU practices.

4.3. Data analysis

Prior to formal analysis, we sampled two of the 11 teachers and independently read through the two teachers' questionnaires, observations, and interview transcripts. We discussed what we perceived as emerging themes and posited starter codes, attending to the ways in which our theoretical lens informed our coding and analysis process. We then conducted a first cycle of coding wherein we read through the remaining documents, attending to these agreed-upon themes, but still allowing for emergent codes that we thought described the phenomena being examined (see Miles, Huberman, & Saldaña, 2013).

We then turned to a second cycle of coding to facilitate a close reading for particular concepts across the documents (i.e., observation scripts, interview transcripts, and questionnaires). Table 4 provides sample excerpts for and descriptions of codes used in this final stage. Finally, we read through excerpts by final code to determine within-code themes pertinent to our guiding questions.

4.4. Credibility

Lincoln and Guba (1985) suggest approaches for bolstering the trustworthiness of qualitative research. Here, we engaged in two such approaches. First, we employed multiple data collection methods (i.e., triangulation). Using the questionnaire (which allowed us to capture more considered thoughts from participants) alongside the rich description of the observation notes and the transcripts of the interviews (where participants did not have time to organize thoughts ahead of time) helped us to approach our research questions from multiple angles. Second, we employed peer debriefing among our research team; during initial construction of instruments (i.e., questionnaires and interview protocols), we discussed ideas for areas of exploration and, during data analysis, conferred on emerging codes and descriptors.

5. Findings: supporting teacher learning for SIDU

Analyses of interview, observation, and questionnaire data resulted in the identification of themes specific to: (1) what learning supports (preservice or post-hire) influenced the ways in which teachers implemented SIDU; (2) how these teachers subsequently understood SIDU; and (3) how they worked to adapt SIDU to practice. Our theoretical lens suggested that the social context of teaching would influence how teachers learned about SIDU, and how they subsequently implemented the practice in their own classrooms. As the following sections indicate, the social sphere did in fact play a substantial role in teachers' development of SIDU-related practices—sometimes to the detriment of common understandings around why SIDU might reasonably be expected to

Table 1
Characteristics of study participants.

Teacher[a]	District	Campus	Teaching area	Experience (Years)	Preparation program
Sonia Lopez	A	Trinity ES	5th grade/Bilingual (Math/Science)	3	Teach For America (Political Science/Sociology)
Heather Nichols	B	Sholtz ES	Kindergarten	7	University-based program
Jacque Peralta	C	Miller ES	4th grade (math/science)	9	Alternative certification (Accounting)
Yelisa Boyle	C	Miller ES	4th grade (math/science)	9	Alternative certification (Psychology)
Pam Holt	C	Miller ES	3rd grade (math/science)	6	Alternative certification (Political Science/Sociology)
Joie Carter	C	Landry ES	3rd grade	3	University-based program
Kate Stevens	C	Landry ES	2nd grade	3	University-based program
Allison Blake	D	Cooper ES	1st grade	19	University-based program
Paul Deacon	D	Cooper ES	2nd grade	6	University-based program
Daniel Stark	D	Cooper ES	3rd grade	12	Mixed[b]
Effie Tylor	E	Clark ES	3rd grade/Dual Language	4[c]	Alternative certification[d] (Education)

[a] Teacher and campus names are pseudonyms.

[b] Daniel completed a university-based teacher program in Kansas; because of a lack of reciprocity amongst certifying entities, he used an alternative certification to obtain certification in Texas.

[c] Effie also worked as a classroom assistant for four years prior to earning her degree and teaching certificate.

[d] Effie reported that she did take education courses as a component of her degree plan, but because the university did not offer a formal teacher certification program, she had to complete alternative certification.

Table 2
District & campus characteristics.[a]

District	District demographics				Campus demographics				
	2013−14 enrollment	% English language learners	% Students qualifying for free/reduced	Racial/ethnic populations price meals[b]	Campus	2013−14 enrollment	% English language learners	% Students qualifying for free/reduced price meals	Racial/ethnic populations
A	84,000	31%	77%	African-American 23% Hispanic 63% White 11% Asian 2%	Trinity ES	600	70%	92%	Hispanic 89% White 3% Asian 7%
B	19,000	5%	31%	African-American 2% Hispanic 38% White 56% Bi/Multiracial 3%	Sholtz ES	625	22%	50%	Hispanic 53% White 43%
C	18,000	8%	41%	African-American 10% Hispanic 36% White 47% Asian 4% Bi/Multiracial 3%	Miller ES	575	26%	53%	African-American 8% Hispanic 44% White 29% Asian 15% Bi/Multiracial 4%
					Landry ES	600	8%	27%	African-American 16% Hispanic 25% White 48% Asian 5% Bi/Multiracial 5%
D	15,000	12%	63%	African-American 39% Hispanic 26% White 27% Asian 5%	Cooper ES	500	9%	68%	African-American 43% Hispanic 25% White 24% Asian 5% Bi/Multiracial 3%
E	6500	9%	54%	African-American 6% Hispanic 35% White 52% Bi/Multiracial 4%	Clark ES	850	18%	58%	African-American 7% Hispanic 38% White 49% Bi/Multiracial 5%

[a] All data reflect the 2013−14 school year, the most recent year for which accountability data were available; all data are also approximated within two percentage points to help preserve participant anonymity. For each district or campus, all racial/ethnic groups that comprise 2% or greater of the overall population are identified.
[b] Proxy for students whose family income is near or below the federal poverty level.
Source: Texas Education Agency (2015). *Texas Academic Performance Reports.*

support improved learning outcomes.

5.1. Learning supports for SIDU

Teachers reported a variety of ways through which they were introduced to SIDU, including: (1) SIDU-specific professional learning; (2) professional learning related to data use in general (but not specific to SIDU); and (3) self-study and socially-based learning.

5.1.1. SIDU-specific professional learning
Of the 11 teachers, only two reported participating in formal trainings focused on SIDU-related practices and strategies, and both of these were through outside entities that contracted with their respective school districts. Heather reported that a former principal had encouraged and supported teams of teachers to attend training by an external provider on "quality tools" strategies a few years prior; she attributed much of her development of and belief in SIDU strategies to this experience. Yelisa also noted that she was provided formal training in strategies in a previous district, which was oriented toward Baldrige continuous improvement principles.

5.1.2. Data use-related professional learning
Though nine of the 11 teachers reported no formal training

specific to SIDU, several did mention formal (but only indirectly relevant) learning experiences related to data use more generally. They then worked to transfer this data use-related learning to the ways in which they involved students with data. For several, these experiences were tied to teacher preparation experiences. For example, Daniel talked about applying information from his graduate-level statistics and leadership courses (he held a Master's in Educational Leadership); Sonia reported that her Teach for America training emphasized data-driven practice (including the use of data walls), and she used much of that knowledge to shape how she implemented SIDU. Pam credited her ability to embrace SIDU to her preparation in early childhood education, noting, "Early childhood education requires you to take things like anecdotal records and documentation. And so, for me, it just—it was like keeping anecdotal records. Just a continuation of noting and charting …" Thus, teachers accessed learning related to general data use, and worked to retrofit strategies to how they engaged children.

5.1.3. Self-study & socially-based learning
The most common responses reflected informal social learning and self-study. Every participant mentioned peer learning in some format (e.g., Professional Learning Communities, student support teams, and Response to Intervention structures). They reported

Table 3
Samples of data from classroom observation scripts.

Category	Scripting sample
Classroom layout/setup	I do see one smaller board with "Our class data" near the teacher's desk (in fact, it is behind her guided reading table). The area for "word study" is blank, but there are smaller graphs for Accelerated Reader™, Reading, and Math. Some of the graphs look to be colored by students (AR) while others look more like data the teacher would have printed out or constructed. It is the only data-specific visual in the room; I did not see any displays in the hallways as I walked to the classroom. [From Effie Tylor's classroom]
General teacher-student interactions/ classroom climate	As they count sides and vertices (I note the use of appropriate vocabulary) she marks them off on the shape, modeling how to use a strategy to count the shapes. A few students bring up that this shape has six sides because of how it's drawn. Kate says, "Oh my gosh! You are so right! I missed that—remember what I say about teachers not being perfect, and I also love how [girl] was very respectful in correcting me. She just raised her hand and said, 'I think there are six sides.'" […] Another student shares how she got her answer a different way, and Kate says, "that's right! That's why we talk about so many strategies, not to make things harder but to make them easier!" [From Kate Stevens' classroom]
SIDU practices in action	"We need to get out our data folders because we need to talk about our test from last week," Yelisa tells the students. Students move to get their data folders from a box. Yelisa shows me a tracking chart the students are using—it contains an initial score, a benchmark score, a second benchmark, and the passing standard for STAAR,[a] so students can measure progression toward the pass rate. Students all have their data folders. […] Yelisa demonstrates at the board how to graph the pre- and post-test for geometry; she also tells them she's going to give them an opportunity to improve their scores. "Let's say I got a 30 on my pre-test, and a 50 on my post-test." A student says, "You improved 20 points!" Yelisa responds, "You did improve 20 points! But it's not enough for me to think you really understand it. These are concepts you're going to need to know." She explains that she's going to let them review, then retake the post-test and use a different color to show growth on top of the second chart to show more progress. […] The students busily color in their data charts (bar charts, in this case). [From Yelisa Boyle's classroom]
Observations of SIDU-related materials	…the "math data" wall has two sets of numbers (not names); one color (yellow-orange) demonstrates where the 'achievers' are in terms of unit tests (from 30% or lower to 100%). And the blue numbers demonstrate the "growers" ("a scholar that grows 10% or more from his or her previous exam"). Each student has TWO numbers—the mastery number and the growth number, and in only one instance across three tests do I see the same number in the bottom of both data sets (#15 was at the bottom on unit 7 in both achievement and growth, but even here, Sonia has managed to post the blue (growth) number about 6 inches higher than the yellow (achievement) note, and I wonder if this is purposeful. [From Sonia Lopez's classroom]

[a] State of Texas Assessment of Academic Readiness (STAAR): The annual assessment required of students in Texas public schools. For elementary schools, exams are required in grades 3 (Mathematics and Reading), 4 (Mathematics, Reading, and Writing), and 5 (Mathematics, Reading, and Science).

seeking out SIDU-related strategies vis-à-vis books, teacher blogs, websites such as Pinterest, or entrepreneurial sites like TeachersPayTeachers.com.

Some noted that they were driven to engage in self-study and frequent peer-to-peer learning because they were provided so *little* in the ways of formal supports for SIDU—by preparation entities or by hiring districts. Though a few were able to point to specific links between teacher preparation and the ways they used data with students, others reported that data use and related concepts were not major emphases in their preservice programs. And, in terms of hiring districts, comments suggested that encouragement to implement SIDU outpaced formal supports for the practice. Yelisa noted, "Everything I have I brought with me. There has been no data training since I got here." Similarly, Allison told us:

We never had any training on it. It was, "we do the running record," because I already knew about running records. But with sight words, I just needed somebody to tell me, "OK, what we put in the [student data] folder?" […] As far as sitting down and explaining data folders? No. There was none.

When asked about formal training or preparation, Daniel explained:

… it was already in place when I got to [this district]. So I didn't get any. I started in November, and all the training was already done by then, so I didn't get any training on it. They're just, Mr. ——, who was the assistant principal at the time, sent me an email that had like 198 different attachments and he said, "Here. Just read through that."

No teachers reported that SIDU was mandated in a particularly rigid format; though all said they were prompted to use data, and some were required to maintain folders or "data walls," teachers did so in a variety of ways. Though SIDU strategies were encouraged, and all of these teachers reported that their districts were moving towards a more systemic embrace of SIDU, ways of learning about data use and about engaging students in tracking and analyzing their own data varied considerably, and seemed largely oriented around learning via social networks (in-person as well as online).

5.2. Teacher understandings of SIDU

Perhaps because teachers came to the practice of SIDU from a diversity of professional and socially-based learning experiences, the ways in which they understood SIDU also varied. Teacher comments suggested a dearth of common understandings around possible theories-of-action underpinning SIDU or about the overall purpose or end goal of the practice.

5.2.1. Common understandings around SIDU

Teachers in the study lacked common understandings in terms of how and why they thought SIDU "worked". They all talked about SIDU "motivating" students, but varied in how they explained this perceived effect. Some said that setting goals and monitoring progress toward those goals fed intrinsic motivation: students were cast as being put "in the driver's seat" of their own learning. Others noted that competition (with themselves, in terms of besting prior achievements, or with other students) increased effort. Though we observed none of the teachers using competition among individual students in public ways, we did see artifacts that suggested team competitions or competitions among homeroom classes. No teachers described faculty meetings or professional learning where efforts were made to calibrate common understandings around these personal theories-of-action.

Further, the ways in which teachers characterized SIDU as intersecting with motivation seemed to influence how they implemented the practice. For example, Daniel spoke at length about making students aware of their strengths and weaknesses; he also noted that he preferred whole class discussions around data, or individual conferences, to competition-based displays. In

Table 4
Coding scheme, descriptors, and representative excerpts.

Code	Descriptor	Representative excerpt
Roots of learning	Comments related to the ways in which teachers learned about or worked to improve SIDU practices in their respective contexts	AB: We never had any training on it. It was, "We do the running record," because I already knew about running records but with sight words I just needed somebody to tell me, "OK, what do we put in the folder?" And they just told me, "You grab sight words" […] As far as sitting down and explaining data folders, no. There was none.
Framing	Descriptions of how teachers frame SIDU for students (e.g., growth mindset or fixed mindset; compliance or improvement, or combination of these)	SL: We really focus on the growth here. We celebrate even the smallest of growth. If you had a 30% mastery in one TEK and you went to 35 [or] 31, we're like "You went up!" Something got better. And we really do focus on the achiever and the grower. Because I think that it's, it's key in order for data to grow, not to just highlight those that are excelling, but also those that are growing. Because we all start somewhere.
Mediating factors	Factors that influence or impact how teachers choose to implement SIDU (e.g., time, age/need of students, scheduling)	DS: … we haven't really had the time—it's very time consuming. But I like the data as far as—I like the data for myself, but as far as the kids doing it? It's … I mean, I don't think they really—they're not old enough to really, to have a developed sense of, "Oh, I made a 60 on the last test, so I need to make …" you know what I'm saying? They're just too young, I think.
Purpose for data use	Comments related to why teachers engage in data use or SIDU	AB: I can remember when I first started teaching—we didn't talk about all this. And you knew, you kind of knew where your kids were, but you weren't really looking at numbers. I think that [data use] gives you the advantage of being able to really see how you're doing as a teacher, also, because if the numbers are really low you can kind of—well, I'm going to blame me. […] I like to go and see what I need to do, or the gaps I need to fill in.
Learning gaps & needs	Comments related to what teacher-identified learning needs specific to SIDU	PH: I think just some visual—some visual aids, going into other classrooms, going into—kind of like what you're doing today—can I go in and see what's going on within a classroom setting so that I can get a feel for maybe what it is that, that they're doing to implement data going forward.
Theories-of-action	Comments that illuminate how teachers think SIDU catalyzes improvement; observed activities that appear to convey a belief about how SIDU catalyzes particular outcomes	PH: … if I just give you back a graded paper that I've marked on, you look at your score—'Eh. Whatever.' You put it in your binder and you keep on going. But I'm making you reflect, question by question, piece by piece, and you're sitting down with a peer, and [your peer] answered it correctly because they showed their work and you answered it incorrectly because you didn't take the time […] you're probably kind of embarrassed because you probably should have known the answer to that question, but you didn't take the time to slow down and pay attention and focus.
Grammar of SIDU	Comments that reference SIDU-specific structures, routines, artifacts, or vocabulary	DS: At the school in general, all the teachers are required to keep data folder—mine are over there [points to a crate by a bulletin board]—it has a bookbag inside of it, actually, I don't know why. But they're [students] required to keep those and what we do is we—they have to mark whatever their scores [are] on the district assessment, and then they have to set a goal for the next one.

Pam's and Sonia's classes, where team-based or intra-class competitions were considered positive, bulletin boards displayed progress by team. In other classes, data tracking (for academics and/or behavior) was linked to extrinsic motivators (tickets, trinkets, special privileges), so a more behaviorist approach seemed to be in play. The ways in which the practice was implemented suggested various ways of understanding SIDU as a catalyst for motivation.

5.2.2. A centering purpose for SIDU

Teachers also seemed to lack shared understandings about a centering purpose or *end goal* for SIDU. In the absence of school-wide or focused professional learning opportunities that could have helped establish such understandings, teachers intuited their own rationales. For some, SIDU was most closely linked to administrative or accountability system mandates—particularly preparation for annual required exams. For example, Paul insisted, "I want every single one of my kids to pass the STAAR [State of Texas Assessments of Academic Readiness] test next year. That's my goal." Allison and Daniel both noted that administrators expected data to be posted on classroom bulletin boards and made a habit of asking students about their data folders during walk-throughs. Daniel spoke dismissively of this particular requirement:

Not once ever has a student just said to me, "Can I go look at my data folder?" I mean, the only times they look at their data folder is when they chart whatever they made and then make a goal, or when somebody from administration walks in and says, "Do you guys have data folders?" and then they say, "Oh yeah—it's over there."

Though a few teachers highlighted such links, compliance and improvement orientations were not mutually exclusive: Every teacher—Allison, Daniel and Paul included—insisted that they found the broader practice of involving students with data beneficial in that it helped students set learning goals and monitor growth, which they considered empowering. Pam said the process provided a platform for reflection and noted that tracking their data "encouraged them to continue to do their best." Joie echoed this, noting that SIDU made the kids "a lot more accountable" for learning. In a similar vein, Sonia insisted that data was "a vehicle … something we're using to move us forward," while noting that tracking the data helped students identify academic strengths and needs and formulate plans for improvement.

Despite moving into their implementation efforts without a common understanding as to the end goal for SIDU, each teacher seemed to believe that some aspects of the practice benefitted student learning, and this drove efforts to include students in the process. This aligns well with Guskey's assertion that teachers will adopt new strategies if they believe there is a reasonable chance that doing so will result in benefit (to students, to the classroom, and/or to the teacher). In this case, the teachers talked about the ways they expected SIDU to result in benefit to students, and therefore adopted the practice—a practice which, our next section makes clear, was not always easy or efficient to implement.

5.3. Fitting SIDU to practice

Likely as a result of the social nature of their learning around SIDU, the teachers in this study implemented SIDU in somewhat consistent ways. For example, they all used data tracking sheets with students, and most bound the sheets into individual student data folders. Each had some kind of data wall in the classroom

(though these varied in how and whether they denoted individual student progress), and each referenced student data in individual and group conversations around classroom activities and assessments. In many classrooms, artifacts and strategies associated with SIDU seemed well-woven into the regular ebb-and-flow of daily practice: Teachers occasionally referred to data wall displays to reinforce a learning need or strategy, and several referred to data folders or to data within the folders as they interacted with students during lessons. (For example, Allison updated data folders as she worked with students in guided reading groups, and Yelisa had students update math skills charts as they discussed recent benchmark assessment results.) However, implementing and navigating SIDU was not an easy task. Although teachers reported that they believed SIDU to be worthwhile, they also experienced complications around how to fit SIDU with existing practice. Descriptions of challenges coalesced around three themes: time, student development and data literacy, and uncertainties around leaders' expectations for SIDU.

5.3.1. Challenges of time

Teachers noted that implementing SIDU was challenging when it came to preparation and planning, both in terms of developing materials, and in facilitating student participation in the process itself. Teachers reported engaging in a number of practices to involve students in using data. These included conferencing with students as to outcomes of (formal and informal) assessments, facilitating student graphing and tracking of their own learning data, and facilitating student reflection (individual and group) around learning progress. Yet each of these aims required time in preparation and planning—time that was over and above what they already dedicated to planning for academic lessons.

Though all teachers in the study spent time on a number of SIDU-related tasks (e.g., setting up student folders, running copies for inclusion in the folders, creating data-rich bulletin boards), teachers with younger students seemed to feel this press most severely, as they were less able to involve their students in the generation and maintenance of displays and folders. Most also reported spending time over and above academic lesson planning searching the Internet for student-friendly data-related materials. According to Yelisa and Heather, the formal training they had received did not solve this problem, as they both described working to cobble together materials in support of their efforts. Sonia spoke to this challenge even as she underscored her belief in the practice as a whole:

> When done right, data makes both the life of the teacher easier and it empowers the students. Starting it off, setting it up, setting up the systems, takes time, work, lots of work, but once those are in place the boat sails so softly. Because the students take real ownership of their learning.

Beyond time required for basic preparation, teachers also talked about the time required to have students physically record and graph data, to reflect on data and set academic goals, and to confer with students about their data. Again, these time requirements seemed more pressing for those working with younger children, who were less independent in terms of interpreting data or even in simpler tasks such as coloring in graphs. Allison reflected on this difficulty:

> I do running records already and having them sit down and graph that kind of got me because it takes time to train the children. You have to tell them which row to graph because they will take a crayon and go, "Where, Mrs. Blake? Did you say here? Color here? Or here?" Showing them how to set a goal—"Do you

want to improve? Do you want to maintain?" And you have to explain what "maintain" means. "Do you want to stay there? How much do you want to improve?" You have to talk about that and have a conversation. When you have ten to fifteen minutes to do all that and then still have to teach all the other subject areas … it is a lot. It is a tremendous amount.

Daniel, Allison, Effie, and Joie all commented on the difficulties of fitting SIDU into the classroom in ways that did not displace other important components of their jobs (that is, lesson planning, assessment, parent interactions, and faculty duties, among other responsibilities). Daniel explained that this was a reason he sometimes completed elements of the data folders for students, so that the time that would be consumed by students updating their folders could be reallocated to class-wide and individual conferences.

5.3.2. Challenges of student development and data literacy

Teachers also described challenges related to helping students interpret data, and to making this a meaningful and positive experience. In navigating this challenge, seven teachers reported adjusting practices to encourage student engagement and to avoid student shutdown (which they said sometimes happened when students received low grades or poor feedback). They responded to these concerns in planned as well as in-the-moment ways. In terms of proactive planning, Sonia leaned on her undergraduate sociology training to set a tone from the beginning of the year; she recounted sharing census data with her fifth graders—data specific to their community. They discussed how these data could be used to predict different quality-of-life outcomes. "That was our first day," she remembered, "and it really pushed their thinking. They were upset. They were angry. And we're like, 'Okay. We're going to use this to be our motivator for this year. We're going to use data and to prove those statistics wrong.' And that was kind of like the foundation for our classroom." Joie talked about purposefully avoiding displays with names or even student-associated numbers in an effort to prevent student teasing. Heather refused to post displays of student data, explaining, "I've not seen that anywhere in all the books that I'm reading, in any of the research that I look at. I'm not seeing where that's beneficial."

Teachers also reported in-the-moment decisions to back away from SIDU practices, given concerns for particular students' overall development. For example, Paul admitted avoiding data chats entirely with a student who was being tested for a reading disability, because his data showed no progress, despite immense effort. Pam, Daniel, and Kate talked about being cautious in how they talked with young students about weaknesses or low scores and avoiding discouraging conversations. Daniel elaborated on why he found this important:

> If their data is good, then they're happy, and if their data is not, they usually walk away pretty upset. Because they feel like they've let me down. Because it's hard—even if you say, 'I'm not mad at you—I'm not upset' they still feel that way because they know below a 70 is failing.

Further, three expressed reservations that some students might not have the math skills to benefit (yet) from SIDU. Yelisa ruminated, "Kids don't understand numbers anyway at this level and getting them to do something with numbers is hard. They have to know, 'What does it mean?' […] They don't get that concept yet." Daniel and Kate also questioned whether students fully understood the data they were tracking, or the application of the data to their learning.

Some attempted to mitigate these gaps in understanding by linking the language of standards to the data being maintained in data folders, and in drawing students' attention to connections between curricular content and data analysis. In sum, teachers seemed eager to engage students with data, but were cautious as they noted the challenges involved in helping students develop the dispositions, habits, and skills needed to engage.

5.3.3. Challenges related to leader feedback

A final element complicating teachers' efforts to fit SIDU with practice involved a lack of specific feedback from leaders: As SIDU was a fairly new practice, teachers said they wanted to have a clearer idea of what school leaders expected. They wanted to know whether they were "doing it right," as Allison noted. For example, though none of these teachers worked in a context where every element of the practice was mandated, most worked where student data folders were an expected component of classroom practice. Yet teachers routinely indicated a lack of consistency in what data or documentation were to be maintained in the folders. Therefore, teachers often decided on their own what would be tracked and analyzed. Allison addressed this when she talked about how she wished SIDU would be supported:

> I have heard a lot of new teachers come in and they are expected to do this and [it's] "Why aren't you doing it?" But [leaders] are not giving them support and I would hope that the principals, after introducing [the practice], would be supportive. … tell them what their expectations are and make sure they understand because you could assume your staff knows but they may not know. … give your teachers feedback as to whether they are doing it correctly, if you are pleased with what you see. If you are not, [say] "Why don't you try this?" and give some suggestions of what to do instead of just saying "You are not doing what I said to do."

In sum, teachers seemed both to appreciate some flexibility in how they implemented the practice and to crave a degree of consistency around what we might term the "grammar of SIDU"—that is, which data count? What formats (data walls, data displays, student folders) will facilitate the practice? How will we talk to students about these artifacts? These elements seemed lacking, resulting in a need for these teachers to seek out and create resources to make the practice work with little in the way of formal, ongoing supports.

6. Discussion: meeting student needs by addressing teacher needs

Though our findings are specific to the teachers in our sample, some of the issues raised by this study can inform both needed research on SIDU and planning dialogues as preparation and hiring entities consider efforts related to supporting SIDU. In this section, we discuss the roles that research, teacher education and preparation entities, and schools and districts may play in supporting teacher learning around SIDU.

6.1. Catching up to practice: research on SIDU and teacher preparation and support

In recent years, researchers and policymakers have focused on how teachers use data to address student needs (e.g., Coburn & Turner, 2012; Hamilton et al., 2009; Means, Chen, DeBarger, & Padilla, 2011). While research has established an evidence base for related practices like formative assessment (e.g., Black & Wiliam, 1998; Wiliam 2011a,b; Van der Kleij et al., 2015),

reflective practice on the part of students (see Marzano et al., 2001); and self-monitoring practices (e.g., Sugai et al., 2000), it has decidedly *not* established to any degree the effects of SIDU as it unfolds as described in this or related studies (e.g., Marsh et al., 2016).

We must wrestle, then, with a conundrum: Is it premature to posit ways to equip teachers to think about or engage in SIDU? We think not, for two reasons. First, as research is establishing, these practices are being implemented in a variety of contexts, and by numerous teachers and leaders (see Jimerson & Reames, 2015; Marsh et al., 2016). Thus, we take inspiration from a quote oft-attributed to 19th century French politician A. A. Ledru-Rollin: "There go the people; I must follow them, for I am their leader." Practitioners are already implementing SIDU; it is thus important for research to ensure that if SIDU is implemented, that it is done in ways consistent with the evidence available.

Second, and related to the first, we *do* have a good amount of related research in the field that could support (in theory) positive outcomes for SIDU. If SIDU were implemented in ways consistent with, for example, formative assessment practice, and goal achievement theory, and developmental psychology, as well as with work on continuous improvement, then the practice might well result in the kinds of benefits that Guskey's work (1989; 2002) suggests are important for the retention of new practices. But before we dive into robust studies of SIDU-related outcomes, we need to make the practice *evaluable*. Without bringing some consistency to the practice, it will continue to be difficult to ascertain the effects of SIDU across multiple classrooms or contexts. Helping teachers understand the factors at play in SIDU is one avenue to creating some consistency of practice that can make SIDU broadly evaluable, particularly for mixed methods or quantitative approaches that take into account various outcome data. Thus, in what follows, we posit some ways in which those involved in teacher preparation and professional learning might build capacity for SIDU in ways that align with research.

6.2. Potential supports: the role of teacher education and preparation entities

Teachers in this study reported receiving little preparation specific to SIDU. As SIDU has not been around long, we were not surprised to hear that it was not a prominent theme in preparation program experiences. Still, for colleges of education and other preparation entities aiming to support preservice teachers, we see four areas where SIDU might be woven into programming: (1) data literacy; (2) purposes of assessment; (3) motivation and goal achievement theory; and (4) developmentally-appropriate practice.

6.2.1. Data literacy

Data literacy is the "ability to transform information into actionable instructional knowledge and practices by collecting, analyzing, and interpreting all types of data […] to help determine instructional steps" (Gummer & Mandinach, 2015, p. 2). Skills, knowledge, and dispositions related to data literacy provide a foundation for the ways in which preservice teachers will later, as in-service teachers, work collaboratively to set goals, develop learning plans, and monitor progress. Without this foundation, preservice teachers may struggle to understand how SIDU fits with broader classroom practice. Preparation programs should therefore consider how programming not only addresses assessment practice and basic statistical concepts, but also helps aspiring teachers build understanding around issues like the value of multiple measures, methods for collecting valid and/or credible data on individual students as well as groups of students, and skills that enable

accurate interpretation in ways that give rise to instructional adjustments. While some preparation entities already address such issues, research suggests that data literacy is often given short-shrift (e.g., Mandinach & Gummer, 2013; Mandinach & Friedman, 2015; Mandinach, Friedman et al., 2015).

6.2.2. Purposes of assessment

As teachers in this study intuited their own purposes or "end goals" for SIDU, we think an opportunity exists to nest SIDU more explicitly in formative assessment practice. For example, Wiliam (2011a,b) details how critical reflective, self-assessment is for all learners, and how exemplary assessment practice requires regular, constructive, specific feedback. Van der Kleij et al. (2015) similarly demonstrate how data use, formative assessment, and diagnostic testing can be used in complementary and mutually reinforcing ways for the benefit of student learning. SIDU thus appears to hold potential for the scaffolding of reflective learning and progress monitoring into the formal learning process.

Though such work suggests promise for SIDU, we think that if a clear purpose is not established for assessment, data use in general, or SIDU in particular, teachers may intuit purposes that are primarily accountability- or compliance-oriented (as did Daniel and Paul). Unfortunately, research is replete in capturing the damage done to school climates and students when success on high-stakes tests becomes the end goal, rather than a marker along a longer journey of learning (e.g., Booher-Jennings, 2005; Daly, 2009; Valli & Buese, 2007). It is important that teachers have a firm grounding in not only the knowledge and skills pertinent to assessment practice, but also a clear understanding of assessment as a process through which educators excavate student needs and inform next steps, rather than as a way to "game" accountability systems.

6.2.3. Motivation/goal achievement theory

What motivates students continues to be a hot topic, with Dweck's (2006) Mindset and work from Duckworth and Gross (2014) on "grit" taking center stage in everything from TED talks to Education Week (see Dweck, 2015). Several of the teachers in this study asserted that SIDU "motivated" students, but they did not have well-developed personal theories-of-action for how the ways in which they implemented SIDU might catalyze motivation.

Without a firm theoretical grounding in motivation, implementation may look quite different depending on how teachers think SIDU works. Teachers who have little grounding in motivation or goal achievement theory might struggle to fit SIDU with practice in ways that are healthy for all students. For example, Jimerson and Reames (2015) posited that implementations of SIDU may be similar from the teacher standpoint, but could have differential effects depending on whether students enter the classroom with a growth or fixed mindset; one student might respond to feedback or a low grade with earnest rededication to schoolwork, whilst another may shut down, perceiving feedback as confirmation of negative self-beliefs. Preparation entities could contribute to balanced approaches to SIDU by ensuring preservice teachers are well-versed in motivation theory (and related concepts, such as positive behavioral intervention strategies).

6.2.4. Developmentally-appropriate practice

Finally, several teachers alluded to struggles in making SIDU developmentally appropriate for students. They talked about the time needed to have young students physically complete graphs or tracking charts in data folders. Some expressed concern that the students failed to grasp meaning in the data. Others worried about self-concept when students received or reflected on low grades or under performance. Some of these concerns may be addressed by helping teachers engage in difficult conversations in ways that are productive and ensure emotional safety for all parties (e.g., Patterson, Grenny, McMillan, & Switzler, 2012).

A solid body of literature in developmental psychology suggests that how we approach and engage children—particularly with abstract or challenging cognitive tasks—must take into account developmental abilities and needs (see Berger, 2015). This means that teachers need not only to understand how to use data, and how to use data with children, but when and under what conditions children might struggle with concepts related to goal-setting and planning, with activities like graphing and tracking data, and with reflection on progress (or lack of progress). They also need a foundation in issues related to child and/or adolescent development so that they may discern when non-progress or regression should raise flags of concern, and when they may be part of the natural ebb and flow of development. Teachers who enter the profession with this foundation may be able to better discern which iterations of SIDU may promote mindfulness or exacerbate the kinds of anxiety that undermine learning (see Zelazo & Lyons, 2012).

We see these four issues as building blocks; without understanding how each influences teaching and learning, teachers may be hard-pressed to integrate SIDU into their classroom practice in constructive ways. In colleges of education where these themes are already well-developed, considering how they may be tied more explicitly to SIDU may enable smoother integration with practice post-hire.

6.3. Potential supports: the role of schools and districts

Though we think colleges of education ideal places for developing a foundation for constructive SIDU practice, we also recognize that hiring entities (i.e., school districts) cannot expect colleges of education to do this work alone, as policies, routines, and expectations specific to SIDU will vary from context to context. To that end, we now turn to a focus on ways schools and districts can support teacher learning around SIDU. We discuss three ways in which school districts can build on or extend the foundation laid by preparation programs: (1) Excavating beliefs and moving toward common understandings around SIDU; (2) Establishing clear expectations for how SIDU unfolds in a given context; and (3) Enabling a nonthreatening climate of inquiry.

6.3.1. Common understandings

Preparation programs may lay a foundation for understandings about assessment, data use, and SIDU, but school districts should not expect that all teachers come into their respective jobs with common understandings around the purpose of assessment, the role of data use in informing practice, how SIDU may motivate (or de-motivate, depending on how it is enacted), or how student developmental needs may necessitate adjustments to practice. Senge (2006) asserts that humans bring various mental models and understandings about concepts to bear on decision-making. This does not mean that the newly-hired (or veteran) teachers are "wrong" in their assumptions about these issues, nor that the preparation programs were inconsistent—it simply reflects the diversity of human learning and experience.

Senge (2006) also suggests a conscious effort to excavate personal mental models is an important part of any organization's work, if the organization wants to move forward, together, in a particular direction. This process of excavating mental models and of arriving at common understandings can generate the kind of buy-in needed to get members of an organization to take steps toward changed practice. District leaders therefore need to consider how they are engaging with teachers to calibrate common understandings around SIDU and data use more broadly (e.g.,

"What counts as 'data'?"; "What is our end goal for SIDU at our school—what do we hope to accomplish?"; "How will we know if SIDU is moving us closer to the kind of place we want to be?") (see Wayman, Cho, & Johnston, 2007).

6.3.2. Grammar of SIDU

Teachers in this study expressed a measure of uncertainty as to whether they were "doing it right"; that is, they worked hard to implement SIDU, often cobbling together resources and working from ambiguous directions from supervisors. We therefore think that a useful component of the calibration process described above would be to collaboratively set expectations for baseline (not lockstep) implementation. Will all students (at all grades) have a personal data folder, and if so, what are the kinds of measures that may be valuable to teachers and students? How will the included materials differ by grade level or by content area? Will the data include only tested areas, or will we also focus on social/emotional data? Will classrooms have data walls, and if so, what kinds of data will be posted? Such conversations must also be informed by work on ethical uses of data and data privacy (Mandinach, Parton et al., 2015).

Teachers in this study were unanimous in describing how time-consuming SIDU could be; conversations to establish expectations for SIDU should therefore take into account the ways in which teachers will need to prepare materials and resources to enact SIDU in the agreed-upon format. And, preparation of materials is only one side of the coin; how teachers will carve out time for dialogues with students must be addressed. The school day is a zero-sum game; if teachers devote an extra 30 min a day to SIDU, what doesn't get done? In some contexts, this may mean a better use of instructional time; in others, it may mean that school leaders have to reconfigure schedules to help teachers fit SIDU to practice. These are not small considerations—even our sample of teachers, who were overall very positive about SIDU—lamented the challenges of time. This fits with broader research pointing to how educators struggle to fit data use with practice in the context of already-harried days (Kerr et al., 2006; Marsh, 2012; Means, Padilla, DeBarger, & Bakia, 2009; Schildkamp & Kuiper, 2010; Schildkamp & Poortman, 2015). Co-constructing how SIDU will look and unfold in the context of day-to-day schooling will likely be a critical component of any implementation efforts.

6.3.3. Nonthreatening, ethical climates of inquiry

Finally, research on data use has already established that data use should occur in a nonthreatening, supportive culture of inquiry (Depka, 2010; Louis, 2007; Wayman & Stringfield, 2006). Educators should be able to discuss strengths and vulnerabilities and dialogue with colleagues about ways to improve (see Katz & Dack, 2014). In SIDU, that culture must extend to the ways in which students are involved in conversations about their learning. School leaders must model appropriate and ethical uses of data with teachers, and must also establish clear expectations for how data will or will not be used with students. For example, uses of data in ways that violate privacy restrictions or serve to shame students, rather than to engage reflection, should be explicitly excluded from practice (e.g., Mandinach, Parton et al., 2015). As teachers transition from pre-service work to full time employment, they will look to the leaders in their new contexts to make clear expectations for practice; leaders can promote and support SIDU implementation by modeling ethical and collaborative data use with teachers.

7. Limitations and conclusion

Future research is needed to add to the depth and generalizability of research on SIDU. This includes more exploratory studies that are able to dive deep into classroom practices, but it also requires approaches that include quantitative or mixed-methods approaches and which are able to discern the effects of SIDU practices on a variety of student outcomes. Still, the experiences of these 11 teachers can give rise to insights and considerations that can inform dialogues in school district and preparation contexts. For some, those dialogues may result in determinations that identified needs or gaps are being well-addressed. For others, they may result in changes in the ways preservice or in-service teachers are supported in learning about SIDU. As research on SIDU accumulates, generalizable studies will speak to broader issues; for now, we think the themes that emerged from this study can help seed worthwhile conversations among those who aim to support students by supporting the development of teachers.

Guskey suggests that as teachers experiment with instructional changes, they will retain and sustain practices perceived as useful (1989; 2002). But if teachers find SIDU confusing or difficult to implement, they may never get to a point where they could see benefit. And, if they do implement, but do so in ways that are counter to the evidence in related fields, they may set themselves and students up for failure and frustration. We therefore need to know more not only about the conditions under which SIDU may effect improved student outcomes, but also about the conditions that give rise to effective teacher learning around SIDU. The present study provides a starting point for those conversations—conversations which will prove most fruitful if they involve those on both ends of the preparation and hiring spectrum.

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