2019

# "Asking, Learning, Seeking Out": An Exploration of Data Literacy for Teaching

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## Original Publication Citation

Beck, J. S., Morgan, J. J., Brown, N., Whitesides, H., & Riddle, D. R. (2019). "Asking, Learning, Seeking Out": An Exploration of Data Literacy for Teaching. *The Educational Forum*, 26 pp. doi:10.1080/00131725.2020.1674438

**Abstract**

The current study explored preservice and inservice teachers' perspectives on data literacy for teaching. Semi-structured interviews were employed with 12 teacher candidates in elementary and special education. The findings revealed participants' misconceptions regarding formative and summative data; their understanding of the value of formative data; perceptions of challenges related to data literacy for teaching including time, making sense of data, and reliability and validity; and candidates' preferences for authentic data literacy instruction.

*Keywords:* data literacy for teaching, preservice teacher education, inservice teacher education

# "Asking, Learning, Seeking Out": An Exploration of Data Literacy for Teaching

The call for teaching to become an evidence-based profession is clear and loud. In the United States standards and accountability have been increasing in intensity since the late 1990s; the new Every Student Succeeds Act (ESSA, 2015) provides direction for state and local educational agencies to offer data literacy for teaching (DLFT) professional development (p. 64, p. 129). This push is also evident in policy related specifically to teacher education. The Council for the Accreditation of Educator Preparation (CAEP; 2015) indicates in Standard 1.2, "Providers ensure that candidates use research and evidence to develop an understanding of the teaching profession and use both to measure their P-12 students' progress and their own practice" (para. 3). Thus, teacher preparation programs must ensure that their candidates are knowledgeable about techniques that they can use to monitor student progress and evaluate their own teaching.

However, the construct of DLFT is still relatively new to teacher education research and preparation programs have sometimes been slow to implement DLFT in their curricula (Mandinach, Friedman, & Gummer, 2015) despite policy keeping a brisk pace in responding to this need (Mandinach & Gummer, 2016; Piro et al., 2014). This is further complicated by debates around assessment literacy and DLFT (e.g., DeLuca & Bellara, 2013; Reeves & Honig, 2015) which we explore briefly below. The current study sought to add to the burgeoning literature on DLFT by exploring preservice and inservice candidates' learning and perceptions of the construct after completing a course on this topic. This is an important contribution since the majority of work on DLFT has focused on inservice teachers (Mandinach & Gummer, 2016; Reeves, 2017). We used a qualitative design to explore our research questions about candidate learning after a DLFT course.

## Literature Review

It is important to acknowledge why we chose to frame our work within DLFT rather than assessment literacy. First, Mandinach and Gummer (2016) have noted how problematic the conflation of the two constructs is because it interferes with the adoption of DLFT in education. This conflation may in part be due to the rise of summative assessments described above which privileges this narrow type of measurement rather than a broad array of data. We chose DLFT because we identify it as a larger construct than assessment literacy since the latter focuses solely on the use of assessment data (Mandinach & Gummer, 2016). For the purposes of this manuscript, we utilize an operational definition of DLFT from Gummer and Mandinach (2015) due to their prolific work on this construct:

> Data literacy for teaching is the ability to transform information into actionable instructional knowledge and practices by collecting, analyzing, and interpreting all types of data (assessment, school climate, behavioral, snapshot, longitudinal, moment-to-moment, and so on) to help determine instructional steps. It combines an understanding of data with standards, disciplinary knowledge and practices, curricular knowledge, pedagogical content knowledge, and an understanding of how children learn. (p. 2)

This definition conveys a broad view of data that moves beyond quizzes and tests to acknowledge the full range of information that can be collected from students and stakeholders to inform instruction and improve a school. This is in direct contrast with assessment literacy.

In our review of the literature on assessment literacy, the most frequently-cited definition of this construct came from Stiggins (1995) who defined "assessment literates" as:

> Those … [who] know how to meet specific standards of quality. Those standards hold that assessments 1) arise from and serve clear purposes; 2) arise from and reflect clear

> and appropriate achievement targets; 3) rely on a proper assessment method, given the purpose and the target; 4) sample student achievement appropriately; and 5) control for all relevant sources of bias and distortion. (p. 240)

The emphasis in the above definition is on reliably and validly evaluating student achievement without any connection to curriculum design. In a more recent study, DeLuca and Bellara (2013) defined assessment literacy in the same manner as Stiggins (1995), but added "assessment literacy involves integrating assessment practices, theories, and philosophies to support teaching and learning within a standards-based framework of education" (p. 356). Thus, they have updated the definition to tie into the current culture of accountability in education. However, their definition fails to acknowledge the broad range of data available on student learning. DeLuca and Bellara (2013) have argued that assessment literacy encompasses DLFT but we find this claim to be problematic due to the narrow focus of assessment literacy on assessment data whereas DLFT encompasses assessment data along with a variety of other data including those on school climate, student affect, observations, etc. Furthermore, DLFT has consistently focused on creating actionable teaching items based on data whereas assessment literacy has not. Thus, we deemed it most appropriate to situate our work within DLFT, and we view assessment literacy as a subskill of DLFT (Reeves & Honig, 2015).

**Data Literacy for Teaching**

Since DLFT is a relatively new and under-researched construct in preservice teacher education, much of the work in this area is theoretical, but empirical work is beginning to emerge. Gummer and Mandinach (2015; Mandinach & Gummer, 2016) have provided a conceptual framework for DLFT that defines the types of knowledge and actions that make up this construct. The authors include seven key knowledge areas that integrate with data use in the

inquiry process: (a) content knowledge; (b) general pedagogical knowledge; (c) curriculum knowledge; (d) pedagogical content knowledge; (e) knowledge of learners and their characteristics; (f) knowledge of educational contexts; and (g) knowledge of education ends purposes, and values. In addition to these knowledge areas, they further denote that DLFT requires teachers to posses particular skills such as identifying problems and framing questions, using data, transforming data into information, transforming information into decisions, and evaluating outcomes. Mandinach and Gummer (2016) have advocated integrating DLFT early on in the teacher education continuum, and Bocala and Boudett (2015) have supported incorporating DLFT into preservice teacher education broadly.

Researchers have approached DLFT integration in various ways. Bocala and Boudett (2015) advocated preparing preservice teachers to be team facilitators of data use. They further urged that this type of training be tied to clinical preparation to foster professional learning. Mandinach and colleagues (2015) reviewed 80 syllabi and state licensure documents as part of their investigation of DLFT instruction in schools of education in the United States. They found that the majority of institutions offered a stand-alone course on data use targeted for undergraduate, preservice teachers. These classes were primarily delivered in a face-to-face setting by a tenure-track professor. Students in these courses had the opportunity to practice with authentic or simulated data. However, modern data systems and data tools were frequently not addressed. The responding schools in this study focused more on assessment literacy than DLFT. Based on these studies, relatively little is known about what DLFT instruction looks like at the preservice level and how it can be improved.

A subcategory of research on DLFT focuses on interventions for improving preservice and inservice teachers' DLFT and sheds some light on DLFT instruction. Kennedy and

colleagues (2016) explored the use of content acquisition podcasts for improving preservice teacher knowledge of curriculum-based measurement. Although both the curriculum acquisition podcast group and reading group showed growth in learning about curriculum-based measurement, the content acquisition podcast group outperformed the reading group. Reeves and Honig (2015) conducted a 6-hour DLFT intervention in an assessment course and demonstrated that it was possible to influence preservice teachers' DLFT knowledge and beliefs in this short intervention. In their quasi-experimental study, Fives and Barnes (2017) found that a brief intervention using a Table of Specifications could scaffold naïve assessment constructors' abilities to construct items. Dunlap and Piro (2016) and Piro and colleagues (2014) have used an approach they call a Data Chat to foster DLFT in their teacher candidates. Their eight-step data chat included a variety of DLFT knowledge and skills including incorporating state standards, contextualizing knowledge of local school districts, using data to drive instruction, evaluating a data set, creating formative and summative assessments, and presenting findings. The authors found that even after this short intervention participants perceived increased confidence in their DLFT skills and the authors also saw changes in how participants contextualized, comprehended, analyzed, and used data. Additional work is needed to better understand the types of DLFT interventions that are most meaningful to preservice teachers, including additional work within particular content areas like Tatar and Buldur (2013) have done in assessment literacy.

Other research has focused on the student teaching element of teacher education specifically or teacher inquiry as a method for fostering DLFT. Cowie and Cooper (2017) conducted an intervention study in New Zealand on student teacher mathematical thinking that included a coach to support teacher candidate learning on a "Maths Hub" website. The authors explored the perceptions of lecturers, school leaders, and candidates in the program and found

that their preservice participants had profiles similar to those of practicing primary teachers in New Zealand. Their participants struggled with many of the same aspects of mathematical and statistical literacy found in other studies. Moreover, a number of participants reported lacking confidence, motivation, and enjoyment for mathematics. They advocate a "pan faculty" approach in that "every citizen needs to be data literate in ways appropriate for their professional and personal circumstances and goals" (p. 160). Reeves (2017) found that the only coursework that demonstrated a significant increase in DLFT use during student teaching was a course on teacher inquiry—thus showing promise for this mode of instruction. Athanases, Bennett, and Wahleithner (2013) studied artifacts from a teacher inquiry course compiled over 6 years. Through quantitative scores on the artifacts, as well as the analysis of two case studies, the authors concluded that development of DLFT is possible through teacher inquiry, but it is challenging.

Throughout the research on DLFT it is clear that the skills within this construct need to be incorporated throughout the teacher education continuum in order to adequately prepare new teachers for the current culture of accountability and to ensure that student achievement is assessed accurately. However, at least one article (Dunn, 2016) has shown teacher candidates to be resistant to DLFT but this article relied solely on a quantitative survey. Moreover, many of the intervention studies reviewed above relied on inductive methods including quantitative surveys (e.g., Reeves, 2017), quantitizing qualitative data (e.g., Athanases et al., 2013), or applying a priori coding (e.g., Fives & Barnes, 2017) rather than using emergent methods like interviews or open-ended responses. A qualitative study that uses emic codes would be a contribution to this body of literature by providing additional depth and nuance to the study of DLFT. Indeed, such a study could help to drive the creation of future intervention studies by better understanding

teacher candidates' perspectives. The current study set out to investigate the following research questions through an emergent, qualitative design to supplement existing research:

1. What are candidates' misconceptions and understandings regarding DLFT?
2. What do candidates perceive to be the challenges of DLFT?
3. How do candidates prefer to learn about DLFT?

## Methods

This qualitative investigation was situated within three DLFT courses. Semi-structured interviews were employed to gather data and then subjected to multiple rounds of data analysis (Saldaña, 2009).

### Research Context

The current study was set within the context of an urban, research-intensive university in the southwestern United States. Southwestern State University[1] serves over 28,000 students—many of whom are first-generation college students. Over 15,000 (55%) come from traditionally marginalized ethnic backgrounds making Southwestern State a Minority Serving Institution. The College of Education at Southwestern State touts a mission of preparing teachers for the large, ethnically and linguistically diverse school district nearby.

The College of Education at Southwestern State offers numerous paths to licensure for students who wish to become teachers including traditional licensure programs for undergraduate students as well as alternative route to licensure (ARL) programs for master's students. In the latter program, students complete one semester of courses and are then eligible to be hired as teachers of record while they complete the remaining licensure requirements while teaching full time on an emergency license. The current study was a collaboration between special education

[1] All names of people and places are pseudonyms.

faculty and teacher education faculty and took place within three courses: two master's level, data-based decision making courses for special education candidates and one undergraduate, elementary education curriculum and assessment course. This collaboration was important for several reasons. First, the field of special education has a history of using data systematically to drive instruction (Deno, 2003), and general educators are beginning to actualize this. Thus, we felt that the study would be strengthened through this collaboration. Moreover, we feel that such interdisciplinary collaborations are important generally for professional learning and to strengthen teacher preparation. From a DLFT perspective, the purpose of engaging in data-based decision making is to create actionable, differentiated instructional plans for diverse learners in a classroom environment—a main clinical focus of collaboration between special and general education teachers. Therefore, we thought it important to consider both general and special education candidates in this process in order to identify trends that may exist in schools.

For the purposes of this paper, we are subsuming both data-based decision making and curriculum and assessment under the larger topic of DLFT. Furthermore, each of the three courses was taught by a different instructor—all of whom were members of the research team. Team members provided support through conducting interviews to avoid any conflict of interest by introducing instructors to the data collection process. While all of the courses differed in their delivery, each course did include one presentation on unwrapping standards (Authors, 2014; see Table 1). Finally, due to disagreements over the definition of formative and summative assessments (Popham, 2009), we have adopted Popham's (2009) approach to differentiating between the two types of assessment based on their use. Specifically, the use of summative assessment to "arrive at go/no-go decisions based on the success of a final-version instructional program" or the use of formative assessment as "a process in which assessment-elicited evidence

is used by teachers to adjust their ongoing instructional activities, or by students to adjust the way they are trying to learn something" (p. 5).

[Insert Table 1 around here]

**Participants**

The candidates who participated in this project were enrolled in one of the three courses described above. We chose the 12 participants through a process of maximum variation sampling (Patton, 2002) from each class; specifically, we chose four participants from each class who were diverse in gender and ethnicity as well as their path to licensure. We chose four participants from each class because this was approximately 20% of the sample in any given class (i.e., each class had about 20 students). A small sample is consistent with the qualitative approach and purposive sampling used for this study. Four participants were undergraduate elementary candidates while the other eight participants were master's students studying special education in ARL, Teach for America, or traditional programs. We purposely chose to focus on candidates from both special education and elementary programs in order to see what common themes were evident across these two programs. Indeed, the candidates in this study represented a variety of pathways to licensure, and we viewed their backgrounds as well as their experience or inexperience in the classroom as a strength of the sample since clear themes emerged across this diversity (see Findings below). Three of the 12 participants were men; this sample was predominantly White (54%) with other students identifying as Asian/Pacific Islander (18%), Hispanic (18%), and Black (1%) (see Table 2).

[Insert Table 2 around here]

**Data Collection**

Two of the courses operated on a 15-week semester schedule while one course operated on an expedited, three-week schedule which caused variation in data collection schedules. For instance, post- interviews were conducted between March 5 and 7, 2015 for the three-week course while, for the 15-week courses, post- interviews were conducted between May 4 and May 13, 2015. Semi-structured interviews were chosen to cull similar information from participants while allowing interviewers the opportunity to ask follow-up questions (Merriam, 2009). Interview questions asked about assessments and tests (e.g., "What do you know about assessments or tests?"), data (e.g., "What do you know about data?"), instruction, (e.g., "What do you know about using data to inform instruction?"), and their preferences for learning, (e.g., "What do you think is the best way to learn about data literacy?"). Participants were also invited to provide us with any information on this topic that they wanted to as part of these interviews.

**Data Analysis**

In order to analyze the data, all members of the research team engaged in open coding of three transcripts as part of the first round of a two-part coding cycle (Saldaña, 2009). Three research team members then open coded the remaining transcripts independently. After the open coding was complete, these research team members used these codes to develop their analyses of participants. These analyses were then organized into a matrix (Stake, 2006) to track recurring ideas and themes across participants (see Table 3). The first author then utilized the theme matrix, summary analyses, and coded transcripts to write up the final results.

[Insert Table 3 around here]

**Validity**

The primary method the research team used to ensure the credibility of our findings was analyst triangulation (Patton, 2002). When we began to conduct open coding of the transcripts,

we chose one participant's data to code concurrently. The entire research team then met to discuss the major ideas we noticed in the data, including the most significant points for that particular participant. This process was repeated twice with one participant from each of the other courses. This analyst triangulation continued into the next round of analysis in which three research team members worked together to finalize the analyses through summarizing and tracking important ideas and themes in the matrix. We also collected rich data in order to ensure the credibility of our findings (Maxwell, 2013) including over 4 hours (268 minutes) of post-interview audiotape which amounted to 129 pages of transcript data.

## Findings

Here we report the findings from our qualitative analysis along with supporting evidence from participant interviews. The following categories were identified through our analysis: (a) DLFT misconceptions and understandings; (b) perceived challenges of DLFT; and (c) preferences for learning about DLFT.

### Data Literacy for Teaching Misconceptions and Understandings

After a semester of coursework on DLFT issues, students demonstrated a range of misconceptions as well as understandings of this content. A primary struggle for students that was evident in these data was understanding the difference between formative and summative data. For example, Heather—a master's in special education candidate—demonstrated what appeared at first to be a clear understanding of formative and summative data, "So the formative is kind of along the way, the little things, while you're assessing while they're learning. Where the summative is after they've learned, to see what they've learned." However, later on she noted that she thought that summative assessment happened a lot, "especially when you're testing at the beginning of the year. You really have no way around that." Thus, she appeared to confuse

baseline or diagnostic data as summative. Hannah, an elementary candidate and undergraduate student, also seemed to struggle in her understanding of these concepts. She defined summative as "like the standardized assessments." Thus, she may have conflated summative with standardized assessments rather than recognizing that other assessments like unit tests or performance assessments are also summative. Other students were unable to think of data broadly like Jamie, a master's special education candidate teaching on an emergency license, who noted, "data is [*sic*] solid numbers and performance on paper... if there is no data, it didn't happen." Although concrete evidence is important, Jamie did not conceptualize this evidence as anything but numbers. Angela, a preservice teacher and an aspiring art and elementary teacher, had a similar struggle. When asked about the difference between formative and summative data she noted, "Formative is administering tests that kind of show the progress of how [students are] doing throughout learning." Thus, she conceptualized formative assessment as tests only rather than the broad array of data that other participants were able to cite as demonstrated below.

However, even though participants struggled with a nuanced understanding of formative and summative data, they clearly understood that formative data could be used to monitor student academic learning and evaluate their own teaching and saw this as the primary benefit of data. For example, Ashley—a preservice teacher and master's special education candidate—said she would use formative assessment regularly to "measure their [students'] growth" and to rethink her instruction. Diana, also a master's special education candidate and preservice teacher, echoed Ashley when she described formative assessment as, "something you're continually doing" to "create the foundation to see where kids are." Grace, a master's in special education candidate teaching on an emergency license, noted these benefits of formative data and added the value for her own professional growth, "also they [assessments and tests] can be used to test our

teaching, if we are teaching the concepts and things the way we should be." Jamie, a master's in special education candidate teaching on an emergency license, expanded on these understandings, "You can have [assessments and tests] that are summative, formative, informal, formal, and they really are what drive our student growth in classroom instruction and behavior-wise.' Jamie's mention of behavior here is important since it demonstrates an understanding that data can measure more than simply academic learning. Tom, a preservice teacher and elementary candidate, was able to cite a broad array of formative data unlike his peers who could think of only assessments, "Formative is weekly quizzes, bell ringer tests, where you are at right now. Quicker snapshot-type picture." Similarly, John—a master's candidate teaching on an emergency license in the Teach for America program—believed that "data can come from anything. Data can come from tests, homework, assessments, observations, home life, files. It can come from anything." Grace, an inservice master's candidate in special education teaching on an emergency license, was able to provide examples of how she used AIMSweb (Pearson, 2014), and a core phonics survey to track student progress in particular areas. Because she was already serving as a teacher of record on an emergency license, her experiences on the job may have afforded her some of this learning. It is important to understand both the struggles of these participants as well as what key concepts they grasped in order to design impactful instruction and interventions.

**Perceived Challenges of Data Literacy for Teaching**

Our participants noted a number of challenges with DLFT including finding time to conduct assessments, making sense of relevant data, and ensuring reliable and valid data. Some of our participants were concerned about finding enough time to implement data practices in their own classrooms. For example, Ashley—a preservice teacher and master's in special education candidate—thought that assessing was time consuming and referenced creating the

assessments as requiring the most time. Angela, an undergraduate teacher aspiring to teach at the elementary level, was also concerned about how much time tests took to administer, which she thought was compounded by the large class sizes in the local school district and technological issues associated with computerized tests. For Grace, a master's candidate in special education teaching on an emergency license, the challenge was finding time to use data to differentiate instruction and/or tailor it to meet the needs of a student's Individualized Education Program (IEPs). Thus, for Grace, the bulk of the work lay in preparation rather than actually administering the tests.

Other participants worried about making sense of the data that they collected. Ashley, a preservice teacher and special education candidate, noted, "There is [sic] just a lot of data to go through, and sift through and analyze." Diana, also a preservice teacher and special education candidate, echoed this sentiment and added,

> Having the ability to focus on the data that you want to collect as opposed to the data that you're required to collect. And also getting the data together, collecting the data, storing the data, as opposed to just having this big pile of numbers and data.

Diana's comments here communicate several ideas. First, she is concerned about being able to collect data for her own purposes that might be extraneous to the data she is required to collect for external purposes. She also expressed concern with data management including storage, as well as analysis. Angela, a preservice teacher and elementary hopeful, summed, "I think the most difficult thing about [DLFT] it's not reading it, but knowing what to do with it."

Obtaining reliable and valid data was a concern for many of our participants and these concerns stemmed from a variety of factors. Some participants were concerned about students' affective states that could influence their performance. Heather, a preservice teacher and master's

in special education candidate, noted that if students experienced test anxiety, "it's just going to skew your data." Heather was also concerned that students might not want to complete assessments. Tamara, a master's in special education candidate and preservice teacher, was concerned with other elements of students' emotional states, "If the child is not being fed, if there is domestic violence going on at home, hormones, moods, things like that. The child is having an off day. It can affect those numbers." Thus, she recognized that data might not always be an accurate portrayal of a child's ability due to factors outside of school. Angela, a preservice elementary teacher and undergraduate student, was concerned about the number of tests students had to take which she thought could be overwhelming for them. She explained an informal interview she conducted with an elementary student while substitute teaching,

> And he was just kind of explaining how many tests he was going to be taking…And he was just like, 'Honestly, they're kind of overwhelming…I just get kind of nervous taking them all.' And then this other student was just kind of agreeing with him, there are just so many tests.

Thus, she was concerned about the emotional distress that these tests could cause for students. Tom, an undergraduate elementary candidate and preservice teacher, recognized that the methods of data collection themselves could be problematic, "they're not always a very clear snapshot of where [students are] at because there is subjectivity, there's bias, there's all those nasty words we use." Some participants hungered for opportunities to apply their knowledge in the field which we turn to now.

**Preferences for Learning about Data Literacy for Teaching**

In soliciting students' preferences for learning about DLFT, we uncovered several important considerations including learning from peers, authentic instruction, and ongoing

exposure to DLFT practices. First, our participants cited a variety of ways in which they learned from their peers. Heather, a preservice teacher and master's in special education candidate, appreciated the conversations with her peers who were teachers already. Indeed, she thought the best way to learn about DLFT was to hear from other people's experiences and to see how they collect data and how it helped in their classrooms. Grace, a master's in special education candidate teaching on an emergency license, also looked to veteran peers for assistance with DLFT, "To practice it. To take data. Ask questions. The teacher next to me, I'm always over in her room, 'How do I do this?' [slight laugh] So just asking, learning, seeking out." Thus, she found the experience of a more seasoned teacher to be a useful method of instruction. Angela, an elementary candidate and preservice teacher, recognized the importance of sharing data in teams, as well as hearing the experiences of the other undergraduate, preservice students in her class. Tom, her classmate and preservice teacher, also noted that the facilitations that his peers conducted in his class were useful to his learning,

> I feel like learning and seeing and interacting with classes with observation and, you know, watching—that's a big part of it. You're seeing what's going on, so you use that information that you've watched and you want to try and take some parts of things you've seen work and then try them out for yourself

Thus, Tom felt that he benefitted from the peer scaffolding that his classmates provided.

Within the subtheme of authentic instruction, participants cited the need both for an instructional rationale for DLFT as well as opportunities for application. For example, Tamara—a master's in special education candidate and preservice teacher—wanted additional information on the Common Core State Standards (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010), Depth of Knowledge (Webb, 2002),

and task analysis (Authors, 2014). Tying DLFT to the larger accountability systems at play in a given state as well as at the national level may help to provide this rationale. Diana, a master's in special education candidate and preservice teacher, thought that the best way for teachers of all experience levels to learn about DLFT was, 'Showing them the benefits of it … showing them how to do it.' These benefits might include those for student academic learning and growth as well as teachers' own professional development. Jamie, an inservice teacher working on an emergency license and special education candidate, wanted DLFT to be interactive and hands-on with one-on-one explanations and examples. Indeed, John—a Teach for America corps member and candidate in special education—added that the best way to learn about DLFT was to utilize his own data. Angela, an undergraduate elementary education student and preservice teacher, appreciated taking assessments as part of her peers' presentations in her class, "it's just kind of helpful in that way, you get some type of practice of like what we could be dealing with later." Hannah, her classmate and aspiring elementary teacher, stated the best way for her to learn about DLFT was to be "thrown in" and participate in case studies in order to see "how important it was really." Tony, an undergraduate elementary candidate and preservice teacher, explained his preference for learning about DLFT, "Useful application. That is what you're going to be introduced to most likely [in schools]. Not just, 'This is how you can use it so let's try that.'…Useful application." His response hearkens back to the need for a rationale for DLFT. Tying it to local accountability systems will help to contextualize this need, too.

Still other participants cited the need for on-going exposure to DLFT. Ashley, a preservice teacher working toward her master's in special education, thought that professional development was the best way to learn about DLFT—particularly with examples and explanations in each session. Tamara, another special education hopeful and preservice teacher,

thought that the best way to learn about DLFT was through "some great websites and resources, and then from there some good journal articles." She seemed to indicate a preference for self-directed learning methods, "Here is a resource list, go figure it out." Thus, teaching educators how to continue to improve their learning independently seems to be important. Caitlin, an inservice ARL master's candidate on an emergency license, thought that it was important to embed elements of DLFT throughout a preparation program,

> If there's only one class then you might lose the history and the importance…what our district is doing with data and that's a whole topic in itself…comparing the data and stuff, not necessarily meaning you have to do hands on. That's all that base knowledge and then the hands-on part of it is like a practicum scenario later on down the road.

Caitlin here recognized the need to embed DLFT in different formats throughout a teacher education program—including in practica experiences for more specific, contextualized learning. We discuss the need for this continuum below.

## Limitations

There is no perfect study. All investigations suffer from threats to validity and the current investigation is no exception. Our study spanned one academic semester. Future studies should take a longitudinal approach and make every effort to follow the same participants from preservice to inservice teaching to understand how their learning changes along the preservice teacher education continuum. Additionally, we made every effort to ensure that participants did not feel coerced to provide us with particular responses in their interviews including ensuring that instructors did not interview their own students. However, participants may have inherently felt compelled to speak positively about DLFT since they knew it was the construct we were studying. Data triangulation can help to combat this in future studies.

## Discussion and Implications

In response to our first research question about candidates' misconceptions and understandings regarding DLFT, we found that candidates struggled with basic vocabulary related to DLFT including formative and summative assessment which we think may be a result of incoherence in the field regarding this construct (Gewertz, 2015). Thus, the field may need to ensure clarity first before this can be addressed at the program level. Specifically, a commission much like the Clinical Practice Commission (American Association of Colleges of Teacher Education, 2015) may need to be convened nationally or internationally for DLFT to resolve on-going issues of incoherence related to DLFT that includes formative and summative assessments as well as larger issues such as the debate over assessment literacy and DLFT (e.g., DeLuca & Bellara, 2013). Furthermore, although we made every effort to emphasize elements of the DLFT framework in our own courses, our instruction may have fallen short due to the limited readings and structures of the field. This finding provided us with an opportunity to re-evaluate our own curriculum and instruction.

At times, participants struggled to conceptualize data broadly. Thus, they may need to be exposed to a broader array of data. Specifically, a continuum for DLFT at the preservice level could be drafted that is similar to the one posed by Smith (2017) for research-based teacher education. For example, after introducing DLFT at the beginning of a program, candidates could be provided the opportunity to focus on and practice elements of the construct. In practicum coursework candidates could be trained to observe a classroom in order to evaluate student engagement and reflect on strategies that could be used to increase student engagement. Additionally, they could administer surveys on classroom climate to be analyzed and presented as part of their coursework. Indeed, survey design would be invaluable for new teachers who

could learn to create developmentally-appropriate items and use the results of the survey to drive their instruction in addition to assessments. Programs should consider collecting data from candidates regarding their prior knowledge and experiences to draft and integrate such a continuum into their coursework.

Our participants did not consistently express critically conscious concerns (Cross, Behizadeh, & Holihan, 2018) about DLFT. For example, Tamara expressed concerns about external and affective variables that could influence students' performance on assessments which showed the beginning of critically conscious concerns about the validity of assessments based on factors such as poverty. Although several other candidates expressed similar concerns these findings were not robust. However, we believe that equity must be explicitly infused into the burgeoning research on DLFT and we have explored these perceptions of four undergraduate teacher candidates in response to an intervention targeted on equity in DLFT elsewhere (Authors, under review).

Surprisingly, in stark contrast to Dunn's (2016) study, our participants did express the importance of DLFT and noted that using data to track student progress was the primary benefit of this construct. These values and understandings could be leveraged and built upon at the course level to tailor instruction to meet students' needs and interests which we describe in greater detail below.

Our second research question explored candidates' perceived challenges regarding DLFT. Although our participants noted that finding time to conduct assessments, making sense of relevant data, and ensuring reliability and validity of data collection were all concerns for them, these concerns could differ from program to program or even course to course. Thus, we concur with Cowie and Cooper's (2017) recommendation for a pan faculty approach to DLFT.

Specifically, teacher educators must model collecting baseline data that include candidates' academic and affective domains and use these data to drive their instruction. It is imperative that instructors model this approach for candidates and share the results with them transparently in order to convey not only its importance, but also methods for actually doing this work. Additionally, in order to contextualize DLFT instruction, experts from local school districts could be sought out to provide guest lectures or panel presentations on these areas of concern to contextualize them and provide concrete examples and strategies for tackling these issues.

Finally, in exploring our candidates' preferences for learning about DLFT, we found that they valued learning from their peers, authentic instruction, and on-going exposure to DLFT practices. Even at the preservice level, candidates found that they could learn from their peers who had, at most, experience as paraprofessionals and substitute teachers. Thus, collaborative and cooperative learning may be valuable modes of instruction. Furthermore, case studies around DLFT (Authors, 2017) could be created to provide the concrete examples our participants asked for and to generate analytic generalizability around DLFT instruction in the field of teacher education writ large. Indeed, these case studies could be tied to local accountability systems to provide the context our participants clamored for. Since context is important in DLFT instruction as demonstrated in our participants' responses as well as advice from leading researchers in this field (Mandinach & Gummer, 2016) context should be at the forefront of DLFT instruction but material sharing is still possible. Finally, our participants felt it was important to have on-going exposure to DLFT. Thus, a continuum for inservice teachers that relies on professional development and teacher leadership should be developed to complement the inservice continuum we have proposed here.

In 1995, Stiggins wrote, "[O]ur progress toward an assessment-literate school culture has been slow. As a result, we continue to place our young people directly in harm's way as potential victims of the ongoing mismeasurement of their achievement in the classroom" (p. 239). This threat still looms today, and valid assessment of students' knowledge and abilities is the most important goal in cultivating a data literate culture. Transparency and reporting of data are important parts of civil society (Webber, Scott, Aitken, & Lupart, 2014) and this data culture should be improved rather than shut down. Educator preparation programs have important roles to play in this work.

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