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“There Is Subjectivity, There Is Bias”: Teacher Candidates’ Perceptions of Equity in Data Literacy for Teaching

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“There is Subjectivity, There is Bias”: Teacher Candidates’ Perceptions
of Equity in Data Literacy for Teaching

Abstract

Research on equity in data literacy for teaching has lagged yet is of critical importance to ensuring new teachers are prepared to serve diverse students. Our multiple case study conveyed four elementary teacher candidates' understandings of this construct and their reaction to instruction in this domain. Data collection included interviews, item analysis, and concept maps. Our participants developed a broader view of data by the end of the course, but often did not recognize inequitable data practices like tracking which conveys a misalignment between beliefs and practices. We explored implications for policy and practice based on our findings.

Keywords: data literacy, equity, preservice teacher education

“There is Subjectivity, There is Bias”: Teacher Candidates’ Perceptions
of Equity in Data Literacy for Teaching

Accountability systems in the United States have historically been driven by an effort to bring equity to education. This was evident in the creation of the Elementary and Secondary Education Act ([ESEA], 1965) during President Lyndon Johnson’s “Great Society” program in 1965 (Popham, 2005) that aimed to serve students from historically underrepresented ethnic, racial, and socioeconomic backgrounds. Reauthorizations of ESEA since that time have dramatically changed the face of American accountability systems—perhaps none more than No Child Left Behind ([NCLB], 2002; DeLuca & Bellara, 2013). Yet these policies have, at times, led to the exacerbation of inequities rather than their remediation (Garner, Thorne, & Horn, 2017). Researchers are now calling loudly for the integration of data literacy for teaching (DLFT) into teacher preparation (Bocala & Boudett, 2015). We propose that this call must be taken one step further. Teacher candidates (TCs) should be taught about DLFT and how to accurately and equitably evaluate the learning of students who are diverse in background, gender, ethnicity, race, language, and socioeconomic status.

There are a number of ways in which the accountability movement has exacerbated inequities rather than mitigating them. Specifically, accountability policies have narrowed curricula to focus on test content (Shahjahan, 2011); exacerbated achievement “gaps” between marginalized communities and their White, middle class counterparts (Braaten, Bradford, Kirchgasser, & Barocas, 2017); pushed historically marginalized students out of schools to increase test scores (Shahjahan, 2011); reinforced deficit narratives about marginalized groups (Garner et al., 2017); and focused instructional efforts and resources unduly on groups of students who are viewed as able to reach benchmarks (Braaten et al., 2017). TCs must be

prepared for the accountability contexts in America's public schools and, specifically, how to recognize and address issues of equity. If equity is not included in this work, further harm may be leveled on marginalized communities. Our study focused on the implementation of equity in DLFT in an undergraduate elementary teacher preparation course in an effort to address this nascent but important work.

Theoretical Framework

In order to conceptualize how the TCs in this study understood equity in DLFT, we draw from the research on TCs' beliefs, DLFT, and equity in education to create an overarching theoretical framework (see Figure 1).

Teacher Candidate Beliefs

Beliefs are a notoriously "'messy'" construct (Fives & Buehl, 2012, p. 471). Beliefs can be explicit or implicit, exist along a continuum of stability, are context-specific, are interwoven with knowledge, and are integrated systems. Beliefs can act as filters of information in which they influence perception and interpretation, frames that define a problem, or guides that move teachers to action. Beliefs are important because of their relationship to practices (Author 2 & co-author, 2015). In particular, beliefs can influence practice, practice can influence beliefs, beliefs can be disconnected from practice, or beliefs may have a reciprocal but complex relationship to practices. Notably, at the preservice level, contextual factors such as mentor teachers' beliefs (Crawford, 2007) and field experiences (Hancock & Gallard, 2004) have been shown to shape TCs' beliefs. Studies of TCs have demonstrated how their beliefs can grow and change over the course of a teacher preparation program (Brownlee, 2003; Ng, Nicholas, & Williams, 2010); indeed, beliefs such as self-efficacy have been shown to be quite malleable in the early years of teaching (Woolfolk Hoy & Spero, 2005). However, beliefs may not always

develop in a robust way (Seaman, Szydluk, Szydluk, & Beam, 2010) and program coherence is critical in fostering TCs' beliefs (Tatto, 1996). In sum, beliefs have a complex but important relationship to practices and must be carefully scaffolded.

Data Literacy for Teaching

We used Gummer and Mandinach's (2015) definition of DLFT to guide this study:

[T]he 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)

DLFT has often been conflated with assessment literacy (Mandinach & Gummer, 2013, 2016), but we view assessment literacy as a construct within the metaconstruct of DLFT (Authors, under revision). For the purposes of the current study, we were particularly interested in DLFTs' knowledge of data including the different types of data and how these relate to how children learn. Until recently, assessments—particularly high-stakes assessments—have been emphasized to the neglect of data broadly (Mandinach & Gummer, 2016). However, a diverse array of data would better serve a student body rich in linguistic, racial, ethnic, religious, and gender diversity (Authors, under revision). Thus, DLFT may be conducive to increasing equity in education.

Equity

The notion of equity has varying definitions in the field of education from centering on fairness, to inclusion, to supporting individual student development (Datnow, Greene, & Gannon-Slater, 2017). For the purposes of our research, we defined equity as, “environments and

systems ... that provide students with what they need on the basis of careful and systematic attention to the particulars of their situation” (Milner, Cunningham, Delale-O’Connor, & Kestenberg, 2018, p. 12). We maintain that this attention must include a recognition of the, “intersections of race, class, teaching, and learning” (Garner et al., 2017, p. 410). Equity requires vigilance to policies and practices at the federal, state, local, and school-building levels to ensure a fair learning environment for all students. Equity in DLFT includes an understanding of how data can be used to marginalize students or narrowly represent them through numbers rather than a holistic portrait of their strengths. It also means understanding how data can be used by teachers to reflect on biases (Popham, 2014). Equity in DLFT has implications for instruction in creating curriculum and learning opportunities for students that draw from their assets and funds of knowledge. Currently, the field has little understanding about how equity can be incorporated into DLFT (Datnow et al., 2017). Although research has been conducted on equity audits (Capper & Young, 2015; Skrla, Scheurich, Garcia, & Nolly, 2004), these collaborative procedures are typically conducted at the district or school-building level rather than the individual level. In the current study, we provided TCs with a mechanism for evaluating their own curriculum materials individually for bias (Popham, 2014). However, more needs to be learned about how TCs conceptualize equity in DLFT including their beliefs.

Literature Review

Our review of the topical research unpacks the metaconstruct of DLFT first before exploring TCs’ beliefs and practices related to DLFT.

Data Literacy for Teaching Beliefs

Attitudes and readiness toward DLFT are important since they can influence the implementation of these practices. However, research on these dispositions at the preservice

level is thin and contradictory. This may be due, in part, to the fact that the majority of research on DLFT has been conducted with inservice teachers (Reeves, 2017). Nascent research is beginning to emerge about how TCs' prior knowledge and experiences influence how they approach DLFT. For example, Dunn (2016) found that TCs "were not receptive to learning more about DDDM [data-driven decision making] until their concerns regarding how DDDM will impact them, how they will be evaluated, and how they will be rewarded or punished are addressed" (pp. 38-39). She regarded these as "entrenched views" (p. 40). This viewpoint is contradicted by Cowie and Cooper (2017) who conducted an intervention that focused on student teacher mathematical thinking and provided a coach to support this learning on a "Maths Hub" website. They found that TCs lacked confidence and motivation and did not enjoy mathematics. They were ambiguous about their previous experiences with math and its role outside of a math classroom. They were concerned about data interpretation and using data to make decisions and professed interest in learning how to use Excel for data analysis and presentation. They also expressed an interest in understanding their students' demographics in order to learn more about them and where they come from.

Additionally, countering Dunn's (2016) findings, we have found TCs to be optimistic about DLFT practices after completing a course on this subject (Authors, 2019). Although they recognized the need to navigate and understand students' contextual factors, our participants conveyed that DLFT offers opportunities to monitor student academic and behavioral progress and evaluate their own teaching. In line with the research on TCs' beliefs, TCs' understanding of DLFT can develop rapidly with interventions as short as 6 hours showing TC growth (Reeves & Honig, 2015). Computer-mediated platforms have shown promise in intervention studies of TCs' DLFT (e.g., Zwick et al., 2008).

Data Literacy for Teaching Practices

Even less is known about TCs' data practices and the reason for this is multi-faceted. In at least one study (Carey, Grainger, & Christie, 2018) the researchers were not able to explore how TCs apply DLFT because the practicum experience did not provide them with sufficient exposure to a school setting nor the authority to use data to make changes to curricula. However, some research about this application exists within the context of teacher preparation programs. Athanases, Wahleithner, and Bennett (2012) explored how TCs applied learning about culturally and linguistically diverse students via teacher inquiry in a field experience. They found that TCs reported on classroom and school contexts but failed to connect to community demographics despite directions to do this. TCs also did not explicitly link their inquiry to cultural and linguistic diversity. However, TCs did provide high challenge and high support in their teacher inquiry projects and chose a variety of actions to learn about their culturally diverse students. Researchers have recommended that courses on DLFT be accompanied by field experiences to allow for application of knowledge and skills (Carey et al., 2018).

Reeves (2017) advocated that future research include the influence of student teacher data use opportunities on their later practices, early opportunities to use data in classroom-based experiences, the processes by which student teachers enact DLFT, and the population of students on which these data practices focus. Indeed there is a dearth of research on using data equitably to support a diverse student body which we turn our attention to now.

Equity in Data Literacy for Teaching. This section of our review includes studies on both TCs and inservice teachers to provide a holistic picture of equity in DLFT due to the scarcity of the work. This research has often looked at routines and structures in schools that may foster or inhibit equity. The most common structure we found that was used to ensure equity in

education are equity audits. These procedures derive from U.S. educational and civil rights history and are collaborative mechanisms for evaluating equity systematically (Capper & Young, 2015; Skrla et al., 2004). These audits often look at proportionality or disproportionality—for example, how many experienced teachers work in an urban or suburban school. Structures such as these are important to ensuring equity in education. In Gannon-Slater and colleagues' (2017) case study of grade-level data use in small, urban elementary schools, infrastructure was not in place to support equity-oriented data use despite a professed focus on equitable outcomes for Black students in the district. In science education Braaten and colleagues (2017) studied the activities of science educators including classroom practice, meetings, and professional development over three years. They discovered missed opportunities to foster equitable science learning. At times this was a result of administration's efforts. Thus, systematic processes such as equity audits can bring some consistency and structure to ensuring equitable educational opportunities.

The importance of administration in DLFT activities, particularly around equity, are highlighted in many of these studies. In Park, St. John, Datnow, and Choi's (2017) study, one administrator reinforced asset dialog about students in the process of generating classroom placements at the elementary level. This helped to reinforce positive talk about students as well as the use of multiple measures of data to find an appropriate placement for the child. However, in this process, narrow conceptions of gender and considerations for exceptional students were not problematized. These studies highlight the complexity of equity considerations which, in turn, must be built into these structures.

In a study of math educators' data use during meetings, Garner and colleagues (2017) found that the teachers reduced complex constructs to numbers, favored remediation over

instructional improvement, and enacted faith in instrument validity. Importantly, the authors noted that the teachers put faith in the tests because they were not positioned to critique them. The authors advocated steering data conversations away from reteaching to consider student thinking, experiences, resources, and cultural funds of knowledge. Park and Datnow (2017) investigated the grouping and differentiated instruction practices at four different elementary schools. The researchers found that district and school policies supported teachers' practices through mandated time for differentiation, curricular tools, and online program adoption. However, teachers ultimately co-constructed differentiated instruction and used a variety of data to make decisions about differentiated instruction and grouping. These are ideals and practices that could be instilled and modeled during teacher preparation coursework.

The goal of our study was to provide an initial foray into equity in DLFT at the preservice level to understand TCs' perceptions regarding this complex construct. Our research questions were, What are the initial beliefs of four TCs regarding equity in DLT? How do four TCs' beliefs about equity in DLFT change, if at all, during a DLFT course?

Methods

The current investigation was set within the context of an undergraduate, elementary teacher education course that the authors redesigned to encompass all of the facets of DLFT operationalized above with an emphasis on equity. Specifically, this included a module on test bias, TC-led facilitations, and weekly absence-of-bias assessments. In order to explore the initial beliefs and development of beliefs of the TCs in this course we chose a multiple case study design (Stake, 2006).

Participants

The university that housed the DLFT course, Southwestern State University¹, is an urban, research-intensive university that serves predominantly first-generation students. It is a Minority Serving Institution with 55% of its student body identifying historically marginalized ethnic backgrounds. In all, 24 elementary TCs participated in this study. However, four participants were chosen for the multiple case study using a maximum variation sample (Patton, 2002) based on diversity in ethnicity and gender.

Data Collection

On the first day of the DLFT course, TCs were taught how to complete a concept map using a video, and asked to make their own concept map using the term *data* as the starting point (see Figure 2). This process was repeated on the last day of the semester when TCs completed a second concept map (see Figure 2). TCs also participated in ongoing per-item absence-of-bias (Popham, 2014) judgments. Specifically, TCs were required to create two questions each week that they would use to collect data from their future students. The questions had to be tied to content standards and TCs were asked to evaluate each question for bias, explain the purpose of the question, and note why it was important for their students to be able to answer this question. These absence-of-bias judgments were written on two notecards that were submitted for instructor feedback. In all, 11 weeks of notecards were collected.

Finally, our four case study participants completed pre- and post- semi-structured interviews (Merriam, 2009). At the pre- interviews, 2 hours and 18 minutes of audio data (72 pages of transcript data) were collected; during post- interviews, 2 hours and 6 minutes of audio data (64 pages of transcript data) were collected. Interview questions related to participants' understanding of data broadly ("What do you know about data?"); how to use data for instruction

¹ All names of people and places are pseudonyms.

(“Can you give an example of how you have used data/plan to use data to inform instruction?”); and their understanding of test bias (“Can you give me an example [of test bias]?”).

Data Analysis

After verbatim transcription, each author conducted an open coding (Saldaña, 2009) of the same interview transcript to look for emic codes. This initial round of coding utilized in vivo codes, descriptive coding, and values coding (see Table 1). After this initial coding was complete, the two authors met to review their codes together—a process called analyst triangulation (Patton, 2002). After reaching consensus on ideas presented in this interview transcript, both authors then completed their open coding of the seven remaining transcripts (three pre- transcripts and four post- transcripts), notecard sets, and concept maps separately. At the completion of open coding of each participant’s data set, each researcher wrote a narrative for that participant that included themes from the interviews, concept maps, and per-item absence-of-bias judgments (Popham, 2014) in a process of themeing the data (Saldaña, 2009). As part of this process, we identified changes at the manifest level (i.e., apparent in the information) as part of the process of writing these narratives. The second author used these narratives to write up the findings, and the first author read and confirmed the accuracy of her synthesis.

Limitations

Our study spanned just one semester in one preservice teacher education classroom. Longitudinal data that map the change, or lack of changes, in TCs’ beliefs from preservice teacher preparation to inservice would likely provide greater nuance in understanding what fosters equitable DLFT beliefs.

Findings

Here we present the findings of four case studies of participants in the course. Each case is a synthesis of pre- and post- interviews, concept maps, and absence-of-bias judgments and is meant to show the variety in participants' equity in DLFT beliefs and reactions to the course.

Angela. Angela is an aspiring art teacher who was influenced by her own 9th grade art teacher. She identifies as Filipina and Hawaiian and is in her mid 20s. She approached education as an issue of equity and was concerned about all students' learning, "I care about where my students are going to go because I have had teachers put me behind in elementary school and disregard everything I'm learning." She already had an understanding of inequity based on her experiences in elementary school and vicarious experiences through her friends who were already inservice teachers.

Beliefs at the beginning of the course. Angela expressed beliefs about equity related to DLFT at the beginning of the course that pertained to both students and teachers. At the student level, Angela was concerned about what she perceived as injustices of standardized testing that she had seen leveled on children, "[S]ome of the students will just stay there and they won't click ... It's hard for them to do. And that's kindergarten." She also came into the course with an inherent concern about the bias of standardized tests, "you don't know what type of anxiety they [students] have. You don't know if they are a good test taker. I know sometimes I'm not." In her notecards from the beginning of the course, she asked what meal the three little bears were eating in the fairy tale, "Goldilocks and the Three Little Bears" which is a European fairy tale. Thus, she may not have understood representation of diverse cultures in a rich way as a means of engaging diverse student populations. She promoted the use of alternate assignments like making a soundtrack to demonstrate understanding of the themes of a book which was a project she did in high school. At the beginning of the course Angela's concept maps reflected an understanding

of data in a straightforward, quantitative way (see Figure 2) as depicted in 18 bubbles like, “graphs,” “percentage,” “facts,” “information,” and “conclusions.”

Beliefs at the end of the course. Angela’s understanding of equity issues in accountability systems seemed to be more deeply entrenched at the end of the course, “It’s [*sic*] very destructive ... I think data is important and this class has helped a lot. But the way that it’s used it’s just stressful from what I see.” Overall, she thought there was an overreliance on data in schools that fell out negatively on students and teachers. Angela’s experiences as a substitute teacher also seemed to reaffirm her beliefs. She described a situation in which she had talked to a student about his state assessments and he had described being overwhelmed and nervous about them. She reiterated her belief that assessments needed to be differentiated for students, “Maybe there can be better ways to assess students because not everyone is going to be good at standardized testing.” However, she began the course with this belief about the misrepresentation of students so it seemed to be merely reaffirmed through her experiences in the course and as a substitute teacher. At the end of the course Angela’s conception of data, according to her concept map, was qualitatively broader but only included 11 bubbles. She noted different types of data including “summative assessments,” “formative assessments,” “testing scores,” and “demographics.”

Tom. Tom hoped to teach middle school because he recognized that it was a developmental time for students and also because he had influential male teachers when he was a middle school student himself, “I would ideally like to have the opportunity to [coach and mentor] for the next generation.” Tom’s experiences as a non-traditional student, military service member, and father all influenced the views he expressed in his pre- and post- interviews. Tom identified as a White male in his late 20s.

Beliefs at the beginning of the course. Tom's views were more subtle than Angela's. He went on at length about "analytics" in his interview and, when asked to explain this concept, he connected it to sports, "Pretty much you can take these [professional athletes] and you don't turn them into people anymore, you turn them into just like these machines ..." This comment conveys a sense of inequity that skilled athletes could be dehumanized through statistics. He then connected this same idea to students, "So the game is the test essentially ... Then you look at a student. You take a test. You look at the numbers ... I think you can draw some parallels." Here Tom hinted that the use of data may dehumanize students rather than portraying the whole child. In his notecards, the only bias Tom noted was related to students' socioeconomic backgrounds, "some students might not relate to having the ability to buy" video games. His concept map indicated a quantitative understanding of data; among the 22 bubbles on his map terms like "numbers" and "ratios" were present. He also connected data to sports with bubbles such as, "Fantasy Football," "analytics," "sports books," and "spreads."

Beliefs at the end of the course. At the end of the semester, Tom's interest in test equity was unshaken and seemed to have deepened as he now had an understanding of formative and summative assessment that he did not at the beginning of the semester,

Some students are bad test takers, some get test anxiety, etc. and some just don't perform well and using those types of summative tests to be able to project out where these students should be might not always be the best case as far as where they're really at. This quote speaks to the need for a variety of data to understand students' learning accurately. Along the same lines, Tom recognized the inherent bias in assessments and tests, "[T]hey're not always a very clear snapshot of where they're [students are] at because there is subjectivity, there's bias, there's all those nasty words we use." However, Tom never explicitly mentioned

historically marginalized groups. At the end of the course, Tom's concept map included only 10 bubbles and was focused solely on data use in teaching including, "cross-system interface," "data dashboards," and "usability." Another set of bubbles indicated his understanding of data use such as "using valid data," "using it properly," and "driven decisions."

Hannah. Hannah was an undergraduate, preservice elementary teacher who already had a degree in art. She identified as a white woman in her early 20s. After completing her art degree, she realized that this career was "probably not the most steady like financial [occupation]." Thus, she decided to pursue teaching which she felt called to do, "I've always loved kids and I've always felt that I connect with them." Hannah substitute taught at the elementary level.

Beliefs at the beginning of the course. Hannah viewed assessments and tests as a tool to help teachers and administrators make decisions. She had only used formative checks for understanding (e.g., show of hands) in her own substitute teaching. Hannah recognized,

you can't control the kids taking it [test]. So if it is that kid who knows what it is, but just doesn't care about the test, they're just so many different kids who don't get the proper breakfast or kids who did not get sleep last night. They know the content on the normal basis.

This latter quote points to equity concerns about social status since poverty can affect students' performance. Because of this potential validity issue, Hannah was an advocate for her students,

So I was just constantly explaining to the other teachers, "No, they know this. I know they know it. We've gone over it in the class. We've gone over it all week." And then if I gave them ... 10 minutes to take this test, they freak out.

Hannah recognized that she had “never been a good test taker” so this perhaps made her empathetic. Interestingly, she thought that data helped teachers to “assess students, to help place students ... this kid fits into this” but didn’t note the equity issues surrounding this sorting and how it could limit student opportunities. At the beginning of the course, Hannah’s concept map indicated a technical, measurement-focused understanding of data, “used as a reference/resource,” “recorded,” “tested,” “developments,” “changes,” and “different methods of research found.”

Beliefs at the end of the course. At her final interview, Hannah described assessments and tests as being used to “track progress. They’re used from the teachers so that they can adjust the instruction to better suit their students if they’re understanding things. It’s really just like a progress checker ... ” She thought that larger, standardized assessments helped the school system. Her experience lay mainly in administering smaller, formative assessments like spelling, math, and reading tests. She saw these as most useful for tracking student progress and grouping them to “get them on track if they’re not on track yet.” Although she planned to use data—like discussions and observations—in her future classroom, she was unsure about her feelings regarding larger, standardized tests, “I’m one of those people who wants to understand all sides.” She noted the necessity of these large tests but wished, “we could just get a better understanding of how to do it the right way and the best way possible.” She also seemed to understand affective elements of teaching, “The lesson plans tell me what to do, but they don’t tell me how the kids are going to react to my lesson. So I’m constantly observing.” She noted relying on observational data more than test data due to her position as a substitute teacher which limited her use of test data. These methods convey a broad use of data which is an equitable DLFT practice; however, Hannah still did not recognize historically marginalized groups specifically.

In her notecards at the end of the course, Hannah's question included the idiom, "once every blue moon." She incorrectly noted that there was no bias since only native English speakers might be familiar with this phrase. At the end of the course, Hannah's concept map included 18 bubbles and demonstrated a more nuanced understanding of types of data including, "formative," "qualitative," "daily," "weekly," "monthly," "quantitative," and "summative." She also wrote, "data literacy," "attitudes toward data," and "improving teacher instruction" which seem to indicate affective issues of DLFT.

Tony. Tony, a White man in his early 20s, took a circuitous path to becoming a teacher; he first enrolled in trade school and later a community college. However, he had always loved teaching and one of his friends became an elementary teacher and then Tony himself was hired as a support staff substitute in the local school district where he realized, "I love elementary. I love little kids." In this role he had mainly worked in Title I schools because, "people don't want to take those positions."

Beliefs at the beginning of the course. When asked what he knew about assessments or tests, Tony drew from his observations and the teacher he worked with. The teacher had received three different sets of test results that day and Tony remarked, "How are you supposed to analyze all of this data [sic] when there's just no time?" Tony also explained that he did not like computer-based assessments, "I've been in testing rooms with students [who] are on the computer and I think it distracts them so much more than a paper test for some reason." Tony saw the benefits of assessments and tests as, "not just data to inform you where they're [students are] at ... apply it to your teaching." Tony conceptualized data as, "quantitative. It's just numbers ... that are on a chart. And it's very pass or fail or falls somewhere in between." This statement seems to imply that Tony did not see data as developmental or qualitative. However, on his

notecards at the beginning of the course, Tony recognized that students' language backgrounds could inhibit their performance when he noted that test bias lay in, "the student's ability to read and comprehend the English language." This was a theme that continued throughout his notecards until the middle of the semester when he stopped indicating this as a potential bias. Because of his observations in schools, Tony believed, "gifted gets neglected sometimes." Thus, Tony observed underrepresentation for gifted students rather than other, historically marginalized groups. At the beginning of the course Tony's concept map indicated a hierarchy of sorts as well as an understanding of data as quantitative. In his 18 bubbles, one indicated "analysis," three indicated "direct," three indicated "indirect," three more indicated "corr." [perhaps correlation], and others indicated "primary," "secondary," and tertiary."

Beliefs at the end of the course. At the end of the course, Tony noted coming out of the class "with a different perspective" and being "more open to it [assessments and tests]." Indeed, he went on to criticize a clip from a popular late night talk show that critiqued standardized testing because it didn't acknowledge the "general idea of testing." Tony described himself as "still on the bandwagon of standardized testing," but qualified, "It needs to be fixed, I think ... I think we need to learn a lot more before I know how to apply them effectively." He explained, "You use the formative and summative assessments in classrooms ... the group type of assessment. There's different types of assessments." Here it seems as though Tony is alluding to the use of various assessments as a boon but did not connect this to how they could be used against historically marginalized groups. Tony also recognized that there were different types of formative assessments but didn't give examples. He further described using summative assessments to differentiate instruction, "Not all kids should have the same test sometimes. It needs to be different levels to where they get into their [zone of proximal development]." This

seems to be a connection to differentiation, but, again, Tony did not discuss potential issues of inequity. Tony was also concerned about having too much data or too many ideas for what to do with the data. Tony's concerns here seem to center on new teachers in disenfranchised positions rather than students. Tony's greatest emphasis in differentiation seemed to be on inclusive classrooms for students with and without disabilities, but he did describe grouping students, "group one low [student], one high [student] with two mediums [students]." Like Hannah, Tony did not see how this labeling could be problematic or the need to move students in and out of groups frequently depending on the standard or skill being taught. On his notecards at the end of the course, Tony noted that he purposely chose a gender neutral name for his word problem to avoid "issue[ing] a particular gender to the noun." Tony did not complete a final concept map.

Conclusions and Discussion

Our participants had rich backgrounds and experiences that they leveraged in completing the course. Angela had firsthand experience with issues of equity related to DLFT as an elementary student that seemed to make her wary of data use in schools, and Tom recognized how statistics could be used to "dehumanize" athletes and children. At the end of the course Tom seemed open to using data to support students, but Angela never did change her perspective on DLFT practices and saw them only as detrimental. Indeed, Angela's experiences as a substitute teacher seemed to reaffirm her view of assessments as dangerous which conveys both her narrow view of data as simply assessments and also her lack of agency in using DLFT practices to advocate for or represent students. Tony and Hannah had substitute taught in schools in the roles of support professional and teacher respectively. They both recognized that data could be used in grouping students for instruction but did not mention equitable practices like flexible grouping; this distinction is important since tracking can be quite dangerous for students (e.g., Noguera &

Wing, 2006). Both Angela and Tom recognized that students could have test anxiety that could interfere with their success on standardized tests but did not discuss DLFT practices like triangulation that could portray a more holistic picture of a student's learning. Our participants seemed to rely on Eurocentric examples (i.e., "Goldilocks and the Three Bears," an American idiom) perhaps because they did not have multicultural examples to employ.

In their study of inservice teachers' sensemaking around data, Bertrand and Marsh (2015) identified four models that their participants used. In the first model, the teacher acknowledged that instruction influences student performance and represented an internal locus of control for the teacher. In the second model, student understanding was viewed as the cause of student performance and represented an external locus of control for the teacher. The third model was also externally located, and attributed student performance to the nature of the test. Finally, student characteristics were viewed as influencing student performance in the fourth model and was also externally located. Our participants drew from many of these models in explaining their views on DLFT. We echo Bertrand and Marsh's call for educators to reflect on their sensemaking around data and add that this must begin in preservice teacher education to build a habits of mind approach to data use (Bocala & Boudett, 2015).

Although the focus of our study was equitable DLFT practices to serve P-12 students, both Angela and Tony were concerned about how DLFT practices fell out on teachers. This makes sense since early teaching concerns typically focus on the teacher (Fuller, 1969). However, this was an unexpected finding. There was also a mismatch between our participants' beliefs and practices at times which is well documented in the teacher beliefs literature (e.g., Fives & Buehl, 2012). Moreover, if an educator's beliefs are in flux they may not match their practices and beliefs and practices may be more consistent for experienced teachers

(Basturkmen, 2012). For example, Hannah expressed concern about narrow summative assessments but professed to use limiting grouping practices. Finally, all four of our participants seemed to understand a broader definition of data at the end of the course. At the beginning of the course, many of the concept maps conveyed an understanding of data as quantitative, while concept maps at the end of the course conveyed a deeper understanding of different types of data. This seems promising in conveying the nuance of using data to serve diverse students.

The influence of a school setting was something we had not anticipated in our study since we had set our research within the context of a course without a field experience at the preservice level. However, three of our participants were experiencing school as part-time education professionals through substitute teaching and cited these experiences in their interviews. These experiences seemed to be largely unscaffolded, yet research has demonstrated the powerful influence of field experiences on TCs which can reinforce or promote modification of beliefs (Hancock & Gallard, 2004) as well as their development of DLFT (Reeves, 2017). Moreover, cooperating teachers' own beliefs and instructional practices (Crawford, 2007) can influence TCs in field experience settings. This raises implications for clinical faculty working with TCs.

Our participants rarely noted historically marginalized groups in their interviews, concept maps, or absence-of-bias judgments which may have been a shortcoming in our own instruction because we did not provide sufficient examples of how inequities show up in accountability systems and how they can be mitigated. Our analysis helped us to realize that our own instruction must reflect rich and nuanced examples of equitable data use practices for student populations diverse in language, ethnicity, socioeconomic status, and gender identity.

Implications

Our study is an effort to contribute to the dearth of research on infusing equity into DLFT instruction at the preservice level. As the field continues to incorporate DLFT into teacher education, this must include a focus on equitable practices due to the potential to misuse data and harm already marginalized populations (Garner et al., 2017; Park et al., 2017). We were unable to find texts that focused on equity in DLFT specifically, and this is certainly an area of growth for the field. Moreover, courses on DLFT may need to be sequenced with other courses with a focus on multicultural education, culturally relevant pedagogies (Ladson-Billings, 2009), or culturally sustaining pedagogies (Paris & Alim, 2014) and practica in diverse settings (Ronfeldt, 2012) to further assist TCs in making connections between diversity and DLFT.

Along the same lines, research on equity in DLFT must be taken up in earnest. This includes infusing equity into existing conceptual frameworks (Mandinach & Gummer, 2016) and weaving this into national policies and standards. Otherwise, existing, harmful practices will continue to be perpetuated (e.g., Datnow et al., 2017). Breaking this cycle may mean that future teachers see greater possibilities for equitable data use to serve diverse populations—including as facilitators of data meetings (Bocala & Boudett, 2015). Teacher educators and colleges of education have important roles to play in this work including modeling these practices.

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Declaration of Interest

No potential conflict of interest was reported by the authors.

References

- Athanases, S. Z., Wahleithner, J. M., & Bennett, L. H. (2012). Learning to attend to culturally and linguistically diverse learners through teacher inquiry in teacher education. *Teachers College Record, 114*, 1-50. Retrieved from www.tcrecord.org
- Authors. (2019).
- Authors. (under revision).
- Author 2 & co-author. (2015).
- Basturkmen, H. (2012). Review of research into the correspondence between language teachers' stated beliefs and practices. *System, 40*, 282-295. doi:10.1016/j.system.2012.05.001
- Bertrand, M., & Marsh, J. A. (2015). Teachers' sensemaking of data and implications for equity. *American Educational Research Journal, 52*(5), 861-893. doi:10.3102/002831215599251
- Bocala, C., & Boudett, K. P. (2015). Teaching educators habits of mind for using data wisely. *Teachers College Record, 117*(4), 1-20.
- Braaten, M., Bradford, C., Kirchgaser, K. L. & Fox Barocas, S. (2017). How data use for accountability undermines equitable science education. *Journal of Educational Administration, 55*(4), 427- 446. <https://doi.org/10.1108/JEA-09-2016-0099>
- Brownlee, J. (2003). Changes in primary school teachers' beliefs about knowing: A longitudinal study. *Asia-Pacific Journal of Teacher Education, 31*(1), 87-98.
doi:10.1080/13598660301621
- Capper, C. A., & Young, M. D. (2015). The equity audit as the core of leading increasingly diverse schools and districts. In G. Theoharis & M. Scanlan, *Leadership for increasingly diverse schools* (pp. 186-197). New York, NY: Routledge.

- Carey, M., Grainger, P., & Christie, M. (2018). Preparing preservice teachers to be data literate: A Queensland case study. *Asia-Pacific Journal of Teacher Education, 46*(3), 267-278.
doi:10.1080/1359866X.2017.1402860
- Cowie, B., & Cooper, B. (2017). Exploring the challenge of developing student teacher data literacy. *Assessment in Education: Principles, Policy & Practice, 24*(2), 147-163.
doi:10.1080/0969594X.2016.1225668
- Crawford, B. A. (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching, 44*(4), 613-642.
doi:10.1002/tea.20157
- Datnow, A., Greene, J. C., & Gannon-Slater, N. (2017). Data use for equity: implications for teaching, leadership, and policy. *Journal of Educational Administration, 55*(4), 354-360.
<https://doi.org/10.1108/JEA-04-2017-0040>
- DeLuca, C., & Bellara, A. (2013). The current state of assessment education: Aligning policy, standards, and teacher education curriculum. *Journal of Teacher Education, 64*(4), 356-372. doi:10.1177/0022487113488144
- Dunn, K. E. (2016). Educational psychology's instructional challenge: Pre-service teacher concerns regarding classroom-level data-driven decision-making. *Psychology Teaching & Learning, 15*(1), 31-43. doi: 10.1177/1475725716636975
- Fives, H., & Buehl, M. M. (2012). Spring cleaning for the "messy" construct of teachers' beliefs: What are they? Which have been examined? What can they tell us? In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA educational psychology handbook* (Vol. 2) (pp. 471-499). Washington, DC: American Psychological Association.

- Fuller, F. F. (1969). Concerns of teachers: A developmental conceptualization. *American Educational Research Journal*, 6(2), 207-226.
- Gannon-Slater, N., La Londe, P. G., Crenshaw, H. L., Evans, M. E., Greene, J. C., & Schwandt, T. A. (2017). Advancing equity in accountability and organization cultures of data use. *Journal of Educational Administration*, 55(4), 361-375. <https://doi.org/10.1108/JEA-09-2016-0108>
- Garner, B., Thorne, J. K., & Horn, I. S. (2017). Teachers interpreting data for instructional decisions: where does equity come in?. *Journal of Educational Administration*, 55(4), 407-426.
- Gummer, E. S., & Mandinach, E. B. (2015). Building a conceptual framework for data literacy. *Teachers College Record*, 117(4), 1-22. Retrieved from <http://www.tcrecord.org>
- Hancock, E. S., & Gallard, A. J. (2004). Preservice science teachers' beliefs about teaching and learning: The influence of K-12 field experiences. *Journal of Science Teacher Education*, 15(4), 281-291.
doi:10.1023/B:JSTE.0000048331.17407.f5
- Ladson-Billings, G. (2009). *The Dreamkeepers: Successful teachers of African American children*. San Francisco, CA: John Wiley & Sons, Inc.
- Mandinach, E. B., & Gummer, E. S. (2013). A systemic view of implementing data literacy in educator preparation. *Educational Researcher*, 42(1), 30-37.
doi:10.3102/0013189X12459803
- Mandinach, E. B., & Gummer, E. S. (2016). What does it mean for teachers to be data literate: Laying out the skills knowledge and dispositions. *Teaching and Teacher Education*, 60, 366-376. <http://dx.doi.org/10.1016/j.tate.2016.07.011>

- Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. San Francisco, CA: Jossey-Bass.
- Milner, H. R., Cunningham, H. B., Delale-O'Connor, L., & Kestenber, E. G. (2019). *These kids are out of control”: Why we must reimagine “classroom management” for equity*. Thousand Oaks, CA: Corwin.
- Ng, W., Nicholas, H., & Williams, A. (2010). School experience influences on pre-services teachers' evolving beliefs about effective teaching. *Teaching and Teacher Education*, 26(2), 278-289. doi:10.1016/j.tate.2009.03.010
- No Child Left Behind Act of 2001. Public law 107-110, 20 U.S.C. § 6319. (2002).
- Noguera, P., & Wing, J. Y. (2006). *Unfinished business: Closing the racial achievement gap in our schools*. San Francisco, CA: Jossey-Bass.
- Paris, D., & Alim, H. S. (2014). What are we seeking to sustain through culturally sustaining pedagogy? A loving critique forward. *Harvard Educational Review*, 84(1), 85-100. <http://dx.doi.org/10.17763/haer.84.1.9821873k2ht16m77>
- Park, V., & Datnow, A. (2017). Ability grouping and differentiated instruction in an era of data-driven decision-making. *American Journal of Education*, 123(2), 281-306.
- Park, V., St. John, E., Datnow, A., & Choi, B. (2017). The balancing act: Student classroom placement routines and the uses of data in elementary schools. *Journal of Educational Administration*, 55(4), 390-406. <https://doi.org/10.1108/JEA-09-2016-0098>
- Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.
- Popham, W. J. (2005). *America's failing schools: How parents and teachers can cope with no Child Left Behind*. New York, NY: Routledge.

- Popham, W. J. (2014). *Classroom assessment: What teachers need to know*. Boston, MA: Pearson Education, Inc.
- Reeves, T. D. (2017). Pre-service teachers' data use opportunities during student teaching. *Teaching and Teacher Education, 63*, 263-273.
<http://dx.doi.org/10.1016/j.tate.2017.01.003>
- Reeves, T. D., & Honig, S. L. (2015). A classroom data literacy intervention for pre-service teachers. *Teaching and Teacher Education, 50*, 90-101.
<http://dx.doi.org/10.1016/j.tate.2015.05.007>
- Ronfeldt, M. (2012). Where should student teachers learn to teach? Effects of field placement school characteristics on teacher retention and effectiveness. *Educational Evaluation and Policy Analysis, 34*(1), 3-126. doi:10.3102/0162373711420865
- Saldaña, J. (2009). *The coding manual for qualitative researchers*. Thousand Oaks, CA: SAGE Publications, Ltd.
- Seaman, C. E., Szydlik, J. E., Szydlik, S. D., Beam, J. E. (2010). A comparison of preservice elementary teachers' beliefs about mathematics and teaching mathematics: 1968 and 1998. *School Science and Mathematics, 105*(4), 197-210. doi:10.1111/j.1949-8594.2005.tb18158.x
- Shahjahan, R. A. (2011). Decolonizing the evidence-based education and policy movement: Revealing the colonial vestiges in educational policy, research, and neoliberal reform. *Journal of Education Policy, 26*(2), 181-206. doi:10.1080/02680939.2010.508176
- Skrla, L., Scheurich, J. J., Garcia, J., & Nolly, G. (2004). Equity audits: A practical leadership tool for developing equitable and excellent schools. *Educational Administration Quarterly, 40*(1), 133-161. doi:10.1177/0013161X03259148

Stake, R. E. (2006). *Multiple case study analysis*. New York, NY: The Guilford Press.

Tatto, M. T. (1996). Examining values and beliefs about teaching diverse students:

Understanding the challenges for teacher education. *Educational Evaluation and Policy Analysis*, 18(2), p. 155-180. doi:10.3102/01623737018002155

United States. (1965). Elementary and secondary education act of 1965 : H. R. 2362, 89th Cong., 1st sess., Public law 89-10. Reports, bills, debate and act. [Washington] :[U.S. Govt. Print. Off.]

Woolfolk Hoy, A., & Spero, R. B. (2005). Changes in teacher efficacy during the early years of teaching: A comparison of four measures. *Teaching and Teacher Education*, 21(4), 343-356. doi:10.1016/j.tate.2005.01.007

Zwick, R., Sklar, J. C., Wakefield, G., Hamilton, C., Norman, A., & Folsom, D. (Summer 2008). Instructional tools in Educational Measurement and Statistics (ITEMS) for school personnel: Evaluation of three web-based training modules. *Educational Measurement: Issues and Practice*, 14-27.

Table 1

Types of Codes and Examples

Type of Code	Example Code	Example Data
In Vivo	"I just feel a little bit of hatred"	"I just feel so strong about, I just feel like a little bit of hatred towards how many tests there are." (Angela, post- interview)
Descriptive	Uses observation to drive instruction	"So I observe them. That's how I use the data. As I go, kind of like if they're not getting it, I know. I'll slow down." (Hannah, post- interview)
Values	Computerized tests are distracting	"Because I've been in testing rooms with students that are on the computer and I think it distracts them so much more than a paper test for some reason." (Tony, pre- interview)

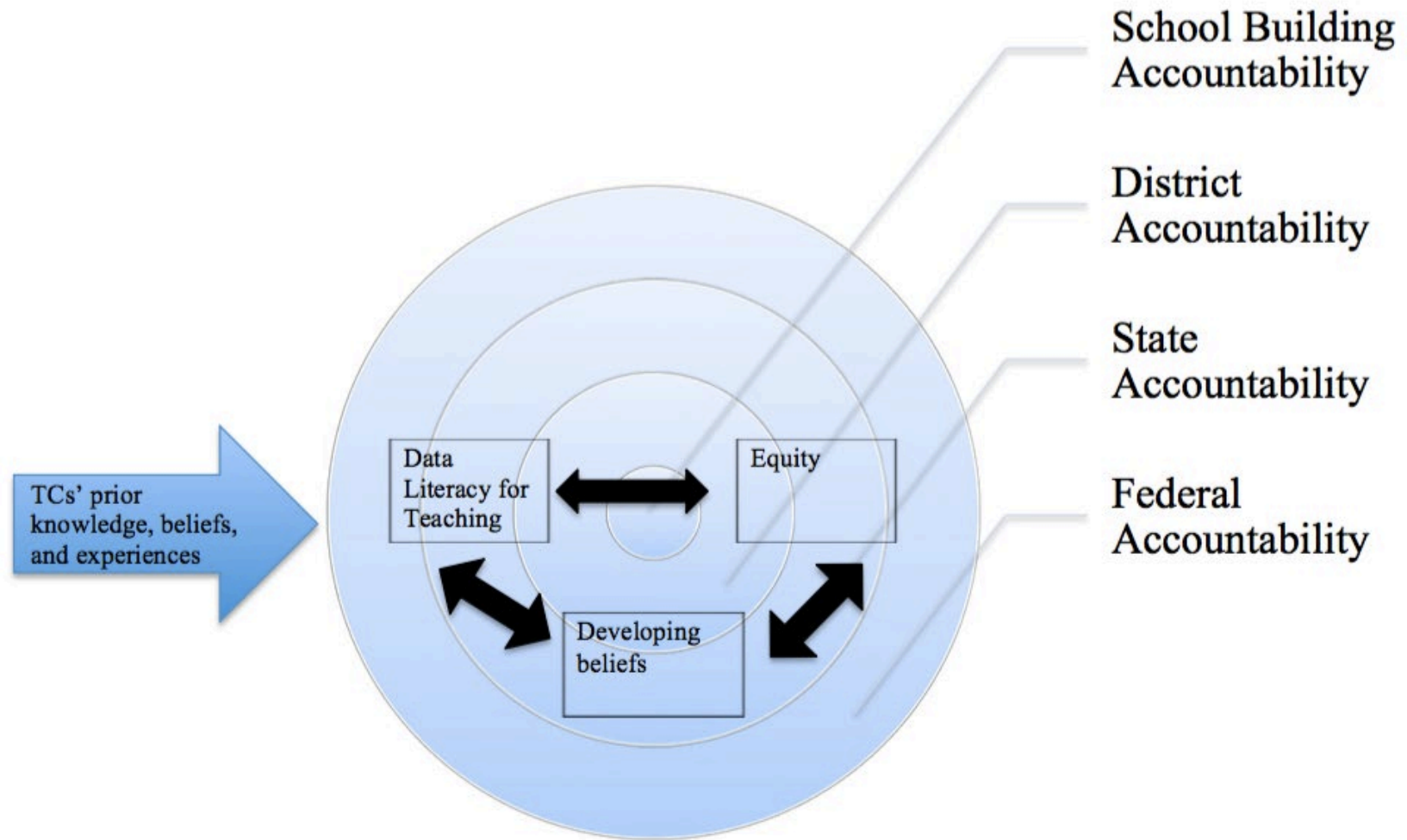


Figure 1. Theoretical framework.

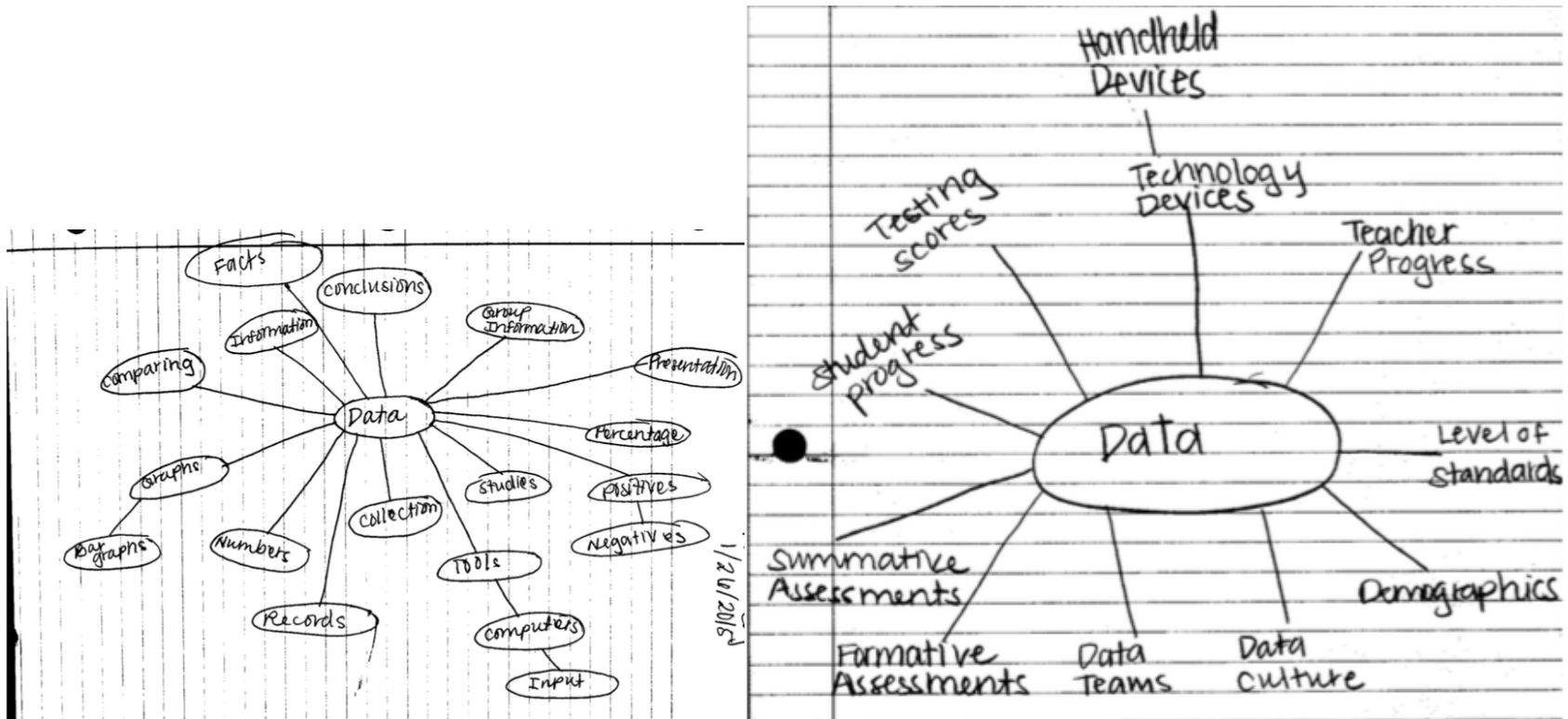


Figure 2. Angela's concept map at the beginning (left) and the end (right) of the course.

